Objective was to evaluate fertility of frozen-thawed semen aged within an AI straw for 8.5 h. Estrus was visually assessed three times daily for at least 30 minutes each time. Jersey heifers (age: 13.9 ± 1.4 mo; weight: 272.8 ± 19.2 kg) observed standing to be mounted between 0700 and 1200 h were randomly assigned to be inseminated with a straw of frozen semen that had been thawed and maintained in a Cito Thaw Unit (34.4 ± 1.0 °C water bath) for 8.5 ± 0.04 min (Control; range 3-14 min) or 8.5 ± 0.68 h (Aged; range 6-10 h). Heifers observed in estrus after 1200 h were inseminated with control semen. All heifers were inseminated according to AM/PM rule. To age sperm, a straw of frozen semen was thawed immediately after visualization of a heifer in estrus and then maintained in a Cito Thaw unit until insemination approximately 8.5 h later. Frozen semen was purchased from various AI organizations (n=6). Individual Jersey bulls (n=30) were randomly and evenly distributed across treatments. Establishment of pregnancy was determined by palpation per rectum at 45 to 65 d post-insemination. Animals were monitored throughout pregnancy and upon calving, sex of offspring was recorded. Data were analyzed using Chi-Square; variables of interest included proportion pregnant, calving, and sex of resulting offspring. Effects of inseminating Jersey heifers with sperm aged within an AI straw for 8.5 h post-thaw were minimal. Fifty percent of heifers inseminated with aged semen became pregnant and delivered a live calf at term (Table). Proportion of female offspring was similar. Ability to maintain frozen-thawed semen within an AI straw for 8.5 h in a 34.4 °C water bath without significant reductions in fertility demonstrates that sperm can be held post-thaw for extended time periods and suggests potential for manipulation post-thaw for sexing or performing diagnostics.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. Bred</th>
<th>Pregnant (%)</th>
<th>Calved (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>59</td>
<td>37(62.7)</td>
<td>37(62.7)</td>
<td>19(51.4)</td>
</tr>
<tr>
<td>Aged</td>
<td>56</td>
<td>28(50.0)</td>
<td>28(50.0)</td>
<td>11(39.3)</td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td>0.19</td>
<td>0.19</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**Key Words:** Frozen semen, Aging, Artificial insemination

The objectives were to determine if a diet enriched in α-linolenic acid (ALA; C18:3n-3) would enhance embryo survival and pregnancy rates in dairy cows fed pelleted grain-based rations. NRC (2001) requirements. Metabolizable protein and NE\text{\textsubscript{L}} concentrations were similar in diets. Based upon a mean DMI of 24.2 kg/d, cows fed FS or SS consumed >410 g or <1 g of ALA, respectively. Plasma progesterone concentrations determined on Days -10, -3, 0, 7, 21 and 24 were not affected by diet. Pregnancy was confirmed by ultrasound 32 d after AI and pregnant cows received no further oilseeds. Nonpregnant cows were placed on a second ovx/ovsynch regimen and rebred 42 d after AI, and received oilseeds until 32 d after second AI. Relative to pre-diet levels, FS and SS diets increased the ALA content of milk by 187% and 21%, respectively. Presumptive pregnancy (plasma progesterone >1 ng/mL on Days 21 and 24) and confirmed pregnancy rates at first AI were higher in cows fed FS than in cows fed SS (72.6 vs 47.5%, P=0.01; and 48.4 vs 32.2%, P=0.07, respectively). Confirmed pregnancy rates (combined for both AI) were 67.7 vs 59.3% for FS vs SS (P≤0.10). Apparent embryo survival rate was higher at Day 24 in cows fed FS, but it was not affected by diet between Days 24 and 32. Inclusion of rolled flaxseed in the diets of postpartum dairy cows improved fertility, apparently through enhanced early embryo survival.

Key Words: Pregnancy, Flaxseed, α-Linolenic acid


To accelerate genetic improvement of traits, both molecular and comparative genomic data are required. We are developing extensive sequence and mapping data for cDNAs expressed in female reproductive tissues. We have produced 25 cDNA libraries from different stages of estrus or gestation for embryo, anterior pituitary, hypothalamus, ovary, uterus, and term placenta. A total of 21,499 EST sequences from random clones have been submitted to Genbank. The average read length across this dataset is >400 base pairs. As assessed by clustering analysis, these data represent 10,574 different genes. A BLAST analysis of these clusters indicates that 4,652 are unique relative to porcine Genbank genes/ESTs (BLAST score >200). To facilitate selection of genes for comparative mapping, we have developed software to predict the cytogenetic location of pig ESTs. We identified pig EST matches (BLAST score >200) to human loci that have consistent cytogenetic and RH mapping locations, and then predicted the pig location of high-scoring ESTs based on mapping data and human:pig chromosome painting information. A total of 721 loci have been mapped across all chromosomes, concentrating on pig chromosomes (1:4.6; 7:15.4X) where litter size or other reproductive QTL have been localized. More than 90% of these loci map to the chromosome predicted by comparative data. A WWW site (http://pigest.genome.iastate.edu) has been established for access to these sequences and the analysis data. This set of sequence and map data can be immediately used to study reproductive biology and look for genes controlling quantitative reproduction traits.

Key Words: Expressed sequence tags, Porcine reproduction, Comparative mapping

5 Effect of semen packaged in 0.25 and 0.50 cc straws on conception rate of lactating dairy cows. N. Michael, C. Marti, E. Roberts, and M. Pace, ABS Global, Inc., 2009.

Cost and efficiency of semen storage can be dramatically improved by packaging semen in 1/4 cc straws. However, it is not clear if fertility of lactating dairy cows would be different by using 1/4 cc straws compared to 1/2 cc straws. This study evaluated the effect of straw packaging size (1/4 cc vs 1/2 cc straw) on conception rates in lactating dairy cows. A total of 428 inseminations from eight herds (3 per herd) was divided equally between 1/4 and 1/2 cc straws using a split collection technique. All straws were packaged and frozen using the ABS Global wind-tunnel freezing process. Numbers of sperm per straw were the same for 1/4 and 1/2 cc straws. Both straw types were equally divided by sire within each herd where herd owners chose the AI sires used in their herd; the number of sires used within the herds was one to four, for a total of 17 sire within herd comparisons. The fewest number of inseminations per herd x sire x straw type was 125. Cows (n = 6602) from eight herds located in Idaho and California were randomly inseminated by odd-even days of the month to receive A.I. in the uterine body from either (even day; n = 3373) or 1/4 cc (odd day; n = 3229) straws from seven professional A.I. technicians between September 2001 and October 2002. Straws were thawed in 35 °C water baths for a minimum of 30 seconds and then held thermo-neutral until A.I. Pregnancy diagnoses were performed between 35 and 42 days following A.I. by the herd veterinarian in cows that had not returned to estrus during this period. Cows that were detected in estrus and re-inseminated between A.I. and pregnancy diagnosis were defined as not pregnant. All inseminations and pregnancy diagnoses information were entered into Dairy Comp 305. Data were retrieved from Dairy Comp 305 from each herd, summarized by sire comparison within herd and entered into Excel. Data were analyzed using a paired t-test on the conception rate means for each straw package type. Conception rates were similar (P > 0.05) between 1/2 (31.1%) and 1/4 cc (31.3%) straws. In summary, comparison of multiple AI sires in multiple locations indicated that fertility was not different from semen in 1/4 vs 1/2 cc straws packaged using the ABS Global wind-tunnel freezing process.

Key Words: Semen packaging, Conception rate, Dairy cows


Split-weaning (SW) of first parity sows decreases the weaning to estrus interval (WEI) and advances ovarian follicular development. However, follicles ovulating soon after weaning start development during lactation when sows are often in a catabolic state. We hypothesise that an extended interval between SW and final weaning will allow follicles in this wave of disadvantaged follicles, trigger a new wave of follicle development after weaning when sows will be less catabolic, marginally increase the WEI, but improve overall sow fertility. To test this hypothesis, first parity sows with standardized litters were randomly allocated to be either Control (C; n=45) or SW (all but the lightest 6 piglets removed) at d14 of lactation (n=45). Feed intake, litter growth and sow metabolic state were monitored during lactation. Ovarian follicular development was determined morphologically after euthanizing groups of C and SW sows (n=15) on d16, 18 and 20 of lactation. A baseline of follicular development was established in an additional group of 15 sows euthanized on d14 (C14). Fewer (5/15; P<0.05) C14 sows had follicles ≥3mm diameter compared to all other groups, indicating a critical and possibly coordinated wave of follicular development between d14 and 16 of lactation. SW increased (P<0.05) the total number of follicles ≥5mm, mean size of the largest 10 follicles, maximum follicle size, mean VF volume, and the percentage of follicles in the ≥5mm category. SW increased (P<0.05) plasma IGF-1 at weaning (105±3 vs. 87±3 ng/mL) and decreased sow body mass loss during lactation (5.9±1.0 vs. 9.1±1.0 kg). Also, irrespective of treatment, plasma IGF-1 was lower (P<0.05) at d14 and weaning, and the decrease in loin muscle depth during lactation was greater (P<0.05), in sows with follicles <3mm diameter at slaughter. Increased catabolism during lactation can therefore critically limit follicle development. Refinements in SW protocols, based on a better understanding of ovarian follicular development in SW sows, have the potential to improve the fertility of weaned, first parity, sows.

Key Words: sow, lactation, ovary
7 Do calcium-mediated cellular signaling pathways, PGE2, estrogen or progesterone receptor antagonists, or bacterial toxins affect bovine placental function in vitro? C. Weems1*, Y. Weems2, T. Welsh3, C. Carsten1, and R. Randle5, 1 Univ. of Hawaii, 2,3,4 Texas A&M Univ.

The bovine placenta secretes little progesterone (P4) when the CL is functional (Conley and Ford, J. Anim Sci 65:500, 1987), while the placenta secretes half of the circulating P4 at day-90 and 57% of the samples at 4 and 8 hr, respectively and PGF2α concentrations of PGE2α function? PGE2α not P4 in the bovine CL (Prostaglandins 46:277, 1992) and PGE2α appears to regulate ovine placental secretion of P4 (Bridge et al, Prostaglandins and Other Lipid Mediators 58:113, 1999). Calcium has been reported to regulate placental P4 secretion in cattle (Shemesh et al, PNAS 81:6403, 1983). Diced placental slices from 193-243 day Brahman and Angus cows were incubated in vitro at 39.5 °C under 95% air/5% CO2 at PH 7.2 in a humidified atmosphere of 100% M of 199 for 1 hr in the absence of treatment and at 4 and 8 hr in the presence of treatments at a dose of 100ng/ml to determine regulation of placental function. Treatments were: vehicle, R24571; Compound 48/80; IP3; PGE2α; CaCl2; cyclosporin A; lipopolysaccharide from Salmonella abortus, enteriditis, and typhimurium; moneosomes; ionomycin; arachidonic acid; mimosine; palmitic acid; androstenedione, aminophylline; sodium nitroprusside, or ET-1. Tissues were incubated in M-199 and in the absence of treatments and were pooled. PGE2α decreased (P < 0.05) by Lutalyse. Concentrations of PGE2α secreted in bovine oocytes cultured at an elevated temperature during maturation (% of control), 41 °C for the autumn (0 to 12 wk), winter (12 to 24 wk) and spring (24 to 32 wk) periods. Due to the presence of treatments, weight gain was greater for C than S (0.74 vs 0.66 ± 0.01; P < 0.05), but the proportion of heifers that had estrus confirmed by progesterone in blood serum collected 8 to 12 d later, and weight, backfat and serum prolactin were measured for each 4 wk period. Ambient temperatures averaged 3.4±1.2 °C, -16.0±7.4 °C and 3.5±8.0 °C for the autumn (0 to 12 wk), winter (12 to 24 wk) and spring (24 to 32 wk) periods. During the prepubeal period, weight gain was greater for A than S (0.74 vs 0.66 ± 0.01; P < 0.05). Prolactin, initially 16.3±1.6 ng/ml, was higher for A than W from 4 to 12 wk, and lower for A than W from 16 to 24 wk (12 wk; 10.1 vs 1.1 and 24 wk; 6.7 vs 20.0 ± 1.8 ng/ml; P < 0.05). Extended photoperiod in autumn advanced puberty independently of the effects of diet on growth, and acute change in photoperiod influenced prolactin, in heifers housed outdoors.

Key Words: Estrous synchronization, Progesterone, Prostaglandins

9 Photoperiod and diet effects on heifer development. J. A. Small1*, A. D. Kennedy2, and D. R. Ward3, 1 Agriculture & Agri-Food Canada, Research Centre, Brandon, MB, Canada, 2 University of Manitoba, Winnipeg, MB, Canada.

A 2x2 factorial arrangement of photoperiod (A vs W) and diet (C vs S) treatments was applied to spring-born crossbred beef heifers (n = 144) assigned at weaning (Sep 21; 0 wk) by body weight (247±19 kg) and age (191±12 d) to one of four pens in one of two similar open shed/drylot facilities. Supplemental light (350 lux, 1 m above ground) was used to extend photoperiod (natural + supplemental light) to 16 h for 12 wk starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant (C), or low then high (S) gain during the prepubertal (4 to 16 wk) and pubertal (16 to 24 wk) periods, respectively. One diet for moderate gain was provided to all groups from 0 to 4 and 24 to 32 wk. From 0 to 4 wk, observations of estrus were made using estrus confirmed by progesterone in blood serum collected 8 to 12 d later, and weight, backfat and serum prolactin were measured for each 4 wk period. Ambient temperatures averaged 3.4±1.2 °C, -16.0±7.4 °C and 3.5±8.0 °C for the autumn (0 to 12 wk), winter (12 to 24 wk) and spring (24 to 32 wk) periods. Due to the presence of treatments, weight gain was greater for A than S (0.74 vs 0.66 ± 0.01; P < 0.05), but the proportion of heifers that had estrus was greater for A than W (48.6% vs 39.9%; P < 0.05). Prolactin, initially 16.3±1.6 ng/ml, was higher for A than W from 4 to 12 wk, and lower for A than W from 16 to 24 wk (12 wk; 10.1 vs 1.1 and 24 wk; 6.7 vs 20.0 ± 1.8 ng/ml; P < 0.05). Extended photoperiod in autumn advanced puberty independently of the effects of diet on growth, and acute change in photoperiod influenced prolactin, in heifers housed outdoors.

Key Words: Photoperiod, Puberty, Prolactin

10 Heat shock increases glutathione in bovine oocytes. R. R. Payton1*, P. Coy2, R. Romar3, J. L. Lawrence1, and J. L. Edwards1, 1 The University of Tennessee, Knoxville, USA, 2 University of the Murcia, Murcia, Spain.

Heat shock increases glutathione (GSH) content in a variety of cell types including embryos. Objective of this study was to examine GSH content in bovine oocytes cultured at an elevated temperature during maturation. Cumulus-oocyte complexes were randomly allocated to one of three treatments and then cultured in the following manner: 38.5 °C for 24 h (Control), 41 °C for 6 h followed by 38.5 °C for 18 h (HS 0-12), 41 °C for 12 h followed by 38.5 °C for 12 h (HS 0-12). After 24 hours, oocytes presumed mature were denuded of cumulus by vortexing. Pools of oocytes (25-32/treatment group) were solubilized in 0.63 M phosphoric acid and frozen at -20 °C for the autumn (0 to 12 wk), winter (12 to 24 wk) and spring (24 to 32 wk) periods. During the prepubeal period, weight gain was greater for A than S (0.74 vs 0.66 ± 0.01; P < 0.05), but the proportion of heifers that had estrus was greater for A than W (48.6% vs 39.9%; P < 0.05). Prolactin, initially 16.3±1.6 ng/ml, was higher for A than W from 4 to 12 wk, and lower for A than W from 16 to 24 wk (12 wk; 10.1 vs 1.1 and 24 wk; 6.7 vs 20.0 ± 1.8 ng/ml; P < 0.05). Extended photoperiod in autumn advanced puberty independently of the effects of diet on growth, and acute change in photoperiod influenced prolactin, in heifers housed outdoors.

Key Words: Photoperiod, Puberty, Prolactin

11 Heat shock increases glutathione in bovine oocytes. R. R. Payton1*, P. Coy2, R. Romar3, J. L. Lawrence1, and J. L. Edwards1, 1 The University of Tennessee, Knoxville, USA, 2 University of the Murcia, Murcia, Spain.

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Key Words: Heat shock, Oocyte, Glutathione

Key Words: Estrous synchronization, Progesterone, Prostaglandins

Growth factors and steroids play an important role in the process of ovarian follicular development. In cattle, two of the earliest detectable differences between healthy dominant follicles selected for development to the ovulatory stage versus subordinate follicles destined to undergo atresia are the greater availability of IGF and the greater capacity to secrete estradiol. IGF-1 and estradiol stimulate proliferation of bovine granulosa cells (GC) in vitro and also promote GC survival by increasing resistance to apoptotic stimuli. Our studies show that the ability of IGF-1 and estradiol to increase resistance to apoptosis is intimately tied to their ability to promote progression through the cell cycle. Cell cycle blockade at the G1/S transition by specific inhibitors prevented the protective effects of IGF-1 and estradiol against apoptosis. The protective effect of IGF-1 against apoptosis is mediated by phosphatidylinositol 3-kinase and its downstream target, protein kinase B/Akt. Constitutively active Akt, expressed by a recombinant adenovirus, protected against apoptosis and this effect was dependent upon cell cycle progression. Therefore, the protective effect of estradiol and IGF-1 against apoptosis is dependent upon their ability to promote progression through the cell cycle. The LH surge induces terminal differentiation of GC and their withdrawal from the cell cycle. By 12 h after the LH surge, bovine GC have withdrawn from the cell cycle and become resistant to apoptosis, even in the absence of growth factors. Treatment with a progesterone receptor (PR) antagonist in vitro caused cells to reenter the cell cycle and reversed the resistance to apoptosis, suggesting that PR is required for these effects. Our studies suggest that the susceptibility of GC to apoptosis is dependent upon the cell proliferation cycle. GC from growing follicles are dependent on growth factors for survival, whereas cells that have terminally differentiated are resistant to apoptosis and relatively independent of growth factors for survival.

Key Words: Ovary, Granulosa cells, Cell cycle

12 Control of follicular growth: local interactions and nutritional influences. R. Webb*, P. C. Garnsworthy*, J. G. Gong1, and D. G. Armstrong2, 1University of Nottingham, Loughborough, UK, 2Roslin Institute, UK.

Reproductive function is an integrated process encompassing both extragranulosa signals and intrafollicular factors. Initiation of primordial follicle growth and the early stages of folliculogenesis can occur without gonadotropins, but FSH may affect the rate of preantral follicle growth. Antral follicle development from 2-4 mm in sheep and cattle is completely gonadotropin dependent. These recruited follicles express a range of mRNAs encoding steroidogenic enzymes, gonadotropin receptors and local regulatory factors and their receptors. As follicles continue to mature, there is a transfer of dependency from FSH to LH, which may be part of the mechanism involved in selection of follicles for continued growth. Locally produced growth factors, such as the IGF's and members of the TGF/β super-family, work in concert with gonadotropins throughout the follicular growth continuum and can have significant effects on follicle selection. Environmental influences such as acute changes in dietary intake also have an impact on ovarian activity. These changes can occur without significant variation in circulating gonadotropin concentrations and can be correlated with changes in circulating concentrations of metabolic hormones including insulin, IGF-I, GH and leptin. For example dietary energy and protein affect the expression of mRNAs encoding components of the ovarian IGF system and these changes can regulate the sensitivity/response of follicles towards FSH and contribute to the observed changes in follicular dynamics. The roles of growth factors in follicular development and survival are dependent on gonadotropin status and differentiation state of the follicle, including the extracellular matrix. In conclusion, it is the integration of these extracellular signals and intracellular factors that determine whether a follicle will continue to develop or be diverted into atretic pathways. Funded by DEFRA, SEERAD and BBSC.
undertaken, does not support the correct development of oocyte competence. Follicle size affects oocyte quality, potentially implicating mRNA or protein stores as factors involved in oocyte competence. Oocytes from preantral follicles grown in vitro are competent to resume meiosis, although development to the blastocyst stage is reduced. An oosparing from oocytes produced using this technique was normal at birth but experienced delayed onset health issues, highlighting the importance of oocyte quality long after embryogenesis. Metabolism may play a critical role in oocyte quality, as glycolytic activity in mature oocytes is correlated with increased embryonic development. Communication between the oocyte and its surrounding cumulus cells is also important for the development of a competent oocyte. Ovarian stimulation causes delayed embryonic development, increased abnormal blastocyst formation, fetal growth retardation and increased fetal loss. Thus, although meiosis and even early development may be completed successfully, there are a variety of processes occurring within the cytoplasm of the oocyte that are required for complete developmental competence. However, the cellular mechanisms that impart oocyte quality are unclear. Until the mechanisms involved in oocyte quality are elucidated, any effort to utilize assisted reproductive technologies in animals for production or biomedical purposes will be inefficient at best.

Key Words: Gamete, Embryo, Assisted reproduction

16 Pre-ovulatory, post-ovulatory and post-maternal-recognition factors that affect establishment and retention of pregnancy in cattle. E. K. Inskeep*, West Virginia University, Morgantown WV/USA.

Although fertilization rate is very high when male fertility is normal in most situations that have been studied, pregnancy rates are well below expectations when defined by the birth of live offspring in response to first service. Factors that affect establishment and retention of pregnancy include: (1) preovulatory influences on the follicle and oocyte, (2) early postovulatory uterine and luteal function, (3) concentrations of hormones associated with trophoblastic and endometrial function during maturation of this pregnancy, and (4) less-well understood factors during the peri-attachment period. For example, decreased concentrations of progesterone during preovulatory follicular development lead to increased frequency of episodic secretion of LH, increased secretion of estrogen by a persistent follicle, premature resumption of meiosis and a high incidence of embryonic death between the 2- and 16-cell stages in the cow. Using the early-weaned postpartum cow as a model, absence of previous exposure to progesterone causes increased secretion of PGF2α during days 4 to 9 of the first estrous cycle. The elevated PGF2α not only causes luteolysis, but also has a direct embryotoxic effect during the morula to blastocyst transition. Ideal conditions during the peri-attachment period are not clearly defined and factors in pregnancy wastage may vary with species. Nominal increases in secretion of PGF2α between days 30 and 35 may be important for completion of attachment and placentalization in the cow. Lower survival of embryos from day 30 to days 45 to 60 in the cow is associated with lower circulating concentrations of progesterone, but association with concentrations of estrogen has varied among experiments.

Key Words: Embryonic mortality, Follicular development, Luteal function

17 Commercial application of marker- and gene-assisted selection in livestock: strategies and lessons. J. C. M. Dekkers*,1 Iowa State University.

During the past decades, advances in molecular genetics have led to the identification of multiple genes or genetic markers associated with genes that affect traits of interest in livestock, including genes for single gene-trait and genes or genomic regions that affect quantitative traits (quantitative trait loci or QTL). This has provided opportunities to enhance response to selection, in particular for traits that are difficult to improve by conventional selection (low heritability or traits for which measurement of phenotype is difficult, expensive, only possible late in life, or not possible on selection candidates), as has been demonstrated in a number of simulation studies. The objective here is to review strategies for the use of genes or markers in genetic improvement, to assess the extent to which and how marker and gene information has been used in commercial livestock improvement programs, to assess the successes and limitations that have been experienced in such applications, and to discuss strategies to overcome these limitations. Focus will be on the use of QTL information from experimental populations, on detection, verification, and estimation of effects in commercial breeding populations, and on the integration of molecular data in methods for genetic evaluation and in selection strategies. Types of molecular information that will be considered include gene tests for causative mutations and linked markers in population-wide linkage equilibrium or disequilibrium with the QTL.

Key Words: Marker-assisted Selection, Genetics, Selection

18 Lessons from QTL analyses in mice. D Pompoli* and E. J. Eisen, University of Nebraska, 3 North Carolina State University.

Most phenotypes with economic relevance are multifactorial traits controlled by complex contributions of genetics and environment. Genetic predisposition results from combinations of relatively small effects of sequence variation within a large number of polygenes, known as quantitative trait loci (QTL). Nearly 200 QTL have been reported for growth and body composition traits in the mouse, likely representing 50-100 distinct genes. Molecular biology has yielded significant advancements in understanding these traits at the metabolic and physiological levels. However, little has been learned regarding the identity and nature of the underlying polygenes due to the inherent inaccuracy of QTL localization and the inability to differentiate between co-localization and co-occurrence when comparing QTL with potential candidates. This wide gap between our knowledge of physiological mechanisms underlying complex traits and the nature of genetic predisposition significantly impacts QTL discovery. Identification and genetic mapping of key transcriptional, proteomic, metabolomic and endocrine events will uncover large lists of significant positional candidates. However, integration of experimental approaches to jointly evaluate predisposition and physiology will increase success of QTL identification by combining the power of recombination with functional analysis. Measuring physiologically relevant sub-phenotypes (e.g. 10,000 expression phenotypes on an array) within a structured gene mapping population will facilitate pathway-specific prioritization among candidate genes. This would advance our understanding of the genetic architecture of complex traits by testing the hypothesis that genes controlling predisposition to a trait are primarily involved in trans-regulation of the physiological pathways that directly regulate the trait. An integrated “polygene discovery database” will enable QTL identification and characterization. This will be critical for the success of marker assisted selection in livestock, given the inherent advantages of using directly predictive assays relative to within-family, linked-marker tests.

Key Words: Mice, QTL, Marker assisted selection

19 Potential use of microarrays and related methodologies in animal breeding. B. Walsh*, University of Arizona.

The age of genomics offers biologists with powerful tools few could even dream of twenty years ago. Biology is being transformed by such tools, and animal breeding is no exception. Genome-wide studies of levels of mRNA expression in specific tissues and/or over time can be monitored by microarrays. The rigorous statistical analysis of such arrays is still being fine-tuned, and we will explore some of the resolved, and unresolved, issues. While microarrays offer an approach to gene discovery (i.e., candidate genes), they likely face many of the same issues as QTL mapping in moving from a powerful genetic tool to a particular tool for applied breeding. Microarrays are one tool of functional genomics, a discipline seeking to understand gene and metabolic networks. Another tool are two-hybrid screens that look for interactions between proteins
Food Safety Symposium: Food safety for animal agriculture: What producers need to know

20 Animal and egg production food safety: Introduction. G. M. Jones*, B. Eastwood1, and J. Mattison2, 3 Virginia Tech, Blacksburg, VA, 2 USDA CSREES, Washington DC, 3 The ADDS Center, Verona, WI

An on-farm food safety program has been developed for Extension specialists and agents and other food animal professionals to use for their own information or in developing educational programs for animal producers. The program consists of modules on various topics related to food safety, a database with selected references, and links to other food safety related websites and is available on CD-ROM through the ADDS Center. Its development and distribution was funded by USDA Food Safety and Inspection Service. Oversight was provided by a steering committee that included Extension agents and specialists representing food science, veterinary medicine, and animal and poultry science. Modules discuss importance of food safety and use of HACCP in development of quality assurance production practices. Specific modules include: causes of foodborne disease, drug use, residues, and resistance, HACCP, management practices that also involve feeds, and control of flies and rodents, farm advisory teams, and commodity assurance programs for aquaculture, beef, chick and poultry, and sheep. Primary emphasis was given to commodity programs. The modules and database were evaluated by the animal science committee of the National Association of County Agricultural Agents and the steering committee.

Key Words: Animal production food safety, Training/teaching modules, Extension education

21 Food safety for animal agriculture: What producers need to know about causes of foodborne illness. D. B. Griffin*, Texas A&M University, College Station, TX.

This module reviews CDC foodborne disease incidence, types of foodborne illness and prevalence, trends in causes of foodborne illness over past century, symptoms and susceptibility, and specific pathogens and sources found in animal products using baseline data of USDA FSIS. Brief discussions are provided of: E. coli, Salmonella, Staphylococcus aureus, Listeria, Campylobacter, Yersinia, Bacillus cereus, Clostridium botulinum, Giardia, Cryptosporidium, and BSE. The relationship between Mycobacterium paratuberculosis and Johne’s disease with Crohn’s disease in humans is explored. The module outlines the roles of pasteurization and irradiation in preventing disease outbreaks.

Key Words: Animal production food safety, Foodborne illness, Extension education

22 Food safety for animal agriculture: What producers need to know about drug use, resistance, and residues. B. Jayarao*, Pennsylvania State University, University Park, PA.

This module reviews uses of antibiotics in animal agriculture, extent of residues and causes, benefits of subtherapeutic drug use, antibiotic resistance and relation to drug use in food-producing animals, extra label drug use, and role of animal producers in minimizing risk. The module looks at the importance of antibiotics to animal production, while discussing why antibiotics are of concern to public health. It discusses the extent of drug residues, using USDA FSIS residue test results, and summarizes some of the causes and/or errors in drug use. Relationship between drug use in food producing animals and antibiotic resistance in humans is examined. Extra label drug use is defined and requirements for use are listed. The role of antibiotic susceptibility tests is outlined. The advantages of subtherapeutic (for growth promotion), prophylactic (disease prevention), and therapeutic (treatment of infections) antibiotic use in animals are presented as well as concerns over excessive use.

Key Words: Animal production food safety, Drug use, Extension education

23 Food safety for animal agriculture: What producers need to know about HACCP and management practices. G. M. Jones*, Virginia Tech, Blacksburg, VA.

HACCP (hazard analysis critical control points) is a system that identifies specific hazards, implements effective control measures, and monitors procedures used to prevent hazards. It is a tool used to protect food against microbiological, chemical, and physical hazards. An illegal drug residue in milk or meat is a hazard. HACCP is a process that collects and analyzes information on hazards and conditions leading to their presence and to decide which are significant. Critical control points are the steps at which control can be applied and are essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. Quality assurance programs are generally based on HACCP concepts and these are embedded in residue avoidance programs. HACCP includes keeping records to trace problems and to measure effects of intervention strategies and the monitoring of progress in controlling hazards. The HACCP module includes: definition/description, potential hazards and their significance, on-farm critical control points, corrective actions, role of quality assurance programs and their benefits, and brief introduction to various commodity Quality Assurance Programs. The management practices module includes sources of hazards and stressors on the farm, on-farm critical control points, animal health (immune system, nutrition, environment), management strategies and practices, biosecurity, transportation of animals, handling disabled animals, and dead animal disposal.

Key Words: Animal production food safety, HACCP, Management practices

24 Food safety for animal agriculture: What producers need to know about quality assurance programs. J. W. Oltjen*, University of California, Davis, CA.

Virtually all food animal commodity organizations have implemented quality assurance education programs (QAP) to maintain or increase food safety, wholesomeness, and quality. The goal of all food animal industries is to produce high quality, safe products. QAP focus on helping producers supply products that are as free as possible of microbial hazards and drug and chemical residues, although QAPs often focused on residue avoidance. Benefits of QAP include improved management practices, avoidance of violative drug residues, decreased production costs, and increased awareness of food safety concerns. QAPs are important because they: promote animal health and welfare, ensure proper drug and antibiotic use, provide records to assure purchasers of good production practices, are proven to reduce residue violations, potentially reduce pathogens through good hygiene and animal health, and improve production efficiency and quality of animals. QAPs take into consideration feedstuffs (additives, medications, mycotoxins, pathogens, clean mixing equipment), cleanliness and ventilation of facilities, appropriate drug use and records, extralabel drug use, identification and tracking of treated animals, injection site blemishes and hazards, and biosecurity. Self-review is important in QAPs, and some utilize third party verification. This module reviews basic concepts behind quality assurance programs, benefits, residue violations, drug withdrawal times, preharvest testing, sensitivities and specificities, false positive and false negative test results, and presents a brief introduction to commodity QAPs.

Key Words: Animal production food safety, Quality assurance programs, Extension education
Dietary fat, Fish oil, Conjugated linoleic acid studies and their potential application to meat animals will be reviewed. The genetic, nutritional, and pharmacological manipulation of adipose tissue in meat animals has been documented. This has led to introduction of human infant essential fatty acids, such as arachidonate and DHA, for brain development. These effects have the potential to affect fat cell numbers very early in adipocyte differentiation. Long chain, saturated and polyunsaturated fatty acids, and fatty acids in the conjugated linoleic acid (CLA) series, reduce differentiation of pre-adipocytes that can have effects on both proliferation and differentiation in pre-adipocytes that have effects on both proliferation and differentiation. Genes known to regulate transcriptional factors, such as CAAT/enhancer binding protein (C/EBP), peroxisome proliferator activated receptor (PPAR), and other adipose-specific genes, very early in adipocyte development. These effects have the potential to affect fat cell number at maturity. Specifically, there is evidence that the fatty acids in fish oil, such as docosahexaenoic (DHA) and eicosapentaenoic (EPA) acids, and fatty acids in the conjugated linoleic acid (CLA) series, reduce pre-adipocyte proliferation in cell lines and reduce adiposity in rodents. Conversely, diets high in saturated fatty acids have been shown to increase adipocyte mass. There is little direct evidence of the ability of fatty acids to manipulate adipocyte development in non-rodent species. However, it should be noted that only recently has the importance of essential fatty acids, such as arachidonate and DHA, for brain development been documented. This has led to introduction of human infant formulas supplemented with these fatty acids. The genetic, nutritional, and pharmacological manipulation of adipose tissue in meat animals has been a long term interest of animal scientists. An understanding of the ability of fatty acids to regulate such factors as adipocyte number, particularly in meat animals, would be of great interest. The evidence for regulatory roles of fatty acids in development from rodent and in vitro studies and their potential application to meat animals will be reviewed.

**Key Words:** Adipose tissue, Primary cell culture, Established cell lines

### 26 Role of fatty acids in adipocyte growth and development. M. J. Azain*1, 1University of Georgia.

The most common association of fatty acids with adipose tissue is related to their storage as triglycerides in mature adipocytes and the consequences of excess accumulation in obesity. There is considerable evidence from cell culture experiments and studies in rodents that fatty acids can also regulate adipocyte differentiation. In this role, fatty acids have hormone like effects and can be shown to regulate gene expression in pre-adipocytes that can have effects on both proliferation and differentiation. Long chain, saturated and polyunsaturated fatty acids have been shown to regulate transcriptional factors, such as CAAT/ENHancer binding protein (C/EBP), peroxisome proliferator activated receptor (PPAR), and other adipose-specific genes, very early in adipocyte development. These effects have the potential to affect fat cell number at maturity. Specifically, there is evidence that the fatty acids in fish oil, such as docosahexaenoic (DHA) and eicosapentaenoic (EPA) acids, and fatty acids in the conjugated linoleic acid (CLA) series, reduce pre-adipocyte proliferation in cell lines and reduce adiposity in rodents. Conversely, diets high in saturated fatty acids have been shown to increase adipocyte mass. There is little direct evidence of the ability of fatty acids to manipulate adipocyte development in non-rodent species. However, it should be noted that only recently has the importance of essential fatty acids, such as arachidonate and DHA, for brain development been documented. This has led to introduction of human infant formulas supplemented with these fatty acids. The genetic, nutritional, and pharmacological manipulation of adipose tissue in meat animals has been a long term interest of animal scientists. An understanding of the ability of fatty acids to regulate such factors as adipocyte number, particularly in meat animals, would be of great interest. The evidence for regulatory roles of fatty acids in development from rodent and in vitro studies and their potential application to meat animals will be reviewed.

**Key Words:** Dietary fat, Fish oil, Conjugated linoleic acid

### 27 Adipose tissue angiogenesis. G. J. Hausman, USDA-ARS.

A review of adipose tissue angiogenesis includes discussion of the morphological and cytochemical development of adipose tissue vasculature and the concept of primitive fat organs. Spatial and temporal relationships between vascular and fat cell development in the fetus are also discussed including dependence on genetic and dependent arterio-arterial differentiation. The relationship between connective tissue deposition and elaboration of adipose tissue vasculature is discussed with respect to regulating adipocyte development in a depot dependent manner. In vitro studies indicate that depot dependent vascular traits may be attributable to intrinsic growth characteristics of adipose tissue endothelial cells. These studies indicate that adipogenesis may be regulated by factors that drive angiogenesis. Fundamental aspects of angiogenesis including basement membrane breakdown, vasculogenesis, angiogenic remodelling, vessel stabilization and vascular permeability are reviewed. Critical angiogenic factors including vascular endothelial growth factor (VEGF), VEGF receptors, angiopoietins, metalloproteinase enzymes and the plasminogen enzymatic system are also discussed. VEGF is the most critical factor that initiates the development of immature vessels and disruption of a single VEGF allele leads to embryonic lethality in mice. Expression of VEGF is influenced by hypoxia, insulin, growth factors and several cytokines. Angiogenic factors known to be secreted and/or produced by adipocytes or preadipocytes are discussed. VEGF expression and secretion by adipocytes is regulated by insulin and hypoxia and is associated with adipocyte tissue accretion. VEGF accounts for most of the angiogenic activity of adipose tissue. The proposed role of leptin as an angiogenic factor is reviewed with respect to efficacy on various aspects of angiogenesis relative to other angiogenic factors. Potential links between VEGF and leptin gene expression have not been examined but both genes are induced by hypoxia. Finally, several studies including a study of mice treated with anti-angiogenic factors indicate that adipose tissue accretion can be controlled through the vasculature per se.

**Key Words:** Angiogenesis, Adipose tissue, Leptin

### 28 The adipocyte as an endocrine cell. J. L. Mine* and K. M. Hargrave, University of Nebraska.

It has been hypothesized since at least since the 1940s that communication between adipose and other tissues may be bidirectional. Despite this expectation, early progress in our understanding of adipose tissue function was largely limited to its role in metabolism and storage of fatty acids, its development, and its response to endocrine and neural cues. However, the last decade has witnessed identification of several molecules that are secreted from adipocytes apparently for the purpose of signaling to other tissues. Cloning of the mouse obesity gene in 1994 is perhaps the most famous impetus for recognition that adipocytes are active in regulation of multiple body functions. The product of this gene, leptin, has since been found to inhibit feeding, enhance energy expenditure, and stimulate gonadotropes. Evidence for the roles other adipocyte-derived signals is being generated. Resistin is a protein that can cause whole body insulin resistance. Its expression is correlated with body fat and is inhibited by thiazolidinediones, perhaps mediating the association of diabetes with obesity, and the effectiveness of these drugs. It and a related molecule, RELMalpha, also can inhibit differentiation of preadipocytes. Tumor necrosis factor alpha is secreted from adipocytes and antagonizes insulin action. Adiponectin/Remp30 secretion from adipocytes is diminished in obese states. This protein can enhance use of fatty acids in lean tissues, and reduce both blood glucose and body weight. Secretion of complement proteins has been observed in adipocytes and these interact to generate a signal called acylation stimulating protein which can promote triglyceride synthesis. Similarly, adipocytes secrete renin-angiotensin system components and adenosine, both of which are anabolic in adipose tissue. It is unlikely that all of the adipocyte’s endocrine signals have been identified. Certainly, much is yet to be learned about how these signals function. However, it is clear that these new discoveries comprise a useful model for our study of growth and development in livestock.

**Key Words:** Adipose tissue, Secretion, Hormone
grown at 30°C column chromatography from crude extracts from L. lactis ATCC 11454 containing the nisin gene cluster. Furthermore, a protein with the same production in lactic cultures by disrupting the signal transduction pathway. This novel finding should enable culture users to the first evidence of a specific mechanism for inhibition of nisin production was likely blocked from the reduced inability of external nisin to coupling protein-1 mRNA initially was elevated in tailhead s.c. adipose tissue, but was barely detectable by birth, and tended to be higher overall in Angus than in Brahman s.c. adipose tissue. In a third experiment, ADISA Dairy Foods Graduate Student Paper Competition and Dairy Foods

Altered growing conditions can inhibit nisin production in lactic cultures by disrupting the signal transduction pathway. H. Li* and D. O’Sullivan, University of Minnesota.

A signal transduction pathway controls the production of the nisin bacteriocin by Lactococcus lactis. In this system, external nisin can signal the nisin genes to be switched on in a dose dependent fashion, involving the membrane bound kinase (NisK) and the intracellular regulator, NisR. Phosphorylated NisR initiates transcription of the genes involved in nisin production. However, we have found that nisin production can be switched off under certain conditions. These conditions are: 1) growth of L. lactis at it maximum growth temperature of 40°C; 2) transfer of the nisin gene cluster into a dairy Enterococcus strain; 3) electroporation of plasmids into certain nisin producing L. lactis strains. In these three cases, Northern and RT-PCR analysis confirmed that the nisA gene was not expressed, but the immunity genes were. This suggested the lack of nisin production under these conditions was possibly due to a blockage in the signal transduction pathway. To address this hypothesis, gel shift experiments were conducted with a nisA promoter fragment using crude cell extracts from cultures growing under these conditions. A shift was observed for cell extracts from the positive control, L. lactis ATCC 11454 grown at 30°C, but not for crude extract from L. lactis ATCC 11454 grown at 40°C or the dairy Enterococcus strain containing the nisin gene cluster. Furthermore, a protein with the same size as NisR (26 kDa) was isolated by nisA competitive heparin-affinity column chromatography from crude extracts from L. lactis ATCC 11454 grown at 30°C, but not from cell extracts under the non-nisin producing conditions. This suggested the lack of an activated, phosphorylated NisR, under these conditions. In addition, RT-PCR and Northern hybridization confirmed the presence of the nisRK transcript, indicating that NisRK was most probably produced. Therefore, the nisin gene expression was likely blocked from the reduced inability of external nisin to initiate the signal transduction pathway during these conditions. This is the first evidence of a specific mechanism for inhibition of nisin production in lactic cultures. This novel finding should enable culture users to more reliably predict nisin production kinetics of cultures during specific culture uses.

Invasion of Mycobacterium avium sub sp paratuberculosis in bovine mammary epithelial cells.

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Main objective of our experiment was to investigate invasion characteristics of Mycobacterium avium sub sp. paratuberculosis (MAP) against bovine epithelial cells and bovine mammary epithelial cells as targets. Johne’s disease is a chronic infectious disease of ruminants caused by a bacterium Mycobacterium avium sub sp. paratuberculosis (MAP). It is estimated that about 30 % of dairy herds are infected with Johne’s disease in the US. It is known that MAP infects the host by the oral route and young calves are infected at early age. Intestinal epithelial cells thus become primary site of infection. For current experiment we hypothesized: 1. Mammary epithelial cells can be a reservoir for MAP and therefore invasion could take place by apical or basolateral surface; 2. MAP can enter intestinal epithelial cells. To test the above hypothesis we evaluated invasion employing immortalized epithelial cell lines, namely Bovine epithelial cell(MDBK purchased from ATCC) and Mammary epithelial cell (MACT, given by Dr. Sheffield, Univ of Wisconsin). MAP strain ATCC 19698 was used in our study. Invasion assay protocol was standardized in our lab. Based on the statistical analysis of data we found that MAP invades M-C-T and MDBK cells successfully, albeit poorly. MAP showed markedly higher rate of invasion in case of MDBK compared to MACT. Exposure of basolateral surface did not have marked influence on invasion in case of mammary epithelial cells, suggesting that the apical surface is the main route of entry however, exposure of basolateral surface of bovine epithelial cells significantly increased the uptake of bacteria, a puzzle that we cannot explain without further studies. MAP is a pathogen that is extremely resistant to wide spectrum of antibiotics. Its control lies in breaking its transmission cycle by inhibiting molecular interaction with epithelial cell surfaces. In this endeavor, in-vitro invasion assay described here can serve as a useful model in screening interesting MAP mutants with reduced or altered invasion efficiency. Main conclusion of our study is- MAP can successfully invade bovine epithelial cells and mammary epithelial cells. Exposure of basolateral surface significantly increases invasion rate in case of bovine epithelial cells.

Key Words: Mycobacterium avium sub sp paratuberculosis, Invasion assay, Bovine mammary epithelial cells


Listeria monocytogenes is a human foodborne pathogen and causes severe systemic infections in animals. L. monocytogenes is responsible for a significant portion of dairy product Class I recalls. Raw milk may harbor L. monocytogenes and pasteurized dairy products may be contaminated if the pathogen become established in processing plant environments. A case-control study involving 22 case farms (4 dairy cattle, 1 beef cattle, 4 goat, and 2 sheep) and 22 pair-matched controls was conducted to probe the epidemiology and ecology of L. monocytogenes. A total of 1652 fecal (n=424), feed (n=420), and environmental samples (soil, n=397; water, n=411) were cultured for L. monocytogenes. While prevalence of L. monocytogenes was not significantly different (p=0.1492) in bovine case (23.13%) and control (19.58%), the pathogen was more common (p<0.0001) in small ruminant (caprine and ovine pooled) case farms (26.41%) than controls (4.40%). The prevalence of L. monocytogenes was not significantly different (p=0.05) in fecal, soil, feed, and water samples from bovine case and control farms. Small ruminant case farms showed a significantly higher prevalence (p<0.05) of L. monocytogenes in all sampling categories than small ruminant controls. Molecular subtyping (EcoRI ribotyping) of clinical (n=15) and farm isolates (n=310) differentiated 49 unique ribotypes.
Ribotype DUP-1038B was associated with case farms and DUP-1045A was linked to control farms (p<0.05). Ribotype DUP-1038B was associated with feces while DUP-1045A was more common in the environment (p<0.05). L. monocytogenes subtypes isolated from clinical cases or fecal samples were more frequent in environmental than feed samples, indicating that case or carrier animals are important to L. monocytogenes dispersal. We determined that L. monocytogenes was abundant in pre-harvest food systems. Our data indicate that the epidemiology and ecology of L. monocytogenes differs between host species. While some L. monocytogenes subtypes may cause disease, others may protect against disease by stimulating host immunity or competitive exclusion. A complete understanding of the L. monocytogenes epidemiology and ecology is needed to implement effective control strategies and ultimately ensure food safety.

Key Words: Listeria monocytogenes, Molecular epidemiology, Pre-harvest food safety

33 The influence of sweet cream buttermilk on the compositional and rheological properties of a stirred-curd cheese. T. Lin*,1, J. Lacev1, R. Govindasamy-Lacev2, M. Johnson2, and J. Jaegger.1 Department of Food Science, UW Madison, 2Wisconsin Center for Dairy Research

Sweet cream buttermilk (SCB) is a by-product from the butter-making process and has been used as an ingredient for cheesemaking. The objective of this research was to determine how the addition of SCB might affect the cheese composition, melt, stretch, and free oil of cheese when used on a pizza. Three trials were done in which stirred-curd cheese was made from partially skimmed milk with the addition of 2, 4, and 6% (w/w) of SCB fortified SCB. Cheeses were assessed for composition, meltability using the UW Melt Profiler, free oil using modified Babcock test, and stretchability by the fork test, over a four-week ripening period. Cheese moisture content increased significantly (P<0.05) with increasing SCB levels, and ranged from 45% (w/w) for control cheese to 51% for the 6% SCB fortified cheese. Cheeses with 6% SCB had significantly (P<0.05) lower pH than control cheese during the entire ripening period. Fat content in cheeses decreased from 23% for control to 20% for 6% SCB fortified cheese. Cheeses with no added SCB had the highest % recovery of its indigenous phospholipids (40%). Cheeses, made with 2, 4, and 6% SCB had total phospholipid recoveries of 32, 33 and 31%, respectively. The extent of flow, or cheese meltability, was significantly higher (P<0.05) for cheeses made with SCB than control cheese during the ripening period. This may be due to the high moisture and low pH of these cheeses. Free oil release was significantly reduced (P<0.05) for all the cheeses made with added SCB for the first week of ripening; however, there was no significant difference between treatments at the second and fourth week. Visually, no significant free oil formation was observed when cheeses were baked on a pizza. Cheese stretchability was significantly reduced (P<0.05) with increasing level of SCB. The stretchability of control cheeses increased during ripening, but decreased in cheeses with added SCB. Results showed the use of high level of SCB resulted in cheese with soft body, poor shredding, high extent of flow, low pH, and high moisture. Whether the physical and rheological changes in SCB added cheeses were due to the compositional changes in the cheese or to the disruption of SCB components in the cheese network is currently under investigation.

Key Words: Buttermilk, Pizza, Phospholipids

34 Characterization of proteolysis in Cheddar cheese produced with isogenic, thermolytic starters expressing various cell envelope proteinases. S. Myaka, L. Metzger#, K. Baldwin, and L. McKay, MN-SD Dairy Foods Research Center, University of Minnesota, St. Paul, MN.

If the use of thermolytic starter strains for accelerating Cheddar cheese ripening is coupled with the use of the extracellular starter proteinase with desired cleavage specificity a more controlled acceleration of ripening and improved flavor formation might be expected. The objective of this research was to investigate how the specificity of the cell envelope proteinase (CEP) in conjunction with the early released peptides affects the accumulation of proteolytic products. In a previous study Cheddar cheese was manufactured with thermolytic isogenic lactococcal starters expressing SCB. Cheeses were aged for 2 and 4 weeks. The intermediate bitterness of treatment g coincided with an even spread of its major peaks from the beginning to the end of the elution time. Thus a correlation between bitterness and elution from a hydrophobic column was observed. Bitter peptides s1S1(1-13) and β(193-209) accumulated to high levels in both bitter and non-bitter cheeses suggesting that these peptides are not the only compounds imparting bitterness. Peptides resulting from the specific CEP cleavage of s1S1(1-23) were found in all the cheeses but only in treatment g did they accumulate to higher levels and appear as separate peaks. Consequently the most abundant peptides in the major peaks are not necessarily traced back to the cleavage specificities of the different CEPs.

Key Words: Cell envelope proteinase, Proteolysis, Peptides

35 Identification of fecal/mothball flavor in Cheddar cheese. M. E. Carunchia Whetstone*,1, Y. Yoon1, and M. A. Drake1, 2North Carolina State University.

Flavor of Cheddar cheese is a key parameter for consumer acceptance and marketing. The application of analytical sensory and instrumental methods to identify and characterize specific flavors and the chemicals that cause specific flavors enhances our understanding of the cheese flavor chemistry. Some Cheddar cheeses have been found to exhibit a fecal/mothball (F/M) flavor. The objectives of this research were to identify and characterize aroma-active compounds that contribute to F/M flavor in Cheddar cheese. Blocks of Cheddar cheeses (6 to 15 months old) were collected and screened for F/M flavor by a descriptive sensory analysis panel (n=14). Two cheeses with F/M flavor and two cheeses of similar age without F/M flavor were selected and analyzed for volatile aroma compounds. Duplicate samples (300g) with internal standards (2-methyl pentanoic acid, 2-methyl-3-heptanone, and 1-pentanol) were extracted with diethyl ether, followed by isolation of volatile material by high vacuum distillation. Volatile extracts were analyzed by gas chromatography-mass spectrometry (GC-MS) and the most odor active compounds were determined using aroma extract dilution analysis (AEDA). Additionally, 5g of each cheese were frozen, grated, and subsequently analyzed using dynamic headspace purge and trap. Compounds were identified by comparison of retention indices, odor properties and GC-MS data against reference standards. Selected compounds were quantified by standard addition. Sensory analysis of model systems was used to confirm the relationship between selected compounds and specific flavors. Sensory analysis determined that F/M flavor was independent of cheese age; present in 6 month cheeses as well as 15 month cheeses. The 15 month cheeses had more intense broth and sulfur notes while the 6 month cheeses had more whey, cooked, and milk-fat flavors. Based on GC-O AEDA results, key volatile flavor compounds in both sets of cheeses were acetic acid (vinegar), hexanoic acid (sweaty), maltol (sweet), furanone (burnt sugar), 3-methylindole (F/M), α-aminoacetophenone (grape), and g-dodecalactone (coconut). Increased concentrations of 3-methyl-indole and butyric acid were observed in both cheeses exhibiting F/M flavors compared to those cheeses without this flavor.

Key Words: Cheddar flavor, Fecal/mothball flavor, Aroma extract dilution analysis

36 Analysis of physico-chemical changes during early ripening of cheese utilizing FTIR Spectroscopy. P. Upreti* and L. E. Metzger, MN-SD Dairy Foods Research Center, University of Minnesota, St. Paul, MN.

The objective of this study was to evaluate the feasibility of Fourier Transform Infrared (FTIR) Spectroscopy for measurement of lactose and lactic acid in cheese/cheese curds and to monitor lactose fermentation in cheeses during the first few days of ripening. A Nicolet 560 FTIR Spectrometer with a ZnSe Attenuated Total Reflectance (ATR) crystal accessory was used, and a protocol for sampling cheese/cheese curds was developed. Cheese/cheese curds were ground to a paste and then mounted on the ATR crystal. Proper contact between the sample and the crystal was ensured using the pressure pad assembly. The sample
was left under these conditions for 5 min before the start of data collection. The spectrum was collected in the region between 4000 and 650 cm\(^{-1}\) at a resolution of 4 cm\(^{-1}\), and a rate of 256 scans per sample. The crystal was cleaned between samples using distilled water, propanol, and distilled water, and then wiped to complete dryness. The spectrum obtained after subtraction of water spectrum from the sample spectrum was used to analyze for lactose and lactic acid. Cheeses spiked with lactose and lactic acid showed a shift in spectrum in the regions of 1200 to 1050 and 1700 to 1500 cm\(^{-1}\) respectively. In the next phase of the study, three replicates of cheeses with two different levels of residual lactose and calcium were manufactured. The levels of lactose and lactic acid were measured by HPLC and the FTIR spectra were collected for the cheese curds prior to salting, and cheese at day 1, 3, 5, 7, and 9 during ripening. The level of residual lactose and calcium in the cheese at day 1 was significantly (p<0.05) different for the two treatments (73 and 193.3% for lactose; 85 and 66% for calcium), and the level of lactose decreased in both treatments during the first 9 days of ripening. Subsequently partial least squares and principal component analysis will be used to characterize changes in lactose fermentation to the shifts in the FTIR spectrum during initial cheese ripening.

37 Evaluation of salt whey as an ingredient in process cheese. R. Kapoor*, L. E. Metzger, and D. E. Bauman

Salt whey refers to the whey stream obtained during the salting and mellowing step of a cheese manufacturing process. Due to its high salinity level, it is underutilized and also leads to disposal costs. Consequently, alternative uses need to be pursued. The major components of salt whey (salt and water) are used as ingredients in process cheese. The objective of this study was to determine whether salt whey, a traditional Cheddar cheese manufacture process, could be used as an ingredient in process cheese. Three replicates of Process Cheese (PC), Process Cheese Food (PCF) and Process Cheese Spread (PCS) with two treatments each were manufactured. Treatment 1 (C) used the control formula and treatment 2 (T) involved the modified formula using salt whey to replace salt and water. Salt whey was collected during the salting and pressing steps of the Cheddar cheese procedure at the University of Minnesota, followed by mixing and pasteurization. There were no significant differences (p≥0.05) in process cheese composition between the treatments. Texture Profile Analysis (TPA) and Rapid Visco Analyzer (RVA)-melt analyses were performed on all the process cheeses. Schreiber melt test was performed on PC and PCF and the tube melt test on PCS. The mean TPA-hardness values obtained respectively for the C and T were 126 N and 115 N for PC, 61 N and 59 N for PCF, and 12 N and 12 N for PCS. The mean melt diameter obtained for C and T process cheeses were 48.5 mm and 49.4 mm for PC, and 61.6 mm and 63 mm for PCF. The tube-melt for PCS (C and T) was 75.1 mm and 79.8 mm respectively. There were no significant differences (p≥0.05) in the TPA-hardness and the RVA hot viscosity for PC, PCF and PCS between the treatments. The Schreiber melt of C and T for PC and PCF and the tube melt values for C and T in PCS also showed no significant differences (p≥0.05). The replacement of salt and water with salt whey in PC, PCF and PCS had no significant effect on their functionality.

Key Words: Process cheese, Salt whey


Infrared milk analyzers are traditionally calibrated using sets of 10 to 12 raw milk samples from individual farms. Although taken from the local milk population, these sets of samples are limited by a short shelf-life, a short and variable range in component concentration, nonuniform distribution of concentrations within the range, and correlation in concentration changes among components. An alternate approach using ultrafiltration (UF) to produce calibration samples provides a means to overcome these weaknesses and improve calibration performance. UF calibration samples were produced by gravity separating pasteurized milk, centrifugally separating the gravity skim to remove residual fat, and ultrafiltrating the skim milk. The gravity cream (ca. 25% fat), UF retentate (2X), UF permeate, lactose α-monohydrate, and water were combined to make calibration sets designed to have a large range and incremental changes in each component and to uncouple the fat and protein correlation. The 12 sample UF calibration set had a range of 2.0-6.0% fat, 2.0-4.3% true protein, and 4.0-5.3% anhydrous lactose. Shelf life of preserved UF calibration samples was 4 wk compared to 2 wk for individual farm samples. Comparison of performance of individual farm and UF calibration sets was by standard deviation of the difference (SDD) between chemistry and infrared prediction, the stability of the instrument slope and bias with time, set to set variation in these values, and the frequency of high leverage samples within calibration sets. UF calibration sets had smaller SDD within sets and were more consistent among sets, indicating better calibration performance with respect to agreement with chemistry. The UF calibration samples exhibited a more stable slope and bias for each component and fewer high leverage samples than for farm milk calibration samples, both within calibration sets and among sets over several months of operation.

Key Words: Infrared milk analysis, Calibration, Ultrafiltration

39 WITHDRAWN

40 Effects of \(\text{trans}-8,\ \text{cis}-10\) CLA and \(\text{cis}-11,\ \text{trans}-13\) CLA on milk fat synthesis. J. W. Perfield II*, A. Sabo*, and D. E. Bauman1, Cornell University, Ithaca, NY, 2Natural ASA, Hovdebygda, Norway.

Conjugated linoleic acid (CLA) supplements that cause a reduction in milk fat secretion in dairy cows have typically been comprised of 4 isomers (\(\text{trans}-8,\ \text{cis}-10;\ \text{trans}-9,\ \text{cis}-11;\ \text{trans}-10,\ \text{cis}-12;\ \text{cis}-11,\ \text{trans}-13\) CLA). Abomasal infusion of pure isomers has shown that \(\text{trans}-10,\ \text{cis}-12\) CLA is a potent inhibitor of milk fat synthesis, whereas \(\text{cis}-9,\ \text{trans}-11\) CLA has no effect (Baumgard et al. 2000, Am. J. Physiol. 278:R179-84). However, there appear to be additional fatty acid intermediates that inhibit milk fat synthesis based on infusion of various CLA enrichments (Chouinard et al. 1999, J. Dairy Sci. 82:2737-45) and studies with rumen-protected CLA (Perfield et al. 2002, J. Dairy Sci. 85:2609-17). The objective of this study was to investigate the effects on milk fat synthesis of additional CLA isomers present in the rumen-protected supplements. Four rumen fistulated Holstein cows (141 ± 8 DIM, mean ± SE) were randomly assigned in a 4 X 4 Latin square experiment. Treatments were abomasal infusion of 1) skim milk (negative control), 2) \(\text{trans}-10,\ \text{cis}-12\) CLA supplement (positive control), 3) \(\text{trans}-8,\ \text{cis}-10\) CLA supplement, and 4) \(\text{cis}-11,\ \text{trans}-13\) CLA supplement. Treatments 2 to 4 were targeted to provide 4 g/d of the CLA isomer of interest and the daily dose provided by infusion at 6 h intervals was used to analyze for lactose and lactic acid. Cheeses spiked with lactose and lactic acid showed a shift in spectrum in the regions of 1200-1400 and 1500 to 1700 cm\(^{-1}\) for lactose and lactic acid showed a shift in spectrum in the regions of 1200-1400 and 1500 to 1700 cm\(^{-1}\) for lactose and lactic acid


Ninety-four multiparous Holstein cows (33.9 ± 0.05 BCS) were used in an adaptive randomization by block design to evaluate the effects of carbohydrate source and monensin on dry matter intake, milk production and blood metabolites of transition cows. Two diets with (+) or without (-)...
supplemental monensin (0 or 330 mg/d) were evaluated in a 2 X 2 factorial arrangements. The prepartum CONV diet contained 70% forage and the NFFS diet contained nonforage fiber sources such that 28% of the forage was replaced with cottonseed hulls and soyhulls. Treatments were designated CONV-, CONV+, NFFS-, and NFFS+. The prepartum diets were formulated to contain 1.55 Mcal/kg NE4, 40% NDF, and 14% CP. Dietary treatments began at dry off and continued until parturition. Monensin was top dressed daily starting 28 d prior to expected calving date. Prepartum dry matter intake (DMI) was significantly higher for cows fed the NFFS diet compared to cows fed the CONV diet (P ≤0.05; 12.5, 11.2, 15.5, 15.1 ± 0.5 kg/d). There were no differences in postpartum DMI (21.2 ± 7.7 kg/d) or milk yield (41.3 ± 2.1 kg/d). Body condition score did not differ prepregnancy (3.38 ± 0.05) or postpartum (2.9 ± 0.05). CONV treatment had higher plasma nonesterified fatty acids (NEFA) prepregnancy than NFSS treatment (P ≤0.05; 236.2, 199.4 ±11.7 µE/L). At d 3 and 5 prepregnancy NFSS diet had lower plasma NEFA concentrations than the CONV diet (P ≤0.05; 171.1 vs. 264.2 ± 25.1; 255.6 vs. 385.5 ± 23.3 µE/L). Postpartum NEFA were not affected by treatment (411.6 ± 22.4 µE/L). Monensin supplementation prepartum did not affect postpartum DMI, milk production or plasma NEFA concentrations. The inclusion of nonforage fiber sources in the prepartum diet increased prepartum DMI and decreased NEFA prepartum but had no affect on postpartum DMI or milk production.

Key Words: Nonforage fiber, Monensin, Transition cow

Photoperiod Manipulation affects milk yield and mammary growth in pubertal heifers induced to lactate. R. Thomason1,2,*, D. Martinez3, G. E. Dahl3, and T. B. McFadden2,
1University of Vermont, Burlington Vermont, 2University of Illinois, Urbana Illinois.

Cows exposed to a short day photoperiod during the dry period produce more milk, but the mechanisms behind this effect are unclear. We hypothesized that exposure to short days during hormonal induction of lactation would stimulate milk production and mammary growth. To test this hypothesis, Holstein heifers (n=12; 14 mo old) were assigned to either long day photoperiod (LDPP; 16h light:8 h dark), or short day photoperiod (SDPP; 8h light:16h dark) treatment and were fed meleagasterol acetate (MGA) for 14 d to synchronize estrous. Heifers were then treated with progesterone and progesterone (E+P; 1 and .25 mg/kg/d) for 7d to induce lactation. Twenty-one days after the initial E+P injection, twice-daily milking was initiated, all heifers were placed on LD, and biweekly treatment with rbST (Posilac®) commenced. Mammary tissue was obtained by biopsy at 0, 5, and 10 d relative to initial E+P injections and explants were used to quantify rates of [3H]-thymidine incorporation into DNA in vitro. Milk yield and composition were also measured. Milk yield was low initially in both groups but began to diverge after 19 DIM and averaged 16.3 ± 1.2 vs 12.6 ± 1.3 kg/d (P=0.05) at 63 DIM for SDPP and LDPP, respectively. Milk composition and SCC did not differ between treatments (P>0.10). Averages across groups for milk protein (3.17 ± 0.04%), milk fat (4.44 ± 1.4%), and SCC (3.27 ± 44%) indicated that milk composition was relatively normal. Incorporation of [3H]-thymidine in vitro did not differ between treatment groups (P>0.10). In both groups, cell proliferation increased over time (P<0.01), averaging 199 ± 54, 726 ± 71, and 558 ± 68 dpm/µg DNA on days 0, 5, and 10, respectively. We conclude that SDPP treatment during induced lactation in pubertal dairy heifers resulted in higher milk yields but did not affect cell proliferation at the times sampled.

Key Words: Photoperiod, Induced lactation, Mammary growth

Abnormal udder conformation in pubertal heifers induced into lactation. E. Wall,†, R. Thomason, D. Maynard, E. Brunst, and T.B. McFadden, University of Vermont, Burlington, VT.

Hormonal induction of lactation in pubertal heifers could provide a potential means to enhance economic efficiency, but effects on mammary development and conformation have not been reported. Twelve, 14 mo old Holstein heifers were assigned to either long day (LD; 16h light:8 h dark), or short day (SD; 8h light:16h dark) photoperiod treatment and were fed meleagasterol acetate (MGA) for 14 d to synchronize estrous. Heifers then received daily injections of estrogen (E; 0.1mg/kg/day) and progesterone (P; 0.25mg/kg/day) for 7 d to induce lactation. Twenty-one days after the initial E+P injection, twice-daily milking was initiated, all heifers were placed on LD, and biweekly treatment with rbST (Posilac®) commenced. Varying degrees of abnormal udder conformation were observed. In general, heifers exhibited highly sloped udder floors with long teats pointing forward. Apparent differences in capacity of individual quarters were quantified by quarter milking at 60, 180 and 300 DIM. Quarter milking yields did not differ between treatments (P>0.10) but confirmed apparent size differences per quarter (P<0.05). Among quarters, the left rear produced more milk than the left front (P= .01) with the other quarters not significantly different. To assess conformation, udders were scored using the linear scoring system at 300 DIM. Total linear udder scores did not differ by treatment and, except for three heifers, were below breed average. To further assess conformation, quartering score was assessed on a scale of 1-45, where 1=no demarcation between quarters, 25=desirable conformation, and 45=extreme quartering. Quartering score averaged 37 ±2.1 and was not different between treatments (P>.10). We conclude that induction of lactation resulted in abnormal udder conformation. This effect could be related to the short length of hormone treatment compared to a natural pregnancy. Heifers will be monitored in their subsequent parturient lactation to determine whether abnormalities are corrected.

Key Words: Pubertal heifers, Udder conformation, Induced lactation


Whole plant corn was harvested at 1/2 milk line (32% DM) and ensiled in 20-L laboratory silos for 108 d to measure the effects of microbial inoculants on fermentation and aerobic stability. Fresh forage was assigned to one of the following treatments: 1) Untreated (U), 2) Lactobacillus buchneri11A44 (Pioneer Hi-Bred Intl., Des Moines, IA, 100,000 cfu/g of fresh forage weight) (PLB1), 3) L. buchneri 11A44 (400,000 cfu/g) (PLB4), 4) L. buchneri 40788 (Lallemand Animal Nutrition, Milwaukee, WI, 400,000 cfu/g (LLB)), and 5) Bimax 5 (L. plantarum PA-28 and K-270, 100,000 cfu/g, Chr. Hansen Biosystems, Milwaukee, WI), (B5). After ensiling, the pH of all silages were similar to U except for PLB4, which was greater (P < 0.05). The concentration of lactic acid in B5 (5.88%) was greatest of all treatments, whereas PLB1, PLB4, and LLB (4.75, 3.72, and 4.40%, respectively) had a lower concentration of this acid than U (5.47%). The concentration of acetic acid was greatest in PLB4 (7.59%), whereas PLB1 and LLB (6.31 and 6.29%, respectively) had greater levels of this acid than U and B5 (3.29 and 2.92%, respectively). Yeasts were undetected in all silages except B5 (4.95 g L10 cfu/g). Aerobic stability was determined by exposing silage to air and recording the number of h before silage temperature increased 2°C above ambient room temperature. The aerobic stability of B5 (52 h) was worse compared to U (73 h), whereas, PLB1, PLB4, and LLB remained stable after > 210 h. In conclusion, the aerobic stability of silage treated with PLB1, PLB4, and LLB may be attributed to the absence of yeasts and high levels of acetic acid present in these silages.

Key Words: Silage, Inoculants, Aerobic stability

The objective of this study was to determine if fat supplementation immediately postpartum influenced serum concentrations of progesterone, LH, FSH, estradiol, and PGF-metabolite (PGFM). Twenty-four three-year-old beef cows were individually fed hay and low-fat control (C, beet pulp pellets) or high-fat (HL, high-linoleate safflower seed) supplements from d 1 to 80 postpartum. Diets were formulated to be isonitrogenous and isoenergetic and HL was formulated to provide 5% dietary fat. Cows were treated with 100 μg GnRH on d 40 to 45 postpartum (d 0) and PGF2α on d 7 (d 7). Concentrations of progesterone did not differ (P = 0.9) between dietary treatments prior to ovulation. Magnitude of the GnRH-induced LH (P = 0.8) and FSH (P = 0.9) surges did not differ between dietary treatments. The interval from the GnRH-induced preservulatory surge release of LH to a significant increase in serum concentrations of progesterone tended (P = 0.1) to be longer in HL than C cows. By d 7, however, concentrations of progesterone (ng/mL) were greater (P = 0.02) in HL (1.1 ± 0.1) than C (0.7 ± 0.9) cows. Peak concentrations of estradiol (pg/mL) during the ensuing proestrus were lower (P = 0.04) in HL (5.7 ± 1.2) than C (9.4 ± 1.2) cows. Concentrations (ng/mL) of PGFM were greater (P = 0.01) in HL (469 ± 24) than C (328 ± 23) from d 25 to 80 postpartum. First service conception rates tended (P = 0.1) to be greater in C (66.7%) than HL (33.3%), however, conception rates were identical by the end of the breeding season. Conception occurred earlier (P = 0.02) postpartum in the C (60 ± 5 d) than HL (81 ± 6 d) cows. Fat supplementation with high-linoleate safflower seeds detrimentally affected early postpartum fertility possibly because of the elevated production of prostaglandin F2α.

Key Words: Fat, Cow, Postpartum


Eighty crossbred beef steers weighing 385 kg (± 5.77 kg) were fed a finishing diet (80% barley, 6% chopped straw, 3% oil and 8% supplement) in a study examining the effects of barley processing (whole vs. cracked), barley bulk density (BD: heavy vs. light: 63.1 kg/ML and 50.8 kg/ML, respectively) and oil type (soybean vs. high linoleic acid safflower oil) on animal performance (ADG, DMI, and DMD) and carcass characteristics. A processing by BD interaction (P < 0.01) was detected for final weight, ADG, DMI, and feed efficiency (FE). Final weight was highest (P = 0.005) for steers fed cracked heavy barley (CH) and cracked light barley (CL; avg. 573 kg), intermediate for steers fed whole light barley (WL; 505 kg) and least for steers fed whole heavy barley (WH; 468 kg). Average daily gain was highest (P = 0.001) for steers fed CH and CL (avg. 11.6 kg/d), intermediate for steers fed WL (9.7 kg/d), and least for steers fed WH (8.1 kg/d). Dry matter intake was greatest (P = 0.03) for steers fed CH and CL (avg. 11.6 kg/d), intermediate for steers fed WL (9.7 kg/d), and least for steers fed WH (8.1 kg/d). Feed efficiency (gain/100 units of feed) was highest (P = 0.002) for steers fed CH (14.7), followed by CL (13.9), WL (9.7), and WH (8.1). Cracked barley (CB) had higher (P = 0.001) NE30 and NE90 values than whole barley (WB; avg. 2.06 vs. 1.69 Mcal/kg for NE30; avg. 1.42 vs. 1.09 Mcal/kg NE90). There was no effect (P = 0.40) of BD on NE30 or NE90 values. No differences (P > 0.08) in carcass characteristics were detected for BD, processing, or their interaction. No effects (P > 0.07) of oil on ending weights, ADG, or carcass characteristics were found. In summary, barleys with BD of 63.1 and 50.8 kg/ML had similar energy contents, while NE30 and NE90 for cracked barley were 22 and 30% higher, respectively, than for whole barley fed to finishing steers.

Key Words: barley, processing, bulk density

Evaluation of time to AI with a modified Co-Synch protocol and calf removal in postpartum beef cows. R. S. Walker, P. D. Burns, G. E. Sides, and D. D. Zalesky, 1 San Juan Basin Research Center, Hesperus, CO, USA, 2 Colorado State University, Fort Collins, CO, USA, 3 Intervet, Inc., Millsboro, DE, USA.

The objective of this study was to evaluate optimal timing for timed AI using a modified Co-Synch protocol with or without insemination of GnRH and calf removal. Suckling, multiparous Composite and Hereford beef cows (n = 202, postpartum interval (PPI) = 67 d, body condition score (BCS) = 5) were synchronized for AI in two different calving seasons. Early calving cows (ECC; n = 79, PPI = 67 d, BCS = 5.2) and late calving cows (LC; n = 123, PPI = 67, BCS = 4.9) were randomly assigned to one of four treatments. All cows were injected with GnRH (100 g; i.m.) on day 0, followed by an injection of PGF2α (25 mg; i.m.) on day 7. Calves were removed at time of PG injection and returned to nurse at time of insemination. Half of the cows were time-inseminated (TAI) 48 h post PG injection, with (48-TAI-G) or without (48-TAI) a second injection of GnRH. The second half of the cows were inseminated 72 h post PG injection, with (72-TAI-G) or without (72-TAI) a second injection of GnRH. Pregnancy rates to TAI were higher for cows inseminated at 72 h compared to cows inseminated at 48 h post PG injection (P < 0.05) for both ECC and LCC. Pregnancy rates at 48 and 72 h were improved when GnRH was incorporated at the time of insemination (P < 0.05) for both ECC and LCC. However, pregnancy rate was no longer significant when sire was used as a random variable in the statistical model (P > 0.05). Pregnancy rates for Sire A (31.3%) and Sire B (49.4%) across all treatments accounted for the variability in pregnancy rates between treatments. We concluded that semen from the two sires used, affected pregnancy rates over all treatments, but delaying TAI to 72 h with a second injection of GnRH may improve pregnancy rates for mass mating programs.

Key Words: Estrous synchronization, GnRH, Calf removal


Young beef cows experience a negative energy balance after parturition and during lactation when grazing dormant, New Mexico range. As a result, sensitivity to insulin may be decreased due to the physiology of lactation and poor forage quality. However, with adequate precipitation during the growing season, forage quality improves, and insulin sensitivity may increase. An experiment was conducted to investigate seasonal changes in nutrient status of young range cows (n = 32) at the New Mexico State University Livestock Research Center and the Corona Range and Livestock Research Center. Two glucose tolerance tests (GTT) were conducted, one at 35 d postpartum (spring) and one at 165 d postpartum (summer). At the time of the spring GTT, 2-year-old cows were group fed a mixture of wheat straw and alfalfa hay (7 to 8% CP, OM basis) similar to New Mexico native range in March and April. Cows were grazing New Mexico green forage at the time of the summer GTT. For each GTT, 50% dextrose solution was infused at 0.5 mL/kg−1 BW via indwelling jugular catheter and serum was collected at 14 intervals for 180 min beginning 3 min post-infusion. Serum glucose and insulin areas under the curve were calculated using trapezoidal summation. Glucose half-life was estimated by determining the time required for a 50% decrease in peak serum glucose concentration. Glucose area under the curve was smaller (P < 0.05) in the summer (9606 ± 573) than in the spring (11337 ± 541). This relationship also existed (P < 0.01) for insulin area under the curve (445 ± 25 vs. 392 ± 27 for spring and summer, respectively). Glucose half-life was 50% shorter (P < 0.01) in the summer when compared to the spring (87 vs. 45 ± 6 min). Cows grazing green summer forage were more insulin sensitive than cows consuming a poor quality diet. Differences in cow performance between late winter and summer may be due to hormonally regulated differences in energy metabolism.

Key Words: Glucose, Insulin, Season

ABSTRACT: Spermatogonial stem cells (SSC) continually give rise to mature spermatozoa; at this time SSC can only be identified and evaluated by their ability to colonize in a recipient testis. Support of these cells in culture may lead to an ability to genetically modify livestock. The present study was designed to evaluate the survival and proliferation of bovine SSC in an explant culture system over a 3wk period. Explants of call (1-2mo) testicular parenchyma were placed on 0.45μm pore membranes in culture and maintained for 1-3wk in DMEM containing 10% fetal bovine serum at 32°C. Histological examination of fresh (t0) and cultured tissues revealed intact seminiferous tubules. Germ cell numbers/tubule increased (P<0.05) after culture vs. t0, yet maturation was not observed. Testosterone was detected in medium throughout the culture period, 6±1.27 (1wk), 3±1.1.3 (2wk), and 2.5±1.1 mg/ml (3wk), indicating functional Leydig cells. Sertoli cell and spermatogonial viability was sequentially evaluated by RT-PCR for cell specific gene expression of stem cell factor and protein gene product 9.5, respectively. Results demonstrated the expression of both genes at 1, 2, and 3wk of culture. Single cell suspensions were prepared from the testicular tissues at t0 and during culture and transplanted into nude mouse testes over time in culture indicates SSC proliferation in vitro. Bovine Leydig cells, Sertoli cells, spermatogonia, and SSC remain viable during explant culture for at least 3wk. This explant culture system appears to provide an environment for enhanced proliferation of bovine spermatogonial stem cells.

Key Words: Bovine, Culture, Spermatogonial stem cells

52 Undegradable true protein, and not ruminally-protected methionine, increases nutrient utilization by growing beef heifers. V. A. Mun,* C. A. Loest, C. P. Mathis, M. K. Petersen, P. J. Defoor, J. E. Sawyer, and C. A. Rogers, New Mexico State University, Las Cruces, NM.

Eight Charolais-cross heifers (266±18 kg) were used in a replicated 4×4 Latin square to determine whether supplementation of ruminally-protected methionine or undegradable true protein would improve nutrient utilization when allowed ad libitum access to a mixture of wheat straw and alfalfa to supply 8.2% CP (DM basis). Treatments were 1.18 kg DM/d of: 1) soybean hull-based supplement (NC; 13% CP); 2) NC containing dietary oil (8% CP); 3) NC containing dietary oil (22% CP); 4) NC containing dietary methionine (M; 22% CP); 5) NC containing dietary oil and methionine (OM; 22% CP); and 6) NC containing dietary oil and methionine (OM; 22% CP). Each lipid extract was transesterified with 0.2 M KOH in methanol to catalyze methyl esterification of both free and esterified fatty acids. The other half of each lipid extract was used for methyl ester preparation using 1.09% HCl in methanol to catalyze methyl esterification. Half of each lipid extract was used for methyl ester preparation using 1.09% HCl in methanol to catalyze methyl esterification of total (both free and esterified) fatty acids. The other half of each lipid extract was used for methyl ester preparation using 1.09% HCl in methanol to catalyze methyl esterification of total (both free and esterified) fatty acids.

Key Words: Bovine, Culture, Spermatogonial stem cells
55 Effect of dietary organically bound selenium and D-α-tocopherol acetate bolus on serum antioxidants status of transit stressed wether lambs. N. K. Chirase1,2, J. B. Taylor3, T. Thelen3, and L. W. Greene1,2, 1Texas Agricultural Experiment Station, Amarillo, 2West Texas A&M University, Canyon, 3Agriculture Research Service, Dubois, ID.

Animals often encounter many stressors and pathogens associated with current production systems which could compromise the antioxidant and immune defense systems. An experiment was conducted to determine the effects of pretransit dietary Se (provided by wheat grain; Se = 6.1 mg/kg) and daily D-α-tocopherol acetate bolus (TOCO; 3.8 IU/kg BW) on pre- and postransit serum free retinol (VitA), α-tocopherol (αVitE), γ-tocopherol (γVitE), Se concentrations (μg/ml), and partial antioxidant capacity (PACA) of wether lambs. Twenty-nine lambs (BW = 57.36 kg) of similar type and origin were weaned, stratified by BW; assigned randomly to and fed one of the following treatments: adequate Se (< 0.3 mg/kg), no TOCO (CON; n = 9); high Se, no TOCO (HSE; n = 9); adequate Se, TOCO (HVE; n = 5); high Se, TOCO (SEVE; n = 6). Diets for all treatments were of similar nutrient composition, isonitrogenous and isocaloric. Lambs were fed the diets 21 d pretransit and fed a common diet for an additional 21 d postransit. Blood samples were taken on d 0, 7, 14 and 20 d and the serum was harvested for Se, VitA, αVitE, γVitE and PACA assays. On d 21, lambs were transported (864 km) by truck and a trailer for 12 h after 24 h of fastin. Sampling and analysis procedures were repeated every 7 d for 21 d postransit. The data were analyzed using Mixed Models procedures of SAS. Weaning stress (7 d post weaning) depressed (P < 0.05) serum αVitE concentrations and PACA of all treatment groups, except those fed SEVE. Lambs fed HVE and SEVE had 1.6 and 2.0 times greater (P < 0.01) serum αVitE concentrations than those fed CON or HSE pretransit, respectively but decreased (P < 0.05) postransit. Serum Se increased linearly pretransit, and subsequently decreased postransit in HSE and SEVE fed groups. Weaning and transit stress altered serum antioxidant concentrations of lambs.

Key Words: Lambs, Organically bound selenium, α-tocopherol

56 Intracellular glutathione concentration in bovine natural killer cells after infection with bovine respiratory syncytial virus or bovine viral diarrhea virus. L. A. Matulka*, T. Taylor*, M. B. Green*, S. Justice*, D. Wylie*, K. M. Eskridge1, D. R. Brink1, and C. L. Kelling1, 1University of Nebraska, Lincoln, NE, 2University of Nebraska Medical Center, Omaha, NE.

Glutathione (GSH), a cysteine-containing tripeptide, is found in millimolar concentrations in all mammalian cells. Cellular glutathione concentrations may be altered nutritionally, since cysteine availability is markedly influenced by diet. Glutathione deficiency contributes to immunological dysfunction in human immunodeficiency virus-infected patients. A similar mechanism may underlie pathogenesis of bovine respiratory disease complex (BRD). In BRD, Mannheimia haemolytica colonisation of lungs resulting in pneumonia may be triggered by impaired host immunological responses following infection with bovine respiratory syncytial virus (BRSV) and/or bovine viral diarrhea virus (BVDV). Bovine peripheral blood mononuclear cells (PBMC) were infected with BRSV and BVDV to determine effect on intracellular glutathione concentration. Peripheral blood was obtained from a donor animal and mononuclear cells by Ficoll-Paque density centrifugation. Cells were infected with either BRSV, BVDV, or left untreated and incubated for 48 h at 37°C and 5% CO2. Samples were enriched for natural killer (NK) cells (10000/μl of interleukin-2 during 48 h incubation). After incubation, cells were stained with antibodies to identify NK cells (CD2+), CD3-. NK cells were stained with monochlorobimane and intracellular GSH levels were determined as the fluorescence produced from the GSH-S-transferase conjugation of monochlorobimane with GSH. Intracellular GSH levels were decreased in the BRSV and BVDV infected NK cells compared to the control (P<0.01). Reduced GSH levels in NK cells may contribute to development of BRD.

Control BRSV BRSV+IL-2 BVDV BVDV+IL-2 SE
MFU† 48.7a 15.9b 17.0b 14.7b 14.6b 4.6 n=4

Key Words: Bovine, Natural killer cells, Bovine

57 Effects of intravenous infusion of triglyceride emulsions varying in lipid source on lymphocyte functions in the bovine. D. Scalia1, U. Bernabucci1,2, D. G. Mashek2, B. Ronchi2, R. R. Grummer3, and N. Lacerda1, 1Università della Tuscia, Viterbo, Italy, 2University of Wisconsin, Madison.

Previous in vitro studies from our laboratory have shown that fatty acids represented in plasma NEFA affect immune functions both in sheep and bovine. However, little is known in ruminants about the effects of fatty acids in vivo. Therefore, our objective was to assess the effects of intravenous infusion of triglyceride (TG) emulsions derived from different lipid sources on peripheral blood mononuclear cell (PBMC) functions during a period of fatty liver induction. Six multiparous, non-pregnant, non-lactating Holstein cows were used in a replicated 3x3 Latin Square design. For d 4, cows were fasted and infused intravenously with a 20% TG emulsion derived from linseed oil (LO), fish oil (FO), or tallow (Ta). The emulsions were administered for 20 to 30 min every 4 h throughout the 4 d fast at a rate of 0.54 g TG/kg BW/d. Blood samples were taken before the first infusion, and then every 24 h during the fast. Cows were fed ad libitum for 24 d between the fasts. After infusion, the PBMC were stimulated by phytohemagglutinin (PHA), concanavalin A (ConA), or pokeweed mitogen (PWM). For all the three mitogens, DNA synthesis was lower (P < 0.05) for Ta than for LO and FO. A significant time*treatment interaction was pointed out. Seventy two and 96 h after first infusion of FO, the DNA synthesis stimulated by PHA increased (P < 0.01). Regardless the mitogens, the infusion of Ta was responsible for a transient and dramatic reduction (P < 0.01) of DNA synthesis, which was evident on 48 and 72 h after first infusion. Infusion of LO did not affect (P > 0.10) the DNA synthesis of PBMC. Results reported here confirm those of in vitro studies and indicate that fatty acids can modify the immune cell functions of cows in a way, which depends primarily on the type of fatty acids.

Key Words: Lymphocyte, Fatty acids, Bovine

58 Lymphocyte functions in obese cows during transition period. U. Bernabucci1,2, D. Scalia1, B. Ronchi1, D. Pirazzi1, A. Nardone1, and N. Lacerda1, 1Università della Tuscia, Italy.

A previous study carried out in our laboratory has shown negative relationships between the intensity of lipomobilization and the immune response in sheep. However, little is known about the relationships between body score and immune functions in cows. Therefore, the objective of this study was to evaluate the effects of body score on lymphocyte functions in transition dairy cows. The study was carried out in 23 Holstein cows. Thirty days before the expected calving, the 21 cows were categorized as thin (n = 6), medium (n = 8), and obese (n = 7) on a condition score basis. Fourteen and 7 d before and 14 and 35 d after calving, blood samples were taken, and peripheral blood mononuclear cells (PBMCs) were isolated. After isolation, the PBMCs were stimulated, and DNA synthesis, immunoglobulin M (IgM), and interferon gamma (IFN-gamma) secretion were evaluated. The DNA synthesis was measured after stimulation with phytohemagglutinin (PHA), concanavalin A (ConA), or pokeweed mitogen (PWM); the IgM secretion was measured after stimulation with PWM; the IFN-gamma secretion was measured after stimulation with ConA. Data referred to the 21 cows, indicated that the DNA synthesis was lower (P < 0.01) on day 7 before calving, that the IgM secretion on day 7 before calving was lower (P < 0.05) than that recorded after calving, and that the IFN-gamma secretion did not change (P > 0.05) during the experimental period. Either on day 14 or 35 after calving, the IgM secretion in obese cows was lower (P < 0.01) compared to that recorded in thin cows. Seven days before calving, the IFN-gamma secretion was lower (P < 0.001) in obese cows compared to thin and medium cows. In conclusion, the immunodepression taking place in cows around calving would be more evident in overconditioned cows.

Key Words: Body score, Lymphocyte, Cow
61 Metabolism and gastric transport of ergot alkaloids in ruminants grazing endophyte-infected tall fescue. N. S. Hill*, A. W. Ayers1, J. A. Studemann2, F. N. Thompson1, P. T. Purinton2, and G. Rottinghaus3 1University of Georgia, 2USDA-ARS, 3University of Missouri.

Livestock grazing endophyte-infected (E+) tall fescue suffer from chronic ergot alkaloid toxicity. Ergovaline is repeatedly implicated as the toxin causing the anomaly, but little or no credible evidence exists as such. Towards that end our objective was to examine gastric metabolism and transport of ergot alkaloid in E+ tall fescue. First, in vitro ruminal digests of E+ and E- tall fescue were conducted for 0, 6, 12, 24, and 48 h and alkaloids in the aqueous fraction analyzed by ELISA and HPLC. Extracted alkaloids from the ruminal digests were tested for in vitro transport across ruminal and omasal tissues using parabiotic chambers. Secondly, three sheep each grazing E+ and E- tall fescue were anesthesia and their right ruminal, right gastric, and mesenteric veins surgically catheterized. Whole blood was collected, plasma alkaloids extracted, and analyzed by ELISA. ELISA analysis from the ruminal digests found no alkaloids in ruminal fluids from E- tall fescue, but alkaloids in ruminal fluids from E+ tall fescue increased with time (P<0.01). HPLC speciation of alkaloids in E+ ruminal fluids found only 9 ppb ergovaline at 0 h, which decreased to 1 ppb at 6 h. Conversely, lysergic acid concentration increased from 20 ppb at 0 h to 240 ppb at 48 h (P<0.01). Lysergic acid was the only ergot alkaloid that transported across ruminal or omasal tissue. More lysergic acid transported across ruminal tissue than omasal tissue (P<0.01) in the in vitro system. In the in vivo study, there were no differences (P>0.05) in plasma ergot alkaloids from mesenteric or gastric veins regardless of whether sheep were grazing E+ or E- tall fescue. However, plasma samples from the ruminal vein of sheep grazing E+ tall fescue had more (13.9 ppb) than that of sheep grazing E- tall fescue (0.56 ppb) (P<0.01). These data indicate lysergic acid, not ergovaline, is the toxin causing fescue toxicosis and its site of absorption is the rumen.

Key Words: Fescue toxicosis, Tall fescue, Alkaloid metabolism


We assessed the effect of dry-season supplementation and seasonal transhumance on ADG and weaning rates of cattle in the Sahel. 108 cows (60 in Katanga and 48 in Guro-Yena, 50 km East of Niamey, Niger) were allotted to 6 treatments, i. e. factorial combinations of 3 supplement levels (0, 360 and 720 g DM/d of millet bran, 16% CP) and two management systems (year-long sedentary management and transhumance to the pastoral zone during the rainy season and to intensively cultivated areas after grain harvest). The study lasted 4 years (1999-2002) in Katanga and 3 years (2000-2002) in Guro-Yena. Cows were individually supplemented for 103-134 d each year and weighed monthly, at the start and end of supplementation and at departure to and return from transhumance to the pastoral zone (98-124 d) and to the intensively cultivated areas (33-55 d). Weight loss (g/d) of non-lactating, non-late pregnant cows was greater (P<0.05) for supplemented cows than unsupplemented cows during the dry season without transhumance (P<0.01). However, this difference was not significant in the dry season when transhumance occurred (P>0.05). Cows supplemented with 360 g DM/d of millet bran were heavier (P<0.01) in the dry season with transhumance than cows not supplemented, indicating the importance of transhumance to pastoral areas for reducing weight losses during the dry season. In the wet season, cows supplemented with 720 g DM/d of millet bran were heavier (P<0.01) than cows not supplemented, indicating the importance of supplementation, but the effect was not as marked as in the dry season. Overall, transhumance and dry-season supplementation increased body condition scores (BCS) at the end of the study (P<0.01), indicating the importance of these management systems for improving BCS and therefore productivity of cattle in the Sahel.
590±17 and 547±18 g/d, respectively (P<0.05). Supplementing with 1 kg millet bran/d in the previous dry season decreased (P=0.02) ADG during the rainy season by 78.5±3.3 g/d. Cows in transhumance tended to gain more weight during the post-harvest season than those under the sedentary system (453±23 vs 383±22 g/d, P=0.09). Cows receiving 0, 360 and 720 g/d supplement during the end of the dry season weaned 0.37, 0.44 and 0.49 calves/yr (SEM=0.04; P=0.09). Supplementation of 0, 360 and 720 g/d supplement during the end of the dry season weaned Kingsville kg millet bran/d in the previous dry season decreased (P=0.02) ADG to gain more weight during the post-harvest season than those under the sedentary system (435±20 vs 383±22 g/d, P=0.09).

Key Words: Transhumance, Supplementation, Cattle

63 Effects of the recessive naked gene on postweaning fryer performance and thermo-tolerance characters in rabbits. A. D. Rogers* and S. D. Lukefahr, Texas A&M University-Kingsville.

This study investigated the effects of the naked gene on postweaning trait performance and thermo-tolerance characters in rabbit fryers during a 42-d growth phase in the summer of 2002 in subtropical south Texas. In 1999, a rare naked rabbit was born in El Campo, TX. “Fuzzy”, a Mini Lop rabbit, was mated to commercial New Zealand White does at Texas A&M University at Kingsville, which resulted in 16 F₁ litters and 113 offspring, all of which had normal fur coats. To reproduce the recessive naked gene in the homozygous state, F₁ x F₁, inter se matings were made between half-siblings to create an F₂ generation. In the F₂ generation, 91 weaned fryers from 18 fraternal litter groups were produced. Based on an expected 3:1 phenotypic ratio (furred to naked classes), 70 rabbits had normal fur coats and 21 rabbits were naked. Most litters produced some naked and furred kits. Fryers were randomly assigned to growing pens containing either two or three non-littermate furred or naked rabbits. Individual fryer traits included initial and final body weights and ADG, as well as respiratory rate, rectal body temperature, and ear length, which were recorded at the end of the study. Pen traits included feed intake as an indicator of feed appetite. Data were blocked for effects of maternal litter, random pen (within naked and furred groups), age batch, gender, and initial age of fryer as a linear covariate when analyzing body weight traits. Results consisted of naked fryers being 212 g heavier and having 2.96 g/d more rapid ADG than furred fryers (P<0.001). Initial ear length was generally associated (P<0.01) with more rapid ADG (linear regression of 0.165±0.05 cm per g/d). Naked fryers had lower rectal body temperature (38.9±3.7°C; P<0.001) and had lower respiratory rate (119.7 and 160.6 bpm; P<0.001) at 1400 h compared to furred fryers, respectively. In addition, pens of naked fryers had higher daily feed appetites by 28.8±4.5 g per fryer than pens of furred fryers (P<0.001). Our results indicate that naked rabbits had better thermo-regulation ability than furred rabbits. Based on these promising results, plans for developing a new breed of naked rabbits is justified, which has the potential to contribute more meat and income for subsistence families in tropical regions.

Key Words: Rabbits, Thermoregulation, Tropical Agriculture

64 Study of some socioeconomic factors affecting small ruminant production in upland ranges of Balochistan-cost of enterprise. A. U. Hyder*1, A. S. Lodhi2, and O.U. Haider3, 1Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan, 2Department of Clinical Medicine and Surgery, University of Agriculture, Faisalabad, Pakistan, 3Department of Agriculture, Quetta, Pakistan.

A survey study for the economic evaluation of different husbandry systems being practiced in Balochistan province of Pakistan was carried out during the year 2001-02. This study comprised 120 sample farmers out of which 32, 70 and 18 were from nomad, transhumant and sedentary husbandry systems, respectively. The stratification was based on the proportion of the farming population. The overall total annual production cost per flock was Rs. 46406.0 (1 US dollar = Rs. 58). The feeding/fodder, shepherd, grazing, health cover, shearing, marketing and miscellaneous costs were Rs. 24622.8, Rs. 12359.0, Rs. 2751.8, Rs. 3542.3, Rs. 844.1, Rs. 1430.8 and Rs. 892.6, respectively. Overall average consumption and social use was 9.0 percent of the total mean flock size. Nomads, transhumants and sedentary were marketing 25.7, 24.0 and 25.9 percent of mean flock size. Overall animals marketed were 25.0 percent of the total mean flock size. Nomads marketed 25.7 percent of their total flock, while sedentary and transhumant 24.0 percent and 25.9 percent, respectively. The overall total income from the mean flock size was calculated as Rs. 112282.0/annum. Overall average gross income was Rs. 112282.0. The Net income became Rs. 65878.4 per annum. The gross income, cost and net revenue per-animal under nomadic husbandry systems was Rs. 827.5, Rs. 294.2 and Rs. 560.1; under transhumant husbandry system, it was Rs. 918.8, Rs. 331.5 and Rs. 587.4; and under sedentary husbandry system it was Rs. 1258.5, Rs. 515.6 and Rs. 741.6, respectively. Overall benefit cost ratio was 2.4:1; however, for nomad, transhumant and sedentary husbandry systems, the benefit cost ratio were 2.8:1, 2.8:1 and 2.4:1, respectively. The poverty alleviation tools like government assistance in the form of micro-credit schemes during off season can play dramatic role in economic uplift of these lifestyles.

Key Words: Small ruminant production, Cost of enterprise

65 Small ruminant production in upland ranges of Balochistan-cost of enterprise. A. U. Hyder*1, A. S. Lodhi2, and O.U. Haider3, 1Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan, 2Department of Clinical Medicine and Surgery, University of Agriculture, Faisalabad, Pakistan, 3Department of Agriculture, Quetta, Pakistan.

The feeding/fodder, shepherd, grazing, health cover, shearing, marketing and miscellaneous costs were Rs. 24622.8, Rs. 12359.0, Rs. 2751.8, Rs. 3542.3, Rs. 844.1, Rs. 1430.8 and Rs. 892.6, respectively. Overall average consumption and social use was 9.0 percent of the total mean flock size. Nomads, transhumants and sedentary were marketing 25.7, 24.0 and 25.9 percent of mean flock size. Overall animals marketed were 25.0 percent of the total mean flock size. Nomads marketed 25.7 percent of their total flock, while sedentary and transhumant 24.0 percent and 25.9 percent, respectively. The overall total income from the mean flock size was calculated as Rs. 112282.0/annum. Overall average gross income was Rs. 112282.0. The Net income became Rs. 65878.4 per annum. The gross income, cost and net revenue per-animal under nomadic husbandry systems was Rs. 827.5, Rs. 294.2 and Rs. 560.1; under transhumant husbandry system, it was Rs. 918.8, Rs. 331.5 and Rs. 587.4; and under sedentary husbandry system it was Rs. 1258.5, Rs. 515.6 and Rs. 741.6, respectively. Overall benefit cost ratio was 2.4:1; however, for nomad, transhumant and sedentary husbandry systems, the benefit cost ratio were 2.8:1, 2.8:1 and 2.4:1, respectively. The poverty alleviation tools like government assistance in the form of micro-credit schemes during off season can play dramatic role in economic uplift of these lifestyles.

Key Words: Small ruminant production, Cost of enterprise

66 Nucleotides in sowscolostrum and milk at different stages of lactation. C. D. Mateo*, H. H. Stein, and D. N. Peters, South Dakota State University, Brookings, SD.

An experiment was conducted with the objective of measuring the concentrations of CP and 5’ monophosphate nucleotides (i.e., 5’AMP, 5’CMP, 5’GMP, 5’IMP, and 5’UMP) in sows’ colostrum and milk. Twelve multiparity sows (Landrace x Yorkshire x Duroc) were used in the experiment. Litter size was standardized at 11 piglets for all sows on the day of farrowing. Sows were fed an 18% CP corn-soybean meal diet throughout lactation. The experimental period comprised the initial 28 d of lactation with colostrum being collected within 12 h of farrowing and milk being collected on d 3, 7, 14, 21, and 28. Milk samples were analyzed for CP and 5’AMP, 5’CMP, 5’GMP, 5’IMP, and 5’UMP. The CP linearly decreased (P < 0.01) from 16.6% in colostrum to 7.7, 21.

Key Words: Sow nutrition

Nonruminant Nutrition: Sow nutrition

6.2, 5.5, 5.7, and 6.3% in milk collected on d 3, 7, 14, 21, and 28, respectively. The concentrations of 5’ AMP, 5’CMP, 5’GMP, and 5’IMP increased from d 0 to d 3 and d 7 and then decreased during the remaining lactation period (cubic effect, P < 0.05). The concentration of 5’UMP decreased linearly (P < 0.01) from d 0 to d 28 of lactation. In colostrum, 5’UMP represented 98% of all monophosphate nucleotides and in milk, 5’UMP accounted for 86-90% of all nucleotides, regardless of d of lactation. The results of this experiment indicate that the concentration of 5’ monophosphate nucleotides in sows milk decline as lactation advances. In addition, 5’ UMP is the most abundant nucleotide in colostrum and milk from lactating sows.

67 Impact of milk supplementation on primiparous and multiparous females’ performance and piglet’s growth during pre and post-weaning periods. M. E. Johnston1, R. Cabrera1,2, R. D. Boyd1, and J. Vignes1. 1 The Hanor Company, 2Ralco-Mix Products, Inc., Advanced Birthright Nutrition, Inc.

This study was conducted to determine the impact of milk supplementation on gilts, sows, and their progeny’s performance during lactation and post-weaning. A total of 112 females (56 gilts, 56 sows) were allotted to one of two treatments: milk supplemented (MS) or non-supplemented (NS) with 28 gilts and 28 sows in each treatment. All litters were standardized to 11.1 pigs/litter. Milk supplementation of gilts started 12-24 h after farrowing with acidified, medicated milk replacer fed ad libitum. Gilts and sows’ BW and backfat depth were measured 24 h after farrowing and at weaning. ADFI was recorded. Lactation length was 18.2 ± 2 d for gilt litters and 19.2 ± 2 d for sow litters. Pigs were weaned 24 h after birth and at weaning. Pre-wean mortality and ADG were recorded. MS and NS gilts weight change, backfat depth change, and ADFI did not differ between treatments (P > 0.05). However, the number of pigs weaned did differ (P < 0.05) between MS and NS gilt litters (10.1 ± 1.0, respectively). Birth and weaning weights (5.62 ± 0.35 kg) were 0.09 and 0.27 kg heavier, respectively (P < 0.05) for MS compared to NS gilt litters. MS and NS sows’ BW change and ADFI did not differ between treatments (P > 0.05). However, MS sows lost 1.3 mm more backfat than NS sows (P < 0.05) during lactation. The number of pigs weaned for MS sow litters was 0.9 pig/litter higher (P < 0.05) than MS sow litters (10.6 ± 0.5, respectively). Birth and weaning weights (6.58 ± 0.59 kg) were 0.09 and 0.59 kg heavier, respectively (P < 0.05) for MS sow litters when compared to NS sow litters. After a 42-d nursery period, MS pigs were 0.8 kg heavier (P < 0.001) than NS pigs (23.4 ± 22.6 kg, respectively). These data suggest milk supplementation during lactation reduces piglet loss and increases piglet weaning weight. The advantage in weaning weight for milk supplemented gilts was maintained through the nursery period.

68 Effects of reducing particle size of corn in lacta-
tion diets on performance and nutrient utilization in mult-
iperaporous sows. E. C. Baudon1, J. D. Hancock, M. D. Tokach, and J. F. Gabaarro, Kansas State University, Manhattan.

Eighty multiparous sows (parities one to four) were used to determine the effects of particle size of corn in lactation diets on sow and litter performance. The sows were fed corn-soybean meal-based diets with targeted corn particle sizes of 1,500, 900, and 600 µm (actual mean particle sizes during the experiment were 1,609, 849, and 630 µm). Particle size did not affect BW gain and survivability in piglets and BW loss, weaning to estrus interval, and fecal moisture in sows (P > 0.10). However, loss of backfat (quadratic effect, P < 0.001) was lowest in sows fed the diet of intermediate particle size. Average daily water intake increased as particle size was decreased from 1,500 to 600 µm (linear effect, P < 0.05). Also, intakes of DM, N, and GE were increased by 1.1, 8, and 12%, respectively, as particle size of corn was decreased (linear effects, P < 0.007). There was greater feed intake (linear effect, P < 0.04) and daily absorption of DM, N, and GE were increased by 16, 12, and 17% (linear effects, P < 0.01) as corn particle size was reduced from 1,500 to 600 µm. Finally, excretion of DM in the feces was decreased (linear effect, P < 0.09) by 84 g/d as particle size was reduced. In conclusion, reducing particle size of corn did not affect sow and litter performance but increased digestibility of nutrients and reduced nutrient excretion.

69 The effect of canola on reproductive perform-

Studies in Europe have reported increases in the litter size of sows when canola-based diets are fed. Therefore, it was the objective of this experiment to investigate the effects of including either full fat canola or canola meal in diets fed to gestating and lactating sows. A total of 60 gestating sows (avg. parity = 3) were randomly allotted to one of three treatment groups: 1) corn and soybean meal control diet; 2) corn and canola meal diet; and 3) corn and full fat canola diet. Gestation diets were formulated to contain 14% CP and lactation diets to contain 18% CP. During gestation, all sows were fed 7,000 kcal/d of their respective treatment diet. During lactation, all sows were allowed ad libitum access to their treatment diets. Feeding of the experimental diets began right after breeding and continued through two reproductive cycles. Reproductive performance parameters were collected throughout both reproductive cycles. There was no effect of reproductive cycle on any of the response criteria measured in this study. Sows consuming the full fat canola diet gained less weight (P < 0.05) during gestation than sows consuming the other two diets. However, they also lost less (P < 0.05) weight during lactation when compared to sows consuming the canola meal diet. The number of pigs born alive was higher (P < 0.05) for sows consuming either the corn-soybean meal or corn-full fat canola diet when compared to sows consuming the canola-meal diet. The number of stillborns, mummies, weight of pigs born alive, and litter birth weight did not differ (P > 0.20) between dietary treatments. The number of pigs weaned and the litter weaning weight was greater (P < 0.05) for sows consuming the corn-soybean meal than sows consuming the canola meal diet. Lactation feed intake was lower (P < 0.05) in wk 2, 3, and overall for sows consuming the corn-canal meal diet when compared to the other two diets. Finally, return to estrus interval was not affected (P > 0.20) by dietary treatment. In conclusion, full fat canola-based diets performed similarly to standard corn-soybean meal diets when fed to gestating and lactating sows. The deleterious effects of the corn-canola meal diet warrant further investigation prior to incorporation into sow gestation and lactation diets.

70 Exogenous enzyme effects on the digestibility of gestation-lactation swine diets. A.L.P. de Souza*, M. D. Lindemann, and G. L. Cromwell, University of Kentucky, Lexington.

The effects of two commercial enzyme products on the ileal and total tract nutrient digestibilities in crossbred sows (n=8: BW=196 ± 15 kg) fitted with ileal stainless steel T-cannula were evaluated. The enzyme products contained cellulase and protease activities (Enz 1; VegPro®, Altech) or xylanase activity (Enz 2; Fibrozyme®, Altech). A fortified corn-soybean meal control diet (0.81% lysine, 0.73% Ca, and 0.61% P) was fed during gestation. Tritt 1 was the control diet; Trit 2 was the control plus Enz 1 (7.700 HUT of protease activity/kg diet, and 75 CMC of cellulase activity/kg diet), and Trit 3 was the control plus Enz...
2 (100 XU of xylanase activity/kg diet). Ileal and fecal samples were collected at Wk 6-7 and Wk 12-13 of gestation and Wk 2-3 of lactation. Females were randomly allotted to a diet in each wk of the collection period. After 5 d adaptation to the diet, ileal samples were collected for a period of 12 h on each of 2 d. Diets were then changed and another collection was made (providing a total of 5-6 observations/diet). Fecal sample collection took place between d 4-7. Apparent digestibility of DM, N, GE, ADF, and NDF was determined using Cr2O3. There were no effects (P > 0.10) of the enzyme products on nutrient digestibility during gestation. Ileal digestibilities (% of DM, N, GE, ADF, NDF) during lactation were 77.3, 79.3, 81.7; 81.2, 82.5, 84.3; 79.5, 81.5, 83.8; 37.5, 36.5, 42.3; 75.4, 79.9, 80.6 for Trt 1, 2, 3, respectively. Total tract digestibilities (% of DM, N, GE, ADF, and NDF during lactation were 89.8, 90.7, 90.8; 89.0, 90.0, 90.6; 90.7, 91.4, 92.0; 75.0, 66.0, 77.8; 88.2, 89.8, 89.4. Ileal DM (P < 0.02), GE (P < 0.02), and NDF (P < 0.08) as well as total tract DM (P < 0.11) and GE (P < 0.04) digestibilities were improved by Enz 2, and total tract NDF (P < 0.11) was positively affected by Enz 1. Gestational enzyme supplementation was not beneficial; however, the enzyme product containing xylanase activity appears to have potential to increase digestibility of nutrients during lactation.

Key Words: Sows, Digestibility, Enzymes


This study was conducted to determine the effects of increased valine levels during lactation on sow and piglet performance. A total of 279 PIC C22, C23, and C24 sows (parities 1-5) were allocated by parity to one of four dietary treatments. Diets 1 and 3 were formulated using corn and a fixed inclusion of soybean meal (16.73%). The dietary valine content was increased by adding L-valine with additional synthetic amino acids supplied as necessary to meet minimum amino acid ratios. The total valine:lysine ratio in diets 1 and 3 were 0.73 and 1.25, respectively. Diets 2 and 4 were typical corn- soybean meal diets containing 0.05% acids supplied as necessary to meet minimum amino acid ratios. The dietary valine content was increased by adding L-valine with additional synthetic amino acids supplied as necessary to meet minimum amino acid ratios. The total valine:lysine ratio in diets 2 and 4 were 0.86 and 1.25, respectively. The diet was positively affected by Enz 1. Gestational enzyme supplementation was not beneficial; however, the enzyme product containing xylanase activity appears to have potential to increase digestibility of nutrients during lactation.

Key Words: Sows, Digestibility, Enzymes


Cows (N=80) balanced for parity, stage of lactation and milk yield were randomly assigned to Korial Kool (KK) or oscillating fan and spray (OS) cooling systems from 6/26-9/26/2002. Each pen included a shade structure (7.3 m by 18.3 m). Three pens were oriented north/south. The KK pen had 100% overhead coolers, with computer driven variable speed fans and variable air temperature water injection into the airstream. The OS pen had three (0.9m) computer driven variable speed fans with variable airstream water injection placed below the western edge of the roof. The arc of the OS fans was 270°. Both systems varied fan speed and water injection according to THI. Water and electrical usage was metered on observation system. Water use (L/d) was higher in OS compared to KK (7330 vs 4989, P < 0.05). Electrical usage (KW/d) was lower for OS compared to KK (76.4 vs 93.3, P < 0.03) Temperature and humidity recorders established THI outside and under each shade. Mean THI outside the shades was 80. Mean THI was higher under OS compared to KK (78 vs 77, P < 0.001). Thermal status of cows was established via infrared thermometers and observation of respiration rate (r). Average cow surface temperature (°C) was higher for OS compared to KK (34.3 vs 26.6, P < 0.001). Likewise r/min was higher in OS cows compared to KK (65.5 vs 56.7, P < 0.001). Milk yield (kg/d) N=79, did not differ in OS compared to KK, (36.2 vs 36.7). We conclude that KK improved cow comfort over OS but this did not result in a milk yield difference.

Key Words: Heat stress, Cooling systems, Dairy cattle

74 Effects of sprinkler, shade, and fan cooling of prepurtrium Holstein cows on postpartum milk performance during summer heat stress. J. H. Urdaz*, M. W. Overton, D. Moore, and J. E. Santos, Veterinary Medicine Teaching and Research Center University of California, Davis Tulare, CA/USA.

The purpose of this study was to examine the effects of shades, fans, and sprinklers on the last three weeks of gestation of Holstein cows during summer heat stress. Outcome variables included postparturium milk production, rectal temperatures, body condition score (BCS), and incidence of postparturium disorders. Four hundred and thirty prepurtrium multiparous cows 250-257 days pregnant were randomly allocated to two identically structured pens. Treatments consisted of sprinklers over the feedbunk (CONTROL, n=209) and sprinklers, fans, and shades over the feedbunk (COOLED, n=221). To be eligible for analysis, cows were
were required to spend a minimum of 14 days in their assigned pen before parturition. After calving, both groups were housed in the same freestall facilities. Computerized data recorders in each pen recorded environmental temperature every half hour. Rectal temperatures were measured twice weekly for three weeks before parturition. Body condition scores were taken at study enrollment and at parturition (60 days in milk (DIM), and 150 DIM). Following calving, the presence of parturient paresis, retained placenta, and metritis were recorded for the first 10 DIM. Milk production was measured using twice-monthly DHIA tests for the first 150 DIM. Descriptive statistics were used for environmental temperatures. Data on rectal temperature, BCS, and milk production were analyzed by the MIXED procedure of the SAS (2002) program. Chi-square analysis was used for postparturient disease outcomes. Average daily environmental temperature in the control group was 79.6 F 19.1 vs. 77.2 F 16.5 in the cooled group during the length of the trial. There was no significant difference in rectal temperatures (P = 0.62), BCS (P = 0.57), incidence of parturient paresis (P = 0.99), or retained placenta (P = 0.69). A treatment by test date interaction was detected for milk production (P = 0.03) and cows in the cooled group produced more milk than controls in the first 15 days in lactation (79.6 vs. 75.0 lbs/d; P < 0.05). Cooling post-parturient cows with shade, fans, and sprinklers may increase milk production immediately after parturition. Further analyses are needed to assess the economic feasibility of adding cooling systems to postparturient cows.

**Key Words:** Cooling, Preparturient Holstein cows, Heat stress

**75 A large-scale survey evaluating the effect of cooling Holstein cows on productive and reproductive performances under sub-tropical conditions. I. Flamenaum1 and E. Ezzi2. 1Ministry of Agriculture, Extension Service, 2Israel Cattle Breeders Association.**

The effect of cooling dairy cows was studied during four years (1998-2001). The survey included 14 farms, located in the costal part of Israel and classified into three different groups according to the intensity of cooling in summer. Cows of group 1 (six farms, intensive cooling), were cooled in the holding and feeding area for a total of 10 cooling periods and 7.5 cumulative hours per day. Each cooling period combined cycles of sprinkling (0.5 min.) and forced ventilation (4.5 min.). Cows of group 2 (three farms, moderate cooling), were cooled in the holding area only, and were provided a total of six cooling periods and 4.5 cumulative hours per day. Cows of group 3 (five farms, no cooling) were not cooled at all. Milk production (kg/d) and conception rates (%), were calculated for summer (July-September) and winter (December-February). The analysis included 125,000 milk recordings (> five recordings for each cow per lactation) and 17,000 inseminations. Average four years daily low and high temperatures (C) were 8.4 and 19.3, and 22.0 and 31.8, for winter and summer, respectively. The effect of the interaction between season and cooling system was significant (P < 0.001). The ratios between summer and winter production were 98.5%, 96.2% and 93.4%, in intensive, moderate, and no cooling regimes, for primiparous cows and 98.5%, 96.1% and 90.7% for multiparous cows, respectively. Conception-rates were 55.8%, 53.5% and 53.9%, and 40.4%, 34.0% and 14.6%, for primiparous cows under the intensive, moderate, and no cooling regimes, inseminated in winter and summer, respectively (P < 0.01). Conception-rates were 46.6%, 45.8% and 43.5%, and 33.8%, 34.5% and 16.7% for multiparous cows in the same groups inseminated in winter and summer, respectively (P < 0.01). The results indicate that intensive cooling significantly reduces the seasonal variations in productive and reproductive performances of dairy cows under sub-tropical conditions.

**Key Words:** Cooling cows, Milk production, Conception rate


Ten lactating Holstein cows (5 primiparous and 5 multiparous) were arranged in a replicated 5x5 Latin Square design to evaluate the effect of low-pressure soaking frequency and high-pressure misting on respiration rate, body surface temperature, and body temperature of heat stressed cattle. Animals were housed in freestall barns and milked 2x. During testing, cattle were moved to a tiestall barn for a period of 2 hours starting at 13:00 on five days of intense heat stress. During the testing periods, respiration rates were determined every five minutes by visual observation. Body surface temperature of three sites (shoulder, thurl and rear udder) were measured with an infrared thermometer and recorded at 5-minute intervals. Body temperature was recorded with a data logger and vaginal probe every minute and averaged over 5 minute intervals. Treatments were control (C) a lower-pressure soaking cycle every 5 (5+F), 10 (10+F) or 15 (15+F) minutes and continuous high-pressure misting (HP+F). Similar amounts of water were used in each soaking treatment. Soaking and misting treatments included supplemental airflow. The skin of cattle receiving the soaking and misting treatments became soaked over the course of the treatment period. Average respiration rates of cattle studied were 111.7, 98.7, 95.3, 84.4, and 87.6 breaths/minute for C, 15+F, 10+F, 5+F and HP+F, respectively. Treatments differed (P < 0.01) from each other and the 5+F treatment showed the greatest reduction in respiration rate. Cooling treatments reduced (P < 0.01) body surface temperatures. Average shoulder surface temperatures were 37.7, 34.6, 33.9, 32.2 and 31.4 °C. Average rear udder surface temperature followed a similar pattern (37.9, 37.8, 37.6, 37.3 and 36.4 °C, respectively) differed (P < 0.01) among treatments. Cooling heat stressed dairy cattle with either low-pressure soaking or misting that soaked the dorsal body surface was effective in reducing respiration rates and body surface temperatures. These data show that more frequent soaking and high-pressure misting that soaks the body surface increases heat abatement of dairy cattle.

**Key Words:** Heat abatement, Environmental modification, Facilities

**77 Hair coat color may influence longevity of Holstein cattle in the tropics. C. N. Lee1, K. S. Bae2, and A. Parkhurst. 1University of Hawaii-Manoa, 2National Livestock Research Institute, Suwon, S.Korea, 3University of Nebraska.**

Previous studies from FL and AZ suggested that Holstein cows with white hair coat produced more milk in hot climates. However, over a decade of observations of dairy herds in Hawaii and Asia suggest that majority of the animals in commercial herds are of black hair coat. Hence, a simple study to determine the accuracy of the observation was conducted in 2 large commercial herds in Hawaii. Cows were classified into 3 groups: a) black (B, >90%); b) black/white (BW, 50-50) and c) white (W, <90%). Cows with other hair color distribution were excluded from the study. In Farm A, 215/960 lactating cows with 4-7 or more lactations were identified and in Farm B, 600/1,350 lactating cows with 2-5 or more lactations were identified for the study. The W cows in both herds had higher milk production (kg), but it was not statistically different: Farm A: B=11,511, BW=11,098, W=11,806; Farm B: B=9,593, BW=9,899, W=9,907 (SE 230). Regression analyses of the data based on % distribution for each hair coat within a lactation showed that the population of W cows decreased with increasing lactations for both farms (p < 0.05). The W distribution decreased from 17.5% to 6.3% in farm A and from 15.7% to 2.7% in farm B as the number of lactations increased. The B cow population increased from 51% to 78% for farm A for 4th to 6th lactation while in farm B, this population increased from 45% to 55.4% for 2nd to 5th lactation. Further analyses by Wilcoxon test for homogeneity of survival curves confirmed this: Farm A (p < 0.05) and Farm B (p < 0.06). Minimum changes in the distribution of BW population were observed. Analyses of B vs W hair coat in cows (ug/cm2) yielded 8.2 vs 18.4 respectively (n=22). The data suggested that W cows had greater risk of survival in the tropics. Factors contributing to this phenomenon are currently being investigated.

**Key Words:** Hair coat, Survival, Milk production

**78 The impact of cooling ponds in north central Texas on milk production and culling. M. Tomaszewski1, M. de Haan2, J. Thompson1, and E. Jordan1. 1Texas A&M University, 2Wageningen University.**

Heat stress is a major impediment to efficient production of milk in the Southern part of the US. One method of cooling cows is the utilization of cooling ponds during periods of high temperatures. The objective of this study was to determine if differences existed for production and culling data between farms with and without cooling ponds. Data from 55 herds located in north central Texas were selected. Monthly production and culling data from 1999 through 2002 were obtained from the DHIA database housed in two herds had installed cooling ponds, while 33 herds had not. Data were analyzed using the PROC MIXED procedure of SAS with cooling pond, season, and their interactions analyzed as.
fixed effects and herd as a random effect. Seasons were grouped as August, the two months prior to August, the two months after August, and all other months. Least square means for differences between herds with and without cooling ponds in August showed an increase (P ≤ 0.001) of 2.62 kg of milk/milking cow/d for herds with cooling ponds. When herds were compared within their pond status category for the two months pre- and post-August, there were no significant differences between the least square means. However, herds with cooling ponds increased production by 1.52 kg of milk/milking cow/d (P ≤ 0.05) in the pre-August season and 1.47 kg of milk/milking cow/d (P ≤ 0.05) in the post-August season when compared to herds without cooling ponds. During months in which cooling ponds were not used, there was no significant difference. When percent of cows that left the herds was evaluated to determine if differences in culling existed, no significant difference was found. In conclusion, cooling ponds had a significant impact on maintaining milk produced/cow/d during periods of heat stress and there was no difference in culling between farms with and without cooling ponds.

Key Words: Cooling pond, Heat stress, Culling


Abstract: The objective was to evaluate alternative drought management strategies for their effects on profitability based on early detection of drought stress. A bio-economic model was parameterized to represent a range-based cow-calf production system in the Northern Great Plains. The base management system was characterized by inputs required to maintain herd size of 511 cows during an average climatic year with a fixed forage base of 4,329 AUM of range forage, plus 571 t grass and 189 t alfalfa hay. Treatments were factorially arranged where management (early vs normal) and intensity of drought (moderate, 20% reduction in available forage vs severe, 40% reduction in available forage) were evaluated for effects on system performance. The early management (EM) scenario included detecting drought by July 15th and decreasing the average age at weaning to 90d. The normal management (NM) scenario included no “early” management changes to emerging drought, but nutritional management was modified as needed to maintain in animal performance. A second bio-economic computer model was used to simulate drylot performance for early-weaned calves. Outputs from the two models were combined and treatments were evaluated based on feed costs, average weaning weight, ranch gross margin (gross margin × variable costs, RGM), and cumulative gross margin (ranch gross margin + revenue from drylot calves, CGM). During average climatic conditions CGM under the base management system was $137,730. During drought CGM was reduced compared to the base system: EM (17.6 and 48.8%) and NM (33.6 and 72.3%) for moderate and severe drought, respectively. For both levels of drought, EM had lower purchased feed costs and higher CGM than NM. Directly feeding EM calves proved more efficient than feeding NM cows to produce milk to maintain calf performance. Early weaning should effectively reduce the negative effects of drought on gross margin. 

Key Words: Beef cattle, Drought management, Early weaning

80 Genetic analysis of the growth performance of Bhagnari and Droughtmaster x Bhagnari crossbred cows in Pakistan. A. U. Hyder1*, A. Wafeed2, and M. S. Khan3, 1Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan, 2Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan, 3Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan.

Pedigree and performance records of 296 Bhagnari and Droughtmaster x Bhagnari crossbred cows maintained at Beef Production Research Centre, Sibi (Balochistan) accumulated over a period of 30 years from 1969 to 1999, were utilized for the present study. The least squares means for birth weight, weaning weight and pre-weaning average daily gain were 23.49±3.76, 107.46±19.00 and 0.39±0.07 kg having coefficients of variation of 12.89, 13.75 and 13.75 percent. Year of birth significantly influenced birth weight, weaning weight and pre-weaning average daily gain, season of birth appeared to be a non-significant source of variation for all of the performance traits studied. Genetic group of the cows had a significant effect on birth weight, While other traits including weaning weight, pre-weaning average daily gain, were non-significantly affected by the genetic group of the cow. Genetic group of the dams had a non-significant effect on birth weight and weaning (P>0.05). The heritability estimates of birth weight, weaning weight, and pre-weaning average daily gain were found to be 0.09±0.02, 0.09±0.01, and 0.01±0.01, respectively. The estimates of phenotypic and genetic correlation between birth weight and weaning weight were - 0.23 and -0.74, respectively. The estimated breeding values ranged from -171.44 to 242.48 kg for birth weight and from -171.44 to 22.48 kg for weaning weight. Estimated breeding values obtained were used to compute the genetic trends for various performance traits. The genetic trends for birth weight was negative and for weaning weight it was, however, slightly positive. All phenotypic trends were negative with the exception of the one for weaning weight, which was slightly positive.

Key Words: Growth, Heritability, Genetic trend

81 The effect of protein intake on milk protein efficiency in heat-exposed cows. A. Arieli1*, and I. Bruckental2, 1Hebrew University of Jerusalem, Rehovot, Israel, 2Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel.

A trial was conducted using 42 mid-lactating (134 DIM) cows to evaluate the effect of dietary CP concentration on the production, composition and efficiency of milk production under hot ambient conditions. The trial was conducted from May until August 2002, in Bet Dagan, Israel. The mean, and maximal ambient temperature, relative humidity and thermal humidity index prevailing throughout the trial were: 27 and 32°C, 70 and 88%, and 76 and 81, respectively. Cows had 3 showers daily; each lasting for 20 min. Cows were individually fed, and were randomly blocked into 2 dietary treatments. Group LP and HP were respectively fed with diets containing 15.1 or 16.7% CP. Other dietary constituent were: 36% RUP (% of CP), 32% NDF (54% of which from forage), 1.72 Mcal/kg NEL. Feed intake, milk yield, and body weight were measured daily, and were averaged every week. Body condition was weekly scored. During the 4th, and 8th wk of trial, blood was sampled before the morning meal. On these weeks six fecal samples were obtained in two succeeding days for digestibility evaluation by the indigestible NDF method. Digestibility of CP was lower in LP (64%) than in HP (66%) diet, while the DM digestibility was higher in the LP (65%) than in the HP (63%) diet. Intake of DM (23 kg/d), milk production (35 kg/d), milk protein (3.1%), fat (3.3%), and lactose (4.7%) were similar between treatments. The efficiency of milk protein production was higher in LP (0.30) than in HP (0.28) diet. Plasma concentrations of glucose (58 mg/dl), NEFA (0.13 mg/l), BHBA (9.7 mg/dl), total protein (8.2 g/l), and albumin (3.8 g/l) were not affected by dietary CP level. Milk protein was lower in LP (0.14 mg/dl) than in HP (0.17 mg/dl). Body weight gain and BCS accretion tended to be higher by 135 g/d, and by 0.1, respectively, in the LP as compared with the HP diet. It was concluded that a dietary CP concentration of 15% might be adequate to maintain production in heat-exposed dairy cows producing 35 kg of milk.

Key Words: Dietary CP, Heat stress, Milk protein efficiency


The National Animal Health Monitoring System’s Dairy 2002 surveyed dairy operations in 21 states representing 82.8% of U.S. dairy operations and 85.5% of U.S. dairy cows. One component of the study investigated procedures associated with milking and other udder health management practices aimed at decreasing mastitis incidence. The objective of this report is to describe current milking procedures and other management practices associated with udder health on U.S. dairy operations. Predip test preparation methods were used on 59.1% (S.E.2.1) of all operations. Prepips were used most frequently on operations with 100-499 cows. The most commonly used pre-drips contained iodophores (70.3% (S.E.2.4) of operations using a predip) and chlorhexidine (10.4% (S.E.1.8) of operations using a predip). The most commonly reported teat wash method
for operations not using a predip were single-use cloth/paper towel. Operations that used a teat wash method most frequently dried teats using a single-use cloth/paper towel (51.2% (S.E. 3.8) of operations that used a teat wash method). Neither a predip or teat wash method was used on 5.3% (S.E. 1.0). Automatic teatdips were used on 36% (S.E. 1.8) of all operations with use increasing with increasing herd size. More than 94% (S.E. 1.0) of operations used a post-milking teat disinfectant (postdip). Iodophors and chlorhexidine were the most commonly used disinfectants in postdips. Most operations reported milking cows twice daily (93.6% (S.E. 0.8) of operations representing 78.6% (S.E. 1.7) of cows). Coliform mastitis vaccines were administered to the majority of cows on 35.8% (S.E. 2.0) of operations representing 57.1% (S.E. 1.8) of all cows. Intramammary dry cow therapy was administered to all cows at dry off on 75.2% (S.E. 1.9) of operations. The majority (42.1% (S.E. 1.8) of cows) was treated with a dry cow product containing cepharin, followed by the combination of penicillin G/dihydrostreptomycin (31.7% (S.E. 2.0) of cows).

Ruminant Nutrition: Dairy calves and replacement heifers

82 Responses to feeding Apex plant extracts to neonatal calves via the milk replacer and starter. T. M. Hill*, J. M. Aldrich¹, and R. L. Schlotterbeck¹, Akey.

Feeding Apex plant extracts improved 0 to 42-day gains by 8 percent when included in an all milk protein milk replacer (MR) and 17 percent when included in a milk plus soy protein MR (no Apex in the starter) in a previous trial. In this trial 48, approximately 3 day old calves (40 kg), were fed a milk plus soy protein MR (20 percent CP and 20 percent fat, 454 g per head daily) with and without .05 percent Apex and an 18 percent CP starter with and without .05 percent Apex. All MR and starters contained deccouminate. Starter and water was fed from 0 to 56 days and MR was fed from 0 to 42 days. Calves were housed in a naturally ventilated nursery with no heat in individual pens. Data were analyzed as a completely randomized block design with factors in the model of block (row in nursery), MR (Apex or no Apex), starter (Apex or no Apex), and MR by starter. There were no significant (P > .1) interactions of MR by starter. Calves fed Apex via the MR had higher gains, consumed more starter, and had better feed efficiency (P < .05) from 0 to 42 days. They also had higher feed scores and required fewer medical treatments (P < .05) from 0 to 42 days. Calves fed Apex via the starter had higher rates of growth and better feed efficiency (P < .1) from 0 to 56 days. Calves fed Apex via the MR consumed more (P < .1) starter from 0 to 56 days. Calves fed Apex via the starter consumed more (P < .1) starter and had greater hip width changes post-weaning. Compared to calves not fed Apex from 0 to 56 days, gains were 4.9 kg, 5.4 kg, and 8.0 kg greater and starter intakes were 9.4 kg, 8.3 kg, and 11.3 kg greater when Apex was in the MR, starter, or both feeds, respectively. Apex is a trademarked product of Brues Feed Ingredients.

Key Words: Calf, Milk replacer, Plant extract


Milk replacers (MR) for herd replacement calves commonly contain all animal fat, which contain fatty acids with predominately 16 and 18 carbons. Shorter chain fatty acids may be more digestible and have antimicrobial properties, while C18:2 and C18:3 fatty acids might aid in immune function. In two trials, a MR formulated with a portion of the animal fat replaced with a blend of vegetable fats and 16 percent better feed efficiency (P < .1) from 0 to 56 days. Calves fed MR via the starter consumed more (P < .1) starter from 0 to 56 days. Calves fed MR via the starter consumed more (P < .1) starter and had greater hip width changes post-weaning. Compared to calves not fed MR from 0 to 56 days, gains were 4.9 kg, 5.4 kg, and 8.0 kg greater and starter intakes were 9.4 kg, 8.3 kg, and 11.3 kg greater when Apex was in the MR, starter, or both feeds, respectively. Apex is a trademarked product of Brues Feed Ingredients.

Key Words: Calf, Milk replacer, Fatty acids

84 Characterization of a colostrum replacer containing IgG concentrate and growth factors. C. J. Hammer¹, J. D. Quigley¹, L. Ribeiro², and H. D. Tyler¹, 1Iowa State University, Ames, ²APC, Inc., Ames, IA.

Objective of this study was to characterize absorption of colostrum replacer (CR) or supplement (CS) containing fractions of bovine plasma. Immunoglobulin concentrate (IGC) was prepared from bovine abattoir blood to a final purity of approximately 90%. Bovine blood was also processed to produce a fraction containing elevated concentrations of IgF-1 and TGF-β (GF). Both IGC and GF were spray-dried and blended with other ingredients to produce CR (30% IGC) or CS (15% IgG containing 0 or 5% GF. Holstein bull calves (n = 40) were removed from the dams immediately after birth and assigned to one of five treatments: 1.9 L of maternal colostrum at 1 and 8 h of age (MC); 1.9 L of CR at 1 and 8 h of age to provide 150 g of IgG (LC); 1.9 L of CR at 1 h of age to provide 150 g of IgG and 1.9 L of a commercial milk replacer (MR) at 8 h of age (HC); and 1.9 L of CR with GF at 1 h of age to provide 150 g of IgG and 1.9 L of a commercial MR at 8 h of age (HG). Blood was collected by jugular venipuncture at 0 and 24 h for determination of IgG concentrations. Six calves fed HG, HC, and MC received an oral xylose solution (0.5% g/kg body weight) at 2 d of age. Jugal blood samples were obtained at 0 and 2 h after xylose ingestion. Apparent efficiency of IgG absorption (AEA) was higher (p = .02) for calves fed HC and HG compared to those fed LC and LG and was lower (p = .03) for calves fed LG and HG compared to those fed LC and HC. IgG concentrations at 24 h were highest (p < .0001) in calves fed MC compared to other calves and were higher (p = .048) in calves fed HC and HG compared to LC and LG. Calves fed LG and HG had lower (p = .02) IgG concentrations at 24 h of age compared to those fed LC and HC. Xylose absorption was not influenced by treatment. These results indicate that 150 g of IgG provided in one dose soon after birth is superior to 150 g of IgG fed in two doses 7 h apart.

Key Words: Colostrum, Calf, Xylose


Due to increased concern over feeding species to species feeds and to new manufacturing technology, the use of vegetable fats in milk replacers may be an alternative to feeding animal fats. Two studies were conducted to evaluate the performance of calves fed milk replacer containing vegetable fat. Both experiments utilized a randomized complete block design with initial weight as the blocking factor. Calves on Exp. 1 were assigned to a diet of all animal fat (ANIMAL), 100% vegetable fat containing Palm Oil as 85% of the fat and Coconut Oil as 15% of the fat (PALM), or a 100% vegetable fat diet containing Soy Oil as 85% of the fat and Coconut Oil as 15% of the fat (SOY). Calves on Exp. 2 were assigned to a diet of all animal fat (ANIMAL), as ANIMAL with 15% of the fat from Coconut Oil (15%COCO), or 100% vegetable oil containing 85% of the fat as Soy Oil and 15% of the fat as coconut oil (SOY). For both experiments, milk replacers were formulated to contain protein and fat levels at 20% DM and were fed at 454 g/d reconstituted to 12% DM. Holstein bull calves (n = 60 for Exp. 1, n = 120 for Exp. 2) were purchased from an area sale barn. Calves were housed in individual hutches with water available free choice from d 0. A high quality, commercial calf starter was available from 0-14 d. Feed intake, incidence of scouring and antibiotic treatments were recorded daily. Calves were weighed weekly. Calves were
Weaned at a minimum of 42 d with weaning dependent on the calf eating a minimum of 454 g of calf starter for 3 consecutive d. For Exp. 1, calves fed the PALM diet had greater average weekly weight gains, ADG, ADFI, and feed efficiencies (P < 0.05) than calves fed ANIMAL. Calves fed SOY were intermediate for all performance characteristics. For Exp. 2, there were no significant differences in average weekly weight gains, ADG, ADFI or feed efficiency between calves fed ANIMAL, 15% COCO, or SOY. These results indicate that vegetable fats can be used as an effective alternative fat source in commercial calf milk replacers.

Key Words: Calves, Milk replacer, Fat

86 Effect of feeding a novel direct fed microbial in a calf milk replacer. M. L. OBrien1, K. J. Touchette1, J. A. Coaol1, R. M. Costello1, T. Rehberger2, and B. Galbraith1, 1Merrick’s Inc. Union Center, WI, 2Agtech Products, Inc. Waukesha, WI.

The objective of this study was to determine the effect of feeding a novel direct fed microbial (DFM) in a calf milk replacer (CMR). Holstein bull calves (n=120), less than 7 d of age were purchased from an area sale barn in two groups of 60 calves. Two experiments were conducted using a randomized complete block design. Calves were assigned by weight to either a control diet (CON) or a diet containing the novel DFM (DFM). All calves were fed a CMR formulated to contain protein and fat levels of 35% and 20%, respectively, and were fed 454 g/d. Calves were housed in individual latches with water available free choice from d 0. A commercial calf starter was available free choice beginning at d 1. Feed intake, scour scores and antibiotic treatments were recorded daily. Calves were weighed weekly. Calves were weaned at d 42 dependent on a minimum intake of 454 g of calf starter for 3 consecutive d. Experimental data were analyzed using ANOVA due to treatment by trial interactions. Initial serum Ig level for calves in Exp. 1 was 50% lower than that for calves in Exp. 2 (3.9 vs. 7.9 mg/ml, P<0.1). Calves fed the DFM in Exp. 1 were significantly heavier than calves fed the CMR diet beginning on d 7 and maintained the difference through d 42. Average daily gains were significantly greater for the first six weeks of the study for calves fed the DFM diet compared to those fed the CMR diet (465g vs. 393g respectively). In Exp. 1, calves fed the DFM had a larger percent scaring than calves fed the CMR diet (27.5% vs. 39.3%, respectively, P=0.35). In Exp. 2, there was no significant difference in average weekly weight gains, ADG, feed intake or gain:feed between calves fed the DFM or CMR diet. For calves fed the DFM, the percentage of calves that scoured was significantly (P<0.05) less than calves fed the CMR diet (17.9% vs. 41.4%, respectively). These results suggest that the novel DFM utilized in this study can be beneficial for the reduction in percentage of calves scaring when fed in a calf milk replacer and may improve calf performance.

Key Words: Calves, Direct fed microbials

87 Performance of Holstein and Holstein-Jersey crossbred heifer calves from birth to 84 days of age. M. L. Raeth-Knight1, J. G. Linn1, D. G. Johnson2, L. B. Hansen1, A. J. Seykora1, B. J. Heins1, and R. M. Templeton1, 1University of Minnesota, St. Paul, MN, USA, 2West Central Research and Outreach Center, Morris, MN, USA.

Forty-two Holstein and forty-four Holstein-Jersey crossbred heifer calves were included from studies conducted at the University of Minnesota, St. Paul (Site A) and the West Central Research and Outreach Center, Morris, Minnesota (Site B). All crossbred calves had Holstein dams and Jersey sires. Calves were fed colostrum twice daily the first three days post birth and then milk replacer (22% CP, 20% fat) at approximately 10% of birth weight until weaning at day 42. Calf starter was offered ad libitum from day 3 to day 84. Calves at Site A were housed individually in hutches while calves at Site B were housed individually and in groups. Housing at Site B did not affect performance measures or feed intake of Holstein or crossbred calves. All calves at both sites were grouped on day 57. Body weights and hip heights were recorded at birth, day 28, 56 and 84. At both sites, Holstein calves consumed significantly (P<0.01) more total kg of milk replacer dry matter from day 3 to 42 (Site A (18.3 Site B (17.24)) as compared to crossbred calves (Site A (14.7) Site B (13.5)). At Site A, Holstein calves numerically consumed more total kg of starter from day 3 to 56 (63.1 vs. 55.1) compared to crossbred calves (n=8). At both sites, Holstein calves weighed significantly (P<0.01) more at birth than crossbred calves, (41.6 kg vs. 34.4 kg). The average body weights at day 84, for Holstein and crossbred calves, were 109.5 kg and 91.2 kg (P<0.01) for Site A and 91.4 kg and 82.3 kg (P<0.01) for Site B. In summary, there was no difference in the feed efficiency or comparative performance (weight gain expressed as a percentage of birth weight) of Holstein or crossbred calves.

Key Words: Crossbreeding, Calf, Growth

88 Effect of feeding fatty acids to prepubertal heifers on first lactation milk production. J. M. Smith1, 1University of Vermont, 2Cornell University.

We previously observed a reduction in pubertal mammary DNA content in Holstein heifers that had been fed a Ca salt of CLA. In this study, first lactation milk yields and components were compared among Holstein cattle that had been fed diets containing either a Ca salt of CLA (CaCLA), a Ca salt of palm fatty acids (CaPalm), sunflower oil (SUN), or no supplemental fatty acids (control; CTRL) between weaning and puberty. Treatments were randomly assigned to pens of 10 heifers as they were weaned. There were two replicate pens per treatment. Treatment diets began at about 3 mo of age. Heifers were limit-fed total mixed rations (TMR) composed of haylage, corn silage, and concentrate formulated using the Cornell Net Carbohydrate and Protein System to provide 1.01 ME- and 1.07 MP-allowable gain (kg/d). Fatty acid supplemented diets averaged 5% of DM. Heifers were weighed weekly and blood was collected twice weekly if over 250 kg to determine onset of puberty by measuring plasma progesterone. Of the 80 heifers enrolled in the study, 67 were followed through 280 d in milk. Heifers were housed together, milked 3x/d, and given bST per label. Monthly milk samples were analyzed for fat, protein, and urea nitrogen. Daily milk weights were used to calculate actual 280-d production. Means of the data were analyzed by ANOVA. Average daily gains between the start of treatment diets and puberty (0.99 ± 0.03 kg/d), ages at puberty (9.2 ± 1.3 mo) and first calving (22.1 ± 1.9 mo), and hip height (144 ± 3.5 cm) were not different, but body weight (BW) at the start of treatment, puberty, and conception differed (P=0.001, P=0.01, and P=0.1, respectively). The BW at the beginning of the treatment period were 95, 101, 95, and 113 ± 1.7 kg for CTRL, CaCLA, CaPalm, and SUN, respectively. Puberty was attained at 286, 280, 269, and 305 ± 4.0 kg and heifers conceived at 377, 386, 363, and 392 ± 4.6 kg for CTRL, CaCLA, CaPalm, and SUN, respectively. Actual 280-d milk production (10720 kg ± 135), percentages of milk fat (3.6 ± 0.42), protein (2.8 ± 0.20), and urea nitrogen (13.0 ± 1.5 mg/dl) were not different among treatments. Fatty acids supplemented at 1% of ration DM to prepuberal heifers did not affect first lactation milk yield.

Key Words: Heifers, Fatty acids, Milk production


The objective of this study was to assess the effects of varying protein fractions, fed in diets containing two forage levels (medium, 72.3% and high, 91.7%), to 16-18 month-old dairy heifers, on rumen fermentation, blood urea nitrogen (BUN), nitrogen (N) and phosphorus (P) balance. Diets were formulated to deliver equal ratios of crude protein to metabolizable energy and arranged in a 2 × 2 factorial with high or low levels of soluble (HSP or LSP) and rumen undegradable protein (HRUP or LRUP). Soluble protein was increased by the inclusion of urea to the appropriate rations, while RUP was increased by the inclusion of fish meal, each to rations in which soybean meal or Soy-Plus comprised the main source of protein concentrate. Treatments were administered in two 4 × 4 Latin squares to eight rumen-cannulated, Holstein heifers over four, 21-d periods (417.6 ± 24.0 kg, initial body weight). When fed in the medium forage diet, there were no treatment effects on mean daily rumen pH or VFA molar proportions (P>0.05). The mean concentration of major VFA, acetic acid (C2), was significantly (P<0.04) by HSP, however there were no significant differences in BUN for any treatment. Apparent digestibility of N (P=0.02) and P (P=0.05) was improved by the inclusion of HSP, although organic matter (OM) apparent digestibility was unaltered by treatment. A treatment interaction improved apparent digestibility of N in the HSP and LRUP ration (P=0.04). When fed in a high forage diet, no significant differences were detected in the molar proportions of VFA, NH3, or BUN (P>0.05), while peak NH3 was highest for HSP and LRUP rations (P<0.05). The highest level of 22 J Anim. Sci. Vol. 81, Suppl. 1/J. Dairy Sci. Vol. 86, Suppl. 1
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P pH (forage DMI. No time x treatment interaction was present for ruminal
appearance that was similar to DMD. Rates of in situ DM disappearance to corn increased DM digestion (P < 0.001) for SUP compared to CON (55.4 vs 50.7%). Addition of RDP to SH increased 0.001) for CON compared to SUP (1.45 vs 1.25% BW). Likewise, addition of RDP increased ruminal ammonia (P < 0.001). There was an ENG x RDP interaction (P = 0.03) for total tract NDF disappearance that was similar to DMD. Rates of in situ DM disappearance were not different (P = 0.34). For moderate quality forages, intake and digestion appear to respond differently to RDP addition depending on energy source. Additional research is needed to determine RDP level to improve the apparent N digestibility when fed to 16-18 month-old Holstein heifers in both medium and high forage diets.

Key Words: Protein, Heifers, N digestibility

90 Influence of energy source and RDP on intake and digestion in beef steers fed grass hay based diets. T. A. Baumann*, G. P. Lardy, J. S. Caton, W. W. Dvorak, and V. L. Anderson, North Dakota State University, Fargo ND.

A 5 x 5 Latin square was used to determine effects of supplemental energy source (ENG; corn vs soyhulls) and rumen degradable protein (RDP) addition on intake and digestion in steers fed grass hay. Steers (686.2 ± 51.4 kg BW) were housed in individual pens during each 14 d adaptation period and individual stalls during each 7 d collection period. Treatments were arranged as a 2 x 2 factorial plus one and consisted of control (CON; grass hay, 7% CP); grass hay plus 0.4% BW soyhulls (SH; 13.5% CP); grass hay plus 0.4% BW SH and 0.15% BW sunflower meal (35% CP); grass hay plus 0.4% BW corn (9.5% CP); and grass hay plus 0.4% BW corn and 0.2% BW sunflower meal. Diets supplemented with RDP were formulated to have a 0 RDP balance with the NRC model. Preplanned contrasts included main effects of ENG and RDP, ENG x RDP interaction, and CON vs supplemented (SUP) treatments. Supplementation increased total DMI compared to CON (1.67 vs 1.45% BW; P = 0.001), but forage DMI was greater (P < 0.001) for CON compared to SUP (1.45 vs 1.25% BW). Addition of RDP to SH increased (P = 0.02) forage DMI, while addition to corn decreased (P = 0.02) forage DMI. No time x treatment interaction was present for ruminal pH (P = 0.79). Ruminal pH was higher (P < 0.001) for CON vs SUP (6.69 vs 6.56). There was an ENG x RDP interaction (P < 0.001) for ruminal pH; pH increased with RDP addition to SH (6.58 vs 6.63), but decreased with RDP addition to corn (6.60 vs 6.46). Supplementation increased ammonia compared with CON (P < 0.001; 0.46 vs 1.46 mM). Likewise, addition of RDP increased ruminal ammonia (P < 0.001; 2.46 vs 0.35 mM). Total tract DM digestibility (TTDM) was higher (P = 0.01) for SUP compared to CON (55.4 vs 50.7%). Addition of RDP to SH decreased TTDM (P = 0.04; 57.86 vs 55.11%), while RDP addition to corn increased DM digestion (P = 0.04; 52.56 vs 56.14%). An ENG x RDP interaction occurred (P = 0.03) for total tract NDF disappearance that was similar to DMD. Rates of in situ DM disappearance were not different (P = 0.34). For moderate quality forages, intake and digestion appear to respond differently to RDP addition depending on energy source. Additional research is needed to determine RDP level and responses in diets using SH as the supplemental energy source.

Key Words: Soybean hulls, Protein supplementation, Digestion

91 Protein utilization of pearl millet grain supplements by growing steers. G. M. Hill1, W. W. Hanna2, A. C. Coy3, B. C. Hand1, W. B. Forlow1, and B. G. Mullinix, Jr., 1University of Georgia, Tifton, GA/USA, 2USDA-ARS, Tifton, GA/USA.

Bermudagrass hay (H; ‘Tifton 85’) was fed with supplement treatments (TRT) to steers to determine effects of corn-soybean meal or hybrid pearl millet grain (PM; ‘TifGrain 102’) on post-weaning transition performance and protein utilization. Supplements (SUP) contained rolled corn, soybean meal, PM (90.9% DM, 15.2% CP; finely ground), and a vitamin/mineral premix, respectively (%): SCS = 87.8, 10.0, 0.0, 2.2; SPM = 88.8, 15.2, 84.5; THR = 72.4, 62.0, 63.6. Digestibilities for DM, OM and ADF did not differ among diets (P > 0.10) by TRT. The DM, CP, and TDN (% DM), respectively, of SUP were: SCS = 88.0, 15.3, 84.5; SPM=88.8, 15.2, 82.5. Each SUP had salt (0.75%), CaCO3 (0.75%), and provided vitamin preximins A, D and E (24,000, 8,000, and 400 IU/d, respectively), lasalocid (150 mg/d) and Se (2.0 mg/d). Steers were randomly assigned to TRT, and initial (IBW) and final BW were means of two daily unshrunk weights. Trial 1. Forty continental cross steers (initial BW = 292 kg) were fed the same four diets while housed in individual metabolism stalls for a 10-day period. Nutrient digestibilities for the four diets were as follows: DM; 72.8, 64.2, 73.2, 69.2, OM; 74.3, 67.8, 75.6, 71.0, CP; 62.0, 63.6. Digestibilities for DM, OM and ADF did not differ among diets (P > 0.10). However, CP digestibility was greatest (P < 0.10) for diet 3 and NDF digestibility was lowest (P < 0.10) for diet 2. Soyhulls can be blended with rice mill feed to produce acceptable backgrounding diets for growing beef calves.

Key Words: Beef cattle, Rice mill feed, Soyhulls

92 Use of rice mill feed and soyhulls in backgrounding diets for beef calves. W. N. Stacey4 and D. L. Rankins, Jr., Auburn University.

Rice mill feed compared favorably with broiler litter for producing economical gains when blended with corn and fed to stocker calves. Two trials were conducted to evaluate the use of soyhulls in broiler litter and rice mill feed (RMF)-based diets. Trial 1. Forty continental cross steers (initial BW = 257 kg) were fed one of four diets over a 112-day period (five steers/pen; two pens/diet). On a dry matter basis, diets were as follows: 1) 47% broiler litter:53% soyhulls, 2) 70% RMF:30% soyhulls, 3) 60% RMF:40% soyhulls and 4) 50% RMF:50% soyhulls. All diets were fed free-choice, and bermudagrass hay also was offered free-choice. Daily gains were higher (P < 0.05) for diet 4 than for the other 3 diets (1.1, 1.0, 1.2 and 1.5 kg/d, respectively). Trial 2. Sixteen Angus x Charolais steers (initial BW = 292 kg) were fed the same four diets while housed in individual metabolism stalls for a 10-day period. Nutrient digestibilities for the four diets were determined. Daily dry matter intake was lower (P < 0.01) for diet 1 (5.0 kg/d) than for diets 2, 3 and 4 (7.8, 7.9 and 7.9 kg/d, respectively). Nutrient digestibilities for the four diets were as follows: DM; 72.8, 64.2, 73.2, 69.2, OM; 74.3, 67.8, 75.6, 71.0, CP; 73.0, 72.6, 81.6, 70.8, NDF; 71.7, 55.8, 66.6, 63.6 and ADF: 66.2, 51.3, 62.0, 63.6. Digestibilities for DM, OM and ADF did not differ among diets (P > 0.10). However, CP digestibility was greatest (P < 0.10) for diet 3 and NDF digestibility was lowest (P < 0.10) for diet 2. Soyhulls can be blended with rice mill feed to produce acceptable backgrounding diets for growing beef calves.

Key Words: Beef cattle, Rice mill feed, Soyhulls

93 Effects of supplementing corn or soybean hulls to steers consuming bermudagrass hay on intake and apparent nutrient digestibilities. A. I. On*, B. J. Rude, D. G. St. Louis, and V. T. Nguyen, Mississippi State University, Starkville.

Effects of supplementing bermudagrass hay with corn or soybean hulls (SBH) on nutrient digestibility was evaluated using six crossbred steers (initial BW 182 ± 24.8 kg) fitted with rumen cannulae. Steers were placed in a latin rectangle arrangement and allowed ad libitum access to bermudagrass hay and assigned to one of three treatments: no supplement; supplemented with SBH; or supplemented with corn. Corn and SBH were fed to provide 161% of the maintenance energy requirement. In addition, soybean meal was added to the ration to meet National Research Council protein requirements because of the increased energy intake due to supplementation. For each of the three periods, steers were acclimated to their respective treatments for 14 days; after which, they were placed into individual stalls for 14 days. Steers were given for SPM indicate that PM was comparable to corn-soybean meal as a SUP for transition steers fed hay as the basal diet.

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Key Words: Steer, Millet, Hay

their respective supplements each morning and allowed ad libitum access to hay day. Dry matter intake of hay was not different (P > 0.2) among the treatments, ranging between 2.19 and 2.60 kg/d. However, total DMI of steers receiving SBH and corn was increased (P < 0.01; 3.60 and 3.50 kg/d, respectively) compared to steers not supplemented (2.27 kg/d). Steers not supplemented (P < 0.01; 52.9 and 53.4%, respectively) than those consuming corn (62.0; 62.8%, respectively) or SBH (65.7 and 66.7%, respectively). Crude protein digestibility for steers consuming hay only was decreased (P < 0.01; 49.2%) compared to steers consuming corn (64.7 and 67.5%, respectively), neutrally. Neutral detergent and acid detergent fiber digestion was increased with SBH supplementation, (P < 0.01; 63.9 and 64.4%, respectively) compared to corn supplementation (52.8 and 49.6%, respectively) and non-supplemented steers (53.9 and 50.3%, respectively). Hemicellulose digestibility ranged between 55.5 and 61.1% and was not different (P > 0.05) among the three treatments. Supplementation of SBH or corn increased the digestibility of OM and protein by steers consuming bermudagrass hay. Additionally, supplementing bermudagrass hay with SBH increased fiber digestion compared to corn supplementation.

Key Words: BERMUDA GRASS, ENERGY SUPPLEMENTATION, SOYBEAN hulls


Fifty individually fed Angus x Brahman crossbreds steers and heifers (250 kg initial BW) were utilized to evaluate the effects of citrus pulp or corn supplementation with varying levels of bypass protein on performance. Calves were stratified by weight, sex, and breed type and randomly assigned to treatment. Treatments consisted of corn or citrus pulp supplements with added bypass protein (SoyPLUS®). Five levels of bypass protein were evaluated including 0, 0.055, 0.11, 0.165, and 0.22 kg/d. Daily gain and body condition score (1-9 scale) was evaluated every twenty eight days. Hay and supplement intake were recorded daily and refused were recorded weekly. All data were analyzed using the proc GLM function of SAS. ADG increased linearly (P = 0.001) as level of dietary supplement increased. The 48-h time point began on a supplement day for one incubation, and two incubations per period on heifers in alternate-d treatments. Fecal and urine products were individually fed for 84 days using Calan gates. Average daily gain (ADG) and body condition score (1-9 scale) was evaluated every twenty eight days. Hay and supplement intake were recorded daily and refused were recorded weekly. All data were analyzed using the proc GLM function of SAS. Contrasts of CON vs supplemented, daily vs alternate supplementation for DDG and DRC-A. Heifers in alternate-d treatments ate fewer (P < 0.01) and larger (P < 0.01) meals, and spent less (P < 0.01) time eating than those supplemented daily. Average rumen pH was greater (P = 0.05) for CON than supplemented heifers (6.30 vs 6.19, respectively). CON heifers had higher (P < 0.04) rate and extent of NDF disappearance than supplemented heifers. Rate of hay NDF disappearance was lower (P = 0.02) for DRC than for DDG. Supplementation decreased hay DM, and changed digestion kinetics. Supplementation frequency affected amount and pattern of DMI. Rate of hay NDF disappearance was greater for DDG than DRC.

Key Words: Supplementation, Forage, Intake

96 Nitrogen metabolism of beef steers fed either Gamagrass or Orchardgrass hay with or without a supplement. K. Magee*, M. Poore, J. Burns, and G. Huntington, North Carolina State University.

This experiment evaluated ruminal protein energy-synchronization in steers fed either gamagrass (Tripsacum dactyloides) or orchardgrass (Dactylis glomerata) hays with or without a soyhull/corn supplement. A balance trial was conducted to compare the effects of the supplement and hay on N intake, N digestion, and N metabolism. The supplement consisted of 50:50 corn:soy hulls mix with 50 g molasses per kg of corn:soy hulls mixture. The supplement contained 31.9% CP, 33.4% NDF, 25.1% ADF, and 14.7% ADL. Each supplement was offered in two equal portions. Steers had ad libitum access to water and a trace mineralized salt block throughout the study. Hay compositions were 8.3% CP, 46.6% NDF, and 26.7% ADF for gamagrass and were 11.9% CP, 46.25 % NDF, and 26.55% ADF for orchardgrass. Steers were individually fed, blocked into two weight groups, and randomly assigned to either gamagrass or orchardgrass hay (4 steers per pen). A N balance trial was conducted to compare the effects of the supplement and hay on N intake, N digestion, and N metabolism. The supplement consisted of 50:50 corn:soy hulls mix with 50 g molasses per kg of corn:soy hulls mixture. The supplement contained 31.9% CP, 33.4% NDF, 25.1% ADF, and 14.7% ADL. Each supplement was offered in two equal portions. Steers had ad libitum access to water and a trace mineralized salt block throughout the study. Hay compositions were 8.3% CP, 46.6% NDF, and 26.7% ADF for gamagrass and were 11.9% CP, 46.25 % NDF, and 26.55% ADF for orchardgrass. Steers were individually fed, blocked into two weight groups, and randomly assigned to either gamagrass or orchardgrass hay (4 steers per pen). We observed no differences in N metabolism.

Key Words: Beef Cattle, Forage, Nitrogen metabolism

97 Supplemental protein to enhance nutrient utilization of steers fed high fiber hay. N. K. Paiva*, M. A. Froetschel, and G. M. Hill, The University of Georgia, Athens, Georgia.

A metabolism trial was conducted to determine effects of incremental levels of rumen undegradable protein (RUP) on nutrient utilization of growing steers fed bermudagrass hay (10.2% CP, 76.4% NDF). Six Holstein steers (217 ± 13.8 kg) were used in a replicated 3 x 3 Latin Square designed experiment. Incremental levels of RUP (26.5, 35.3, and 44.0% of CP) were fed as supplements at 1.63 kg/hd/d. Supplements were iso-nitrogenous (25.9% CP) and fed in the form of pressed molasses blocks. RUP was controlled by feeding different ratios of SBM, corn gluten feed, poultry protein meal and soy hulls. Steers were fed treatments for 14 d. On d 10 to 14, steers were placed in metabolism crates for total fecal and urine collection. Jugular blood was sampled before and after feeding on d 10 and 14 respectively. Hay supplement intake increased by 3.95 to 4.27 kg DM/d and 5.56 to 5.92 kg/d with RUP (P < 0.05). Fiber digestion responded linearly to RUP supplementation (P < 0.05).
however DMD, OMD and DE were not affected (P > 0.10). Treatment did not affect N retention (P > 0.10; 49.46 ± 5.22 g/d) but there was a trend for more digested N to be retained. Blood urea nitrogen (BUN) increased after feeding (P < 0.05; 14.15 vs. 16.3 mg/dL) and tended to be negatively related to RUP. In a 63-d ± 2 factorial feedlot trial, British and Brahman × British steers (n = 48; 556 ± 2 kg initial BW; age 9 mo.) were ranked by BW, randomly allocated to one of 8 pens and fed two levels of RUP (26.5 ± 44% of CP) and two types of supplement form (meal and pressed blocks). Bermudagrass hay (13.1% CP) was offered free choice and supplements were fed at 1.5 kg DM/bd/d. Blood samples were collected on d 21 and 63. Intake was not affected by treatments. Steer ADG (0.67 ± 0.05 kg) did not respond to RUP or form. BUN was lowered with RUP (14.1 ± 12.1 mg/dL; P < 0.01). A trend for interaction between RUP levels and form was also observed. Despite indications that RUP improved nutrient metabolism of cattle fed high fiber hay, animal performance was not affected.

Key Words: Protein supplementation, Fiber, Growing steers

98 Effects of ammonia load on methionine utilization in growing steers limit-fed soybean hull-based diets. M. S. Awawdeh*, E. C. Tigtgemeyer, K. C. Candler, and D. P. Gnad, Kansas State University, Manhattan.

Six ruminally cannulated Holstein steers (203 kg BW) housed in metabolism crates were used in a 6x6 Latin square to study effects of rumen ammonia load on methionine (Met) utilization. Steers were fed the basal diet (83% soybean hulls, 8% wheat straw, and 0.3% urea) twice daily at 2.5 kg DM/d. Periods were 6 d, with 2 d for adaptation and 4 d for fecal and urine collection to determine N retention. Treatments were arranged as a 3x2 factorial and were continuously infused into the rumen (0, 40, or 80 g/d urea to supply ammonia load) and into the abomasum (2 or 5 g/d Met). Basal ruminal infusions contained 200 g/d acetate, 200 g/d propionate, and 50 g/d butyrate to provide energy without increasing microbial protein supply. Basal abomasal infusions contained a mixture (255 g/d) of all essential amino acids except Met, 10 mg/d vitamin B-6, 10 mg/d folate, 0.1 mg/d vitamin B-12, and 300 g/d glucose. Rumen ammonia concentrations were 4.5, 21.5, and 19.7 mg/mL when 0, 40, and 80 g/d urea were infused, respectively. Urea infusions linearly increased plasma urea (P < 0.01) from 4.5 to 7.8 mg/mL for 0 and 80 g/d urea, respectively. Fecal N was similar among treatments. There was no urea x Met interaction for fecal, urine, or retained N. Urea infusions did not affect (P > 0.2) affect retained N (25.2, 23.4, and 25.7 mg/d for 0, 40, and 80 g/d urea, respectively), but increased (P < 0.01) urine N excretion (48.5, 67.3, and 84.6 g/d for 0, 40, and 80 g/d urea, respectively). Increasing Met from 2 to 5 g/d decreased (P < 0.01) urinary N excretion and increased (P < 0.01) N retention from 22.9 to 27.5 g/d. Serum insulin and IGF-1 concentrations were similar among all treatments. The efficiencies of deposition of supplemented Met between 2 and 5 g/d were 22.5% and 18.4% when steers received 0 or 80 g/d urea, respectively. In our model, regardless of whether Met was limiting, increasing ammonia load did not impact whole body protein deposition in growing steers. (Supported by NRI Competitive Grants Program/CSREES/USDA, Award No. 2003-35206-12837.)

Key Words: Methionine, Ammonia, Amino acids

Teaching/Undergraduate & Graduate Education

99 A partnership of universities and agri-business for an effective dairy herd management learning experience for undergraduates: the Dairy Challenge. M. Tomaszewski1, M. S. Weber Nielsen2, D. K. Beede3, D. Thorbahn1, M. Budine1, and D. Seiner5, 1Texas A&M University, College Station, 2Michigan State University, East Lansing, 3Select Sires, Plain City, OH, 4Cargill Animal Nutrition, Montene, IN, 5Shawano, WI.

The North American Intercollegiate Dairy Challenge contest allows undergraduate students to apply knowledge gained in the classroom in an evaluation of the management practices of commercial dairy farms. University faculty partnered with industry representatives to develop the competition. Participants in the Dairy Challenge do the following: 1) visit local dairy farms and gain knowledge of different farms' management practices; 2) evaluate herd records, and utilize knowledge of dairy herd management software and computer presentation tools; 3) critically evaluate dairy herd management practices and make recommendations for improvements; 4) test their speaking, presentation, and problem-solving skills; 5) work as a team to build consensus and tag-team speaking formats; and 6) meet and interact with potential employers from the dairy industry during the contest. Teams of four undergraduate students critically evaluate a commercial dairy farm using herd records, a description of farm operations, and tour of the farm facilities. The farmer answers questions pertaining to management of the farm in a group interview with all teams and in a separate interview with each individual team. Teams give a 20-minute presentation that is scored on the description and assessment of the management practices and recommendations for improvements in management and facilities. Additionally, scoring is based on apparent level of preparation, speaking, presentation skills, and responses to judges' questions. The judges are university specialists and dairy industry professionals. This capstone experience allows students to interact with dairy farmers and representatives from the dairy industry, and expands their knowledge and skills gained during their academic career.

Key Words: Undergraduate, Dairy herd management, Industry


Experiential learning is an important component of the undergraduate program in the Animal and Poultry Sciences (APSC) Department at Virginia Tech. Undergraduate research has become an increasingly important facet of that learning. Reasons include: many students are interested in the sciences, specifically veterinary medicine, and they are encouraged to gain such experience; faculty have become more aware of the valuable resource these students represent; and students can earn credit toward their degrees. Undergraduate APSC students become involved in research projects on and off campus via several routes: volunteering in research labs and at the animal units; interning at branch stations throughout Virginia; participating in programs at other universities and institutions; and traveling abroad. To earn direct credit for undergraduate research, students must have junior standing and at least a 2.75 GPA. They must take ownership of their project, from planning the design, to conducting the research, to final write up and presentation. Students that do not meet those criteria, but put substantial effort into on-going research projects, can earn independent study credit. All such proposals must meet quality standards before they are approved. In five years (Fall 1998 - Spring 2003), 81 students working with 18 APSC faculty will have earned 157 credits for undergraduate research. Of those students, 18 were non-majors. Projects have ranged from botanicals in poultry feed to conformation analysis in horses. Students have presented the results of their research projects at regional and national meetings. One student will present results in Europe this summer. At least 40 of the 81 have continued on to graduate or professional school. Involving undergraduates in research conducted by faculty members can be beneficial to both parties. Faculty gain help in conducting research, and can recruit outstanding students into graduate programs. Students learn to apply principles learned in the classroom, gain valuable work experience, obtain a wider exposure to career possibilities; and often get a jump start in graduate school.

Key Words: Research, Undergraduate education

101 Biotechnology for the animal science classroom - Development of an inquiry-based curricula for undergraduate and graduate students. S. T. Willard*, T. R. Smith, and P. L. Ryan, Mississippi State University, Mississippi State, MS.

The objective of this educational program was to develop a pilot course to instruct graduate and undergraduate students on the theories and practices behind laboratory-based biotechnological procedures. A course was created under the "Special Topics" option to accommodate both graduate (n = 6) and junior/senior level undergraduate (n = 6) students as a split-level course. Graduate students were randomly paired with an undergraduate student as laboratory partners. The six laboratories consisted of (I) Restriction Digest of DNA, (II) DNA Fingerprinting, (III) PCR, (IV) Protein Fingerprinting, (V) Bacterial Transformation and (VI) an Immunocytochemistry laboratory. After each module,
students were asked to complete a laboratory report and an evaluation form to assess usefulness of the lecture and laboratory material, and to evaluate the working relationship between graduate and undergraduate students. Evaluations were conducted based on a 1 to 5 scale (1 = Strongly Dissagree and 5 = Strongly Agree), and were analyzed to ascertain differences between modules and graduate versus undergraduate student respondents. At the conclusion of the course, a final overall course evaluation was conducted to assess student perceptions of the course as a whole. The overall course evaluation revealed that the students felt the course was relevant to the animal sciences (4.3 ± 0.14), the lecture and laboratory materials complimented one another (4.3 ± 0.13), that they learned a lot from the course (4.1 ± 0.23), and that what they learned would be useful later in life (4.2 ± 0.17). There were no cases where undergraduate students and graduate students differed across scoring categories (Agree vs. Disagree) on the individual modules or the overall course evaluations. Students agreed that pairing graduate with undergraduate students was beneficial (3.9 ± 0.26), and agreed that they worked well with their laboratory partner (3.8 ± 0.33). However, most disagreed that this type of course should be mandatory at the undergraduate level (2.8 ± 0.31). In summary, both undergraduate and graduate students agreed that this type of course was beneficial and complimented their current academic programs. [This study was supported, in part, by a William White Special Projects grant].

Key Words: Teaching, Biotechnology, Science education

102 Adding value to education: an undergraduate animal sciences internship program. K. E. Fike* and A. K. Lahmers, The Ohio State University.

Internship experiences became a required component of the undergraduate curriculum in the College of Food, Agricultural and Environmental Sciences at The Ohio State University in 1998. With approximately 450 undergraduate students in the Department of Animal Sciences, a structured and centrally-coordinated internship program was developed to: 1) facilitate the development of new internship opportunities for students, 2) incorporate a more substantial preparation and evaluation component to the internship experience, 3) facilitate ease of management by academic advisors, and 4) enhance the career development of students. Students are required to complete 200 to 400 work hours in an advisor-approved internship experience for 3 to 5 credit hours, graded satisfactory/unsatisfactory. Upon completion of the internship, students are required to present their internship experience to students, faculty, and staff at a quarterly Internship Forum. During the fall of 2002, approximately 75 students presented their experiences at the Internship Forum in areas ranging from avian research to dairy nutrition to emergency veterinary medicine. Internship job descriptions and supervisor contact information are maintained within the Department’s Student Advising Center and student-initiated internship contacts are available for use by students when addressing concerns over the internship experience. Weekly emails provide students and advisors current information on available positions and application information. The Department’s Student Services Coordinator assists students with internship searches, resume and cover letter development, interview and job search skills, and career planning. Preliminary observations indicate that participation in the Internship Forum has facilitated increased awareness, by students and advisors alike, of the variety of career opportunities available for Animal Sciences majors. Students also gain valuable communication experience through development and presentation of their internship experience to faculty and fellow students.

Key Words: Internship, Career, Teaching

103 Experiential learning through a short-term dairy internship program. A. Ahmadzadeh1, A. J. Zanella2, and R. Hatch2, 1University of Idaho, Moscow, 2Kowa R Us Dairy, Castleford, ID.

Experiential learning is essential in preparing future graduates to advance knowledge and technology. The objective of this five-day course is to enhance students’ learning experience in dairy management. To accomplish this objective we developed this program to enhance student knowledge, communication skills, and hands-on experience to better prepare them for the challenging dairy industry. This one-credit short-internship course is designed to expose animal and dairy science lower classmen to modern dairy facilities, management strategies and practices of a dairy herd, and to allow them to interact with herd health veterinarians and representatives of allied dairy industry. During the five-day period, students: a) tour several progressive dairy farms, a feed mill, and a dairy processing plant; b) work for two days on separate dairy farms and become intimately involved with all aspects on daily activities of a dairy (e.g. artificial insemination, balancing feed rations, assisting in calf care, and travel with members of the allied dairy industry (e.g. nutritionists, technical service personnel); and c) spend one day with a herd-health veterinarian and review all aspects of the herd health program while assisting the veterinarian. Furthermore, there are two evening sessions with student and veterinarian to earn the credit. This course provides students with the means to apply, analyze, synthesize and evaluate the knowledge they construct in the context of real-world situations. The program utilizes cognitive methods, which merge students into authentic practices through activity and social interaction in a way similar that of learning by craft apprenticeship.

Key Words: Dairy education, Experiential learning, Partnership

104 Recent advances in animal welfare: a Purdue-Michigan State long distance video course. E. A. Pajor*1,2 and A. J. Zanella2, 1Purdue University, 2Michigan State University.

The field of animal welfare includes various scientific disciplines. Graduate courses in animal welfare that reflect its interdisciplinary nature and expose students to the latest scientific advances are lacking. In order to address this deficit we have developed the first long distance, multi-disciplinary, multi-instructional course for senior undergraduates and graduate students at Purdue and Michigan State University. Multiple lectures allowed us to take advantage of the expertise available at both universities. Lecturers addressed a variety of issues relevant to animal welfare including, animal ethics, physiology, cognition, companion animal issues, euthanasia, and economics. Lectures originated at Purdue or MSU and were video-linked to the partner university. This course was offered as a 2 credit course and consisted of a 1-h lecture and 1-h discussion of a recent scientific paper. Course objectives included: a) developing an understanding of the intricacies associated with animal welfare, b) introducing students to the ethical issues associated with animal use and c) developing skill to critically evaluate the scientific literature as well as their own research in animal welfare. Evaluation included a midterm and a final examination. Students also submitted a written evaluation of each week’s assigned paper and were awarded a significant number of points for their contribution to the weekly discussion. In addition, students prepared a term paper and gave a presentation based on their term paper or their graduate research project at a joint meeting at MSU during the last week of class. Student evaluations of the course at both institutions were fairly positive with all students encouraging the course organizers to offer the course again. Criticisms of the course included statements about the effectiveness of distance learning and a desire to have met the students at the partner universities at least twice, at the beginning and the end of term.

Key Words: Distance education, Animal welfare, Teaching

105 Animal welfare judging: multimedia training material. D. R. Hains* and E. A. Pajor, Purdue University.

The welfare of farm animals is an issue of increasing societal concern. Training students in the objective assessment of animal welfare should be a goal of animal science departments. Using the traditional animal science livestock judging team as a model, the animal welfare judging teams have recently been developed (Heleski et al., 2001). In order to help teams comprehend animal welfare concepts and to prepare for competition we have developed a) a series of computer-based educational modules b) reading lists, and c) other animal welfare orientation activities. There are presently 6 modules in the computer based training package. The first is an introduction to the basic concepts and definitions of animal welfare. The animal welfare species specific covering swine, dairy, equine, poultry and beef cattle. Each module provides an overview of animal welfare related recommendations, indicators and issues associated with each of the various production stages, specific to that species. In order to clarify behavioral indicators of stress, Quick Time video clips have been integrated within the power point presentation. Examples include such abnormal behaviors as tongue rolling in cattle, cribbing in horses, bar biting in swine and feather pecking in poultry. Other topics within each species module
include transportation, handling, facility management and euthanasia. After each module is completed, students can assess a question set that can be used to evaluate their comprehension. In addition a list of discussion points is also provided. Within each species module, a sample scenario is included to allow students to practice evaluating welfare. After each scenario, an example of an oral presentation of welfare assessment “reasons” is provided using quick time video. Students are also given a set of seminal papers on animal welfare and behavior as well as a reference bibliography and a glossary of terms. As a final educational activity students visit the Purdue research farm and assess the welfare all major farm animal species.

Key Words: Animal welfare, Judging team, Behavior

106 Performance and cognitive level of questions asked by rural and urban students in a beginning Animal Science course. E. A. Buescher* and D. R. Brink, University of Nebraska-Lincoln.

Animal Science departments are seeing an increase in urban student and a decrease in rural student enrollment. This provides a challenge for educators to reach students at both levels of animal agriculture knowledge. For two months (24 class periods) we have observed and evaluated the questions students (n=67) asked in Animal Management 250. We were interested in the cognitive level and performance on the final examination as related to student’s background and experience in the animal industry. Each class period students were chosen at random to ask a question and it was recorded and evaluated using Bloom’s Taxonomy. Cognitive level of the questions was then compared with individual performance in the class and how it related to their peers from urban or rural backgrounds. A survey was distributed to obtain the demographics of the students along with the extent of their agriculture background. Rural students (n=45) and urban students (n=22) received approximately the same grade on the short answer part of the final exam. The average level of question asked was 2.6, indicating student’s questions were between the comprehension and application levels of Bloom’s Taxonomy. No difference in the cognitive level of questions asked by urban or rural students was observed. Students indicated knowing they may be asked a question helped them stay more alert in class (average = 4.0) on a scale where 5=strongly agree, 3=no opinion, and 1=strongly disagree. Students that asked higher level questions scored higher on the final exam (r=.36). Sixty-six percent of the students said they prepared more for class, because they may be asked a question. In conclusion, students that asked higher level questions scored higher on the final exam. Students indicated they prepared more for class, because they may be asked to provide a question. Animal agriculture background did not influence class performance or cognitive level of questions students asked.

Key Words: Cognitive, Question, Background

107 Heptachlor contamination of Oahu’s fluid milk supply: A case study to teach contemporary ethical issues to undergraduate animal science majors. D. Vincent*, University of Hawaii, Honolulu.

A course with a focus on contemporary ethical issues is a new requirement for all undergraduates at the University of Hawaii. Use of case study methods is encouraged to expose students to these issues. Cases can be used in discussion, in small groups and in role-playing to expose students to current issues in animal agriculture and assist in developing critical thinking skills. The 1982 contamination of the Oahu fluid milk supply with the PCB pesticide, heptachlor is an excellent case for introductory students. In 1981, ensiled pineapple “green chop” (tops of the pineapple plants after fruit were harvested), contaminated with heptachlor, was fed to Oahu’s dairy cattle as a low cost alternative feed. Feeding green chop resulted in contaminated milk being sold to consumers from both of Oahu’s milk processors. The Hawaii State Department of Health (HDOH), in routine screening of milk in January 1982, discovered Heptachlor epoxide (HE) contamination of the milk supply. HDOH continued to permit sale of dairy products while waiting for verification of results and internal efforts to reduce the HE levels until March 1982, when homogenized milk supplies were pulled from grocery shelves. This was the first of many recalls of dairy products from store shelves and a near complete loss of confidence in the HDOH’s ability to protect the public health. Cows could not be slaughtered and dairy farmers were forced to “milk” the HE out of the cows in order to reach EPA action levels. On some dairies, it took over 12 months before processors would accept milk. Following the contamination, high levels of HE were discovered in human breast milk. The contamination resulted in political scandal, a large class-action lawsuit, dairy bankruptcies and a continuing concern about the long-term health effects of exposure to HE in Oahu’s population. The case illustrates a situation where animal scientists were called upon to assist the local dairy industry to find alternative feeds. However, when problems arose, unethical behavior on the part of several critical individuals resulted in the compounding of the problem to the detriment and distrust of a “wholesome” product and created public health fears and uncertainty among Oahu’s milk drinking consumers.

Key Words: Heptachlor epoxide contamination, Case study, Dairy

Animal Health Symposium: Laminitis in dairy cattle

108 Subclinical laminitis, or not? The aetiology and early pathogenesis of sole and white line lesions in dairy heifers, A. J. F. Webster* and J. F. Tarlton, University of Bristol, Langford, Bristol BS40 5DU, UK.

The existence of the condition known as acute laminitis in cattle, and associated with improper feeding, especially of starchy concentrates, is not in dispute. The chronic condition variously called aseptic pododermatosis or subclinical laminitis, featuring haemorrhagic lesions of the sole and white line (SWLL), has a more complex aetiology. The major risk factors are phenotype, physical environment, diet, season and stage of lactation. The main predisposing factors may be described mechanistically as direct strains and stresses within the foot, disorders of rumen function, and physiological changes inherently associated with parturition and the onset of lactation.

At this conference, Bill Stone will review the importance of disorders of rumen function. Christoph Lischer will present anatomical evidence to describe the changes within the internal structures of the foot that accompany and precede the superficial sole lesions of aseptic pododermatosis. Our paper will describe the pathogenesis of SWLL in dairy heifers around the time of parturition and the first 6 months of lactation, and review the extent to which these are determined by housing type, nutritional changes accompanying the onset of lactation, and/or the physiological consequences of parturition and lactation per se.

In our studies SWLL appeared in nearly all heifers within 4 weeks of the physiological consequences of parturition and lactation per se. We have measured biochemical and biomechanical properties of the connective tissue attaching the third phalanx (P3) to the laminated wall of the hoof. Biomechanical changes occurring in early lactation include an increase in laxity permitting increased movement of P3.

109 Environmental influences on laminitis and Sub-Acute Ruminal Acidosis (SARA) in dairy cows. N. B Cook* and K. Nordlund, University of Wisconsin-Madison, School of Veterinary Medicine.

Sub-acute ruminal acidosis (SARA), and hormonal changes occurring around parturition, have been suggested as trigger factors for bovine laminitis. This paper will review the environmental risk factors present on North American dairy herds, which may influence the onset of SARA, contribute to the changes in claw architecture observed around parturition, and significantly impact cow behavior and resultant claw lesions and lameness.

The prevalence of lameness measured on 30 well managed Wisconsin dairy herds using a system of locomotion scoring was 22.5%. The lameness treatment rate for a sub-sample of 10 herds averaged 69.1 foot

treatments per 100 cows per year, with a range from 15.1 to 132.7. Les-
sions typically associated with laminitis were responsible for 34% of foot

Existing data regarding the significance of risk factors such as over-
crowding, limited access to feed, heat stress, exposure to concrete, stall
usage and pen design will be reviewed. New data from two surveys of
lameness on well managed Wisconsin dairy farms will be presented,
demonstrating significant differences in lameness prevalence between dif-
ferent housing systems and different stall surfaces. Preliminary cow behavior and locomotion scoring data from current re-
search conducted on herds utilizing freestall housing, using 2 or 3 row
pen designs, and either sand or a rubber cushion filled mattress stall sur-
face will be presented, which will test the working hypothesis that the
environment in which we place the cow is the final determinant of the
prevalence of lameness and laminitis on the farm.

Key Words: Lameness, Laminitis, Environment

110 Nutritional approaches to minimize subacute ruminal acidosis in dairy cattle. W. C. Stone*, 1 Cornell Uni-
versity Ithaca, NY.

Subacute ruminal acidosis (SARA) is very costly to the United States
dairy industry. Reduced ruminal efficiency, liver and lung abscesses, and
laminitis are all thought to be related to SARA. Both the nutri-
tionist and the dairy’s management are responsible for the delivery and
consumption of a ration that is likely to be ruminally pH healthy. Nu-
tritionists should consider the expected amount of physically effective
NDF provided by ration ingredients, along with their expected ruminal
fermentabilities and resultant microbial acid production. Environmen-
tal conditions, such as heat stress, over-crowding, and uncomfortable
stalls, which may alter feed intake patterns and animal behavior should
also be considered in ration formulation. Additional physically effective
NDF, and/or a reduction in ruminal NSC availability, may well be war-
ranted during times of increased animal stress. Higher levels of intake
may also predispose the rumen to SARA, since buffer production may
not adequately compensate for additional acid production. The addi-
tion of dietary buffers, biotin, and organic zinc may also aid in reducing
acidosis and laminitis. Dairy managers and feeders are responsible for
delivering the formulated ration. Forage dry matters should be taken
biweekly, or more frequently if results vary by more than five percent of
the DM value. Ration variability can be further reduced by premixing
individual forages, or at least attempting to make each loader bucket of
feed a uniform mix obtained from the entire height of the silo. Dairies
should consider investing in electronic feed recording systems. These
systems record the precision of ration manufacture by the feeder, and
foster the development of healthy competition among feeders, resulting
in enhanced mixing accuracy. Ingredient sequencing and mixing time
should be standardized on a given dairy. Techniques to minimize sort-
ing, including frequent feed pushups, the addition of water or a low dry
matter byproduct, and appropriate forage processing, should be adopted
by managers.

Key Words: SARA, Laminitis, Dairy cattle

111 Biomechanical aspects of the pathogenesis of claw horn disruptions in dairy cattle. C. Lischer*1, K. Nuss2,
S. Nacamo3, S. Meyer2, and P. Ossent3.

Despite intensive study, knowledge of the precise aetiology and patho-
genesis of bovine laminitis is still incomplete. It is often hypothesized
that changes in the microcirculation of the corium (dermis) of the bovine
claw contribute significantly to the development of laminitis. The cause

of laminitis should be considered as a combination of predisposing fac-
tors leading to vascular reactivity and inhibition of normal horn synthe-
sis. Nutrition, disease, management and behaviour appear to be closely
involved in the pathogenesis of bovine laminitis. The only consistent fea-
ture in chronic laminitis is the sinking of the pedal bone that compresses
the corium in the sole and heel. However, the relationship between the
development of these lesions and the anatomical structures of the dis-
tal phalanx or the support heel cushion under the bone are unclear.
These structures were therefore examined in 19 cows with an ulcer at the
typical site. There was a direct relationship between displacement of the
third phalanx and ulceration of the sole or heel; the third phalanx had
dropped out of all the ulcerated claws and the subchondral bone under-
the bone were thinner than in the controls. The supportive cushions of
the ulcer group contained less fat tissue. There was no histological
evidence of damage to the epidermis or the corio-epidermal junction in the
ulcerated claws nor were the lamellae elongated. Similarly, there were
no morphological alterations in the connective tissue layer (sub-
mural dermis). The lack of support for the theory that the separation of

Field tests for ruminal acidosis have emerged to complement ration anal-
yses. Rumenocentesis is a direct measure that provides diagnostic in-
formation when adequate samples are collected. Visual evaluations of
washed screened feces provide useful information about rumen passage
rates. Production records, combined with clinical signs of SARA such
as diarrhea, irregular and reduced dry matter intake, laminitis, multi-
focal hepatic and pulmonary abscesses, and hemoptysis or epistaxis,
can provide useful diagnostic information.

Key Words: Laminitis, Ruminal, Acidosis

113 Epidemiological principles relating to the study of antimicrobial resistance and implications to animal agriculture

The emergence and spread of antimicrobial resistance among bacterial
populations has major health and economic consequences in both human
and animal populations. Of particular concern is the impact of animal
agricultural antimicrobial use on human health. Understanding the epi-
demiology and ecology of antimicrobial resistance and finding solutions
to counter this problem will be difficult, primarily due to the complexity
of the issue. The purpose of this presentation is to highlight key epidemi-
ological principles that are often overlooked and always problematic in
antimicrobial resistance studies. One key epidemiological principle that
must be considered is the background level of antimicrobial resistance.
For example, to state that a certain antimicrobial use causes changes in

Food Safety Symposium: Emergence of antimicrobial resistance and implications to animal agriculture

Randall Singer*, University of Illinois, Urbana, IL.

The emergence and spread of antimicrobial resistance among bacterial
populations has major health and economic consequences in both human
and animal populations. Of particular concern is the impact of animal
agricultural antimicrobial use on human health. Understanding the epi-

antimicrobial resistance, we must estimate the level of resistance in the absence of this use. Another difficulty in comprehending antimicrobial resistance relates to the diversity of ways in which antimicrobial resistance can be defined. Elevated MIC of the bacterial isolate, presence of a resistance gene in the bacterial isolate, or presence of a resistance gene in the total community DNA of the sample have all been used as resistance definitions and each necessitates a different study design and warrants different conclusions. Implicit in the methods of epidemiology is the ability to describe and predict distributions, trends and patterns; these methods can be problematic in relation to antimicrobial resistance. One difficulty is determining whether fluctuations are due to real changes in the prevalence of resistance mechanisms or simply due to changes in the prevalence of a single resistant bacterial clone. Assessing trends is also made more difficult by the presence of genetic linkages, thus enabling genes that are not under selection pressure to persist or even increase in prevalence. In conclusion, there are many factors that can dramatically affect antimicrobial resistance investigations and their inferences, based on these factors. Research into the effects that these factors have on perceived outcomes and the means by which these factors can be controlled is essential if we are to make accurate inferences about the dynamics of antimicrobial resistance.

Key Words: Antimicrobial resistance, Epidemiology, Molecular

114 Transfer of antibiotic resistance genes from farm animals to man - how likely, how dangerous? A. A. Salyers*, University of Illinois, Urbana, IL

A safety issue that has been central to the debate over agricultural use of antibiotics has been the possibility that antibiotic-resistant bacteria or antibiotic-resistance genes would move through the food supply and into the human intestine. A number of studies have shown that bacteria from the intestines of animals are unlikely to be able to colonize the human intestine and would persist only transiently in that site. Transfer of resistance genes, however, is more likely and thus more problematic. The concern is that resistance genes could move into human intestinal bacteria that persist in the human colon for years and are capable under some conditions of causing human disease. Most of the literature on the movement of resistance genes through the food supply and into the human intestine has focused on bacteria such as Escherichia coli or Enterococcus sp., which are minor components of the human colonic microbiota, accounting for <1% of bacteria in the colon. The more numerous species such as Bacteroides species or the Gram-positive anaerobes, which account for 25% and >70%, respectively, of colonic bacteria are the species most likely to encounter incoming bacteria and acquire genes from them. The colonic anaerobes are opportunistic human pathogens that can cause disease if they escape from the colon, e.g., during surgery or trauma to the abdominal area, and enter blood or tissue. A recent survey of Bacteroides isolates revealed that a surprising amount of horizontal gene transfer takes place among Bacteroides strains in the colon. The gene transfer elements most often involved in these resistance gene transfer events were conjugative transposons, a type of conjugal element that has not received much attention until recently. Another more recent survey has revealed two new conjugative transposons that may have entered Bacteroides species from Gram-positive bacteria. Thus, results obtained to date support the hypothesis that there are few, if any, limits on resistance gene transfer among colonic bacteria. Although these transfers appear to have occurred relatively recently, in most cases the genes are expressed in their new hosts. These studies have provided information about the movement of DNA into one group of colon bacteria, Bacteroides species. Nothing is known about gene transfer elements of the Gram-positive anaerobes, the other major group of colonic bacteria.

Key Words: Antimicrobial resistance, Food safety, Bacteria


Antimicrobials have been used for over fifty years in food animal production to maintain herd health and to increase productivity. But the resulting increase in antimicrobial resistance among enteric bacteria has created two principal concerns: 1) the emergence of drug-resistant pathogens leaves the producer with fewer tools to manage disease, and 2) a reservoir of antimicrobial-resistant bacteria has the potential for transmission to humans via the food chain. The most logical intervention strategy to combat the increase in antimicrobial resistance is to reduce the selection pressure. Prevention and control measures seek to promote prudent use of antimicrobial drugs through educational programs and to limit the availability of antimicrobials through regulatory actions. But such measures may not be sufficient to reduce the prevalence of resistance, as linkages of resistance genes allow the selection pressure of a single antibiotic to co-select for resistance to multiple agents. Thus, simultaneous reductions in the selection pressures of all co-selecting agents may be required to reverse the persistence of antimicrobial resistance in the animal production environment. This necessitates the development of alternative, non-antimicrobial methods to maintain animal health and productivity. Some of the products currently under development include the following: 1) clorox, to reduce certain populations of the family Enterobacteriaceae in the gut, including Escherichia coli O157:H7 and Salmonella; 2) immune modulators, to protect against infection through preventive activation of the innate immune system; and 3) competitive exclusion cultures, to prevent gut colonization with pathogens by first treating the gastrointestinal tract of neonates with healthy gut microflora. The application of alternative pathogen control measures will decrease the total usage of antimicrobial drugs and will likely have the greatest impact on reduction of antimicrobial resistance among enteric bacteria in food animals.

Key Words: Antimicrobial resistance, Food safety, Animal health

116 Antimicrobial resistance in commensal and pathogenic bacteria from swine and their implications for the swine industry. J. T. Gray* and P. J. Fedorka-Cray, USDA-ARS, Antimicrobial Resistance Research Unit, Athens, GA

Resistance to antimicrobials is an increasingly common problem in both veterinary and human medicine and its management is the subject of an important debate. Considering antimicrobial resistance on a broad scale, across an entire industry, can be a complex and daunting task. However, to consider all antimicrobials, all bacteria and all antimicrobial use as respective equals, creates a skewed view of the problem. Therefore a more systematic approach is warranted. The development of antimicrobial resistance in swine pathogens, which can have a direct impact on the health and well being of the animals as well as on production costs, is important to consider. Antimicrobial resistance in zoonotic pathogens is an important occurrence identified worldwide and the industry has a role in the control of these organisms. Additionally, development of antimicrobial resistance in commensal organisms may play an important role in the ecology of resistance overall, thus cannot be ignored. The antimicrobial resistance problem has a broad landscape, however it is important to understand why an organism has become resistant and consider the consequences of the particular antimicrobial resistance. Programs that are in place to answer these questions will be explored as well as a presentation of data resulting from some of these programs. Antimicrobial resistance has had some important impacts on animal production industries, including the swine industry. The swine industry has put forth important efforts to understand antimicrobial resistance in its production systems. With the wide reaching impact of this problem, it is important that efforts to understand and control antimicrobial resistance in all organisms and host species are refined and continued.

Key Words: Antimicrobial resistance, Swine, Bacteria

117  A global overview of sustainability in animal agriculture systems. C. de Haan*, World Bank.

The strongly increasing demand for animal products in developing countries presents exciting opportunities, but also serious challenges to the socio-economic and environmental sustainability of four main global animal agriculture production systems. This paper will argue that in those systems, the policy and institutional framework will largely define the sustainability of the technology being adopted. In arid range lands, institutional failures in the management of resource access, climatic variability and markets, are serious threats, but new forms of risk management and enhanced integration of animal agriculture with environmental services, offer interesting opportunities, as will be shown in the paper by examples from East Africa. In smallholder mixed farming, animal agriculture is a key contributor to sustainable nutrient and energy flows of about 100 million smallholdings, but labor productivity and land tenure are key conditions for long term sustainability of those systems, as will be demonstrated in the paper by the example of smallholder dairy in India. Animal agriculture is a serious threat to some of the world’s most valuable ecosystems in the humid savannas and tropical rainforests, but innovative systems for payment of environmental services can result in “win-win” situations, as demonstrated by the increase in income and contribution to bio-diversity conservation and global climate change on small ranches in Central America. Finally, probably the most serious threat to environmental sustainability is nutrient loading of land and water, caused by emerging large scale intensive production units, favored by skewed incentive systems and poorly enforced zoning regulations. Different policy instruments, being developed in East Asia, will be presented to “level the incentive playing field” between small holders and large scale farmers, and arrive a more sustainable spatial distribution of these units.

Key Words: Global livestock systems, Sustainability, Policies and technologies

118  Is rangeland agriculture sustainable?. R. K. Heitschmidt*, L. T. Vermeire, and E. E. Grings, USDA-ARS, Fort Keogh LARRL, Miles City MT.

Agriculture enterprise sustainability is most often assessed by examining long-term ecological sustainability, short- and long-term economic viability, and social acceptance. From an ecological perspective, rangeland agriculture (i.e., managed grazing) is deemed fully sustainable providing the rangeland resource is sustained. This is because grazing is a natural ecological process that has impacted the evolutionary history of all natural ecosystems. Because the magnitude of the evolutionary impacts of grazing by large herbivores varied greatly among ecosystems, sustainable levels of livestock use vary greatly, and, in turn, alter levels of ecological and economic risks. These risks can be diminished by the infusion of exogenous energies, primarily fossil fuels, into the system, but the long-term economics of this strategy are questionable. The sustainability of rangeland agriculture is further challenged by economically viable alternative uses of rangelands (e.g., expansion of suburbia, ranchettes, single use recreation, etc.) and economics of scale with low diversity, medium-sized ranching enterprises facing the greatest challenges. The challenges associated with social acceptance of rangeland agriculture also continue to increase as various factions of society vigorously oppose rangeland agriculture, particularly on Western U.S. public lands. Some view this position as largely driven by emotion, but in reality it is simply a reflection of differing value systems. Thus, we doubt this position will be abandoned in the near future and, as a result, a shift in the geographical span of rangeland agriculture across the U.S. may occur. However, this conclusion may become folly if the cost of fossil fuels increased to a level whereby substitute feeding of grains would become cost prohibitive, thereby encouraging a return to more “natural” animal production systems that rely largely on grazing of rangeland ecosystems.

Key Words: Ecology, Economics, Grazing


The contribution of animals to sustainable agriculture is discussed with emphasis on the animal in their natural interactions with soil and plants. The separation of animals in particular ruminants from this interaction in many countries is not sustainable and lead to poor resource management i.e., manure becomes a waste product rather than a resource and crop residues in arable areas with no animals become poorly utilised. Examples of animal production systems in positive interaction with plants and soil will be illustrated as well as animals contributing to the many diverse animal products which must be considered in the context. On a global scale the animal contribution to security is probably the largest product. Sustainable agriculture, Animal contribution


Livestock production is an important component of the rural sector in the developing countries. Its importance goes beyond the traditional concept of economic/financial gains. It is estimated that over one sixth of all international agricultural trade is accounted by trade of livestock and livestock products. The pressure to liberalize world trade is producing dramatic changes in the way livestock production takes place as industrialized countries continue to use excessive amounts of subsidies, less developed countries are forced to find alternatives for their animal production systems. The most notable changes will be brought about by the need to comply with international agreements, pressure to preserve and improve the environment, and pressure from consumers. As consequence the development of economically, socially and environmentally sustainable production systems will be based in exploiting local comparative advantages.

Key Words: Sustainable animal agriculture, Economics

121  Redirecting government policies to ensure agricultural sustainability. J. Ikerd*, University of Missouri.

American agriculture is in crisis. Without current farm subsidies, which are among the largest in the world, the financial situation today would be no better than during the farm financial crisis of the 1980s. The Farm Security and Rural Investment Act of 2002 does little more than formalize the annual “emergency bail out” process of the failed Freedom to Farm Act. The “lions share” of subsidies and benefits will continue to go to wealthy landowners and corporate agribusiness, not to family farmers. Current U.S. farm and agricultural trade policies are based on the faulty assumption that American farmers can compete in a global free market. In fact, U.S. farmers have lost their global competitive advantage. Land and labor costs are far lower in other major agricultural areas of the world and are likely to remain so. Agribusiness corporations are shifting their capital and production technology to those areas. Current farm policies, coupled with global free trade policies, could mean the end of American agriculture, thus threatening America’s food security. Thankfully, a different philosophy of farming is emerging in response to the growing economic, ecological, and social problems arising from the industrial agricultural paradigm. Thousands of farmers, calling themselves organic, holistic, practical, or just family farmers, are creating “the new American farm.” New livestock producers may promote their products as grass-fed, free-range, hormone and antibiotic free, or humanely raised. But these farmers are all pursuing approaches to agriculture that are more ecologically sound, economically viable, socially responsible, and thus, more sustainable. Free markets provide no incentives for farmers to take care of the land, to maintain a rural culture of stewardship, or to provide food security for all, in times of crisis or tranquility. Thus, farm programs should be redirected to encourage these “public benefits”, to reward farmers for their contribution to long run food security. Trade policies should be redirected to ensure the rights of all nations to protect their resources and their people from exploitation. American farm and trade policies must be fundamentally changed.

Key Words: Sustainable agriculture, Farm policy, World trade
122 Manipulation of rumen fermentation, microbial population and blood metabolites of Holstein neonatal calves using Yeast Culture as a microbial additive. Behnam Saremi* and Abasali Naserian, Ferdowsi University of Mashhad, Khorasan, Iran.

Yeastes have synergism effects on some strains of bacteria and antagonism activity against some yeast. These yeasts such as strains of Saccharomyces cerevisiae are widely used as additives in ruminant nutrition and could alter end products or substrates, which are used by other microorganisms and subsequently alter the feed digestibility. So the objective of this study was to determine if baker's yeast product could affect calves rumen fermentation, microbial population, blood metabolites and feed digestibility. Eighteen female Holstein neonatal calves were used in this study and randomly placed on treatments and fed colostrums at 10% of birth weight and milked until 45 days old. All calves were fed calf starter (NRCS)1 containing high quality alfalfa (15%) from seven days of age and weaned at 45 days. Calf starter was offered until 90 days old and the yeast was added at 0, 0.5 and 1% to the calf starter, which was, used daily. Rumen (pH, Ammoniated nitrogen (N-NH3), Microbial population (MP)) and blood samples (Total protein (TP), Glucose (GLS), Blood urinary nitrogen (BUN)) were taken from 0 to 90 days in regular periods. In day 90, feed and feces samples obtained to determine, nutrient digestibility. Data were analyzed using General Linear Model procedures of SAS v6.12 to evaluate differences among experimental groups. The design was completely randomized. Means were compared with Duncan test. Data showed that Yeast culture could not significantly alter protein, NDF, ADF and Ash digestibility, also have no effect on MP, pH, N-NH3 of the rumen. Indeed it couldn’t affect TP and GLS in blood plasma. But BUN, Organic matter and Dry matter digestibility were significantly different between treatments (P<0.05). Results of this experiment showed that addition of yeast culture to calves starter could improve DM and OM digestibility and also reduced BUN. We suggested that better weight gain and reduced DMI (Data not shown) could be result of better digestibility and also reduced BUN.

Key Words: Bakery's yeast, Rumen and blood manipulation, Neonatal calves


The objective of this study was to investigate the effects of fiber from cottonseed hulls (CSH) added to the starter and of live yeast (YST) or mannanoligosaccharide (MOS) added to milk, on growth, intake, rumen development, and health parameters in calves. Bull and heifer calves (n=116) were assigned randomly at birth to one of six treatments for 63 d. Calves were dehorned at 42 d. Bulls were castrated by 14 d. Calves were fed 3.8 L of colostrum once for the first 24 d and then 3.8 L of whole milk supplemented with either no additive, 4g YST, or 3g MOS once daily through weaning at 42 d. Treatments included: 1) a corn/soybean meal based starter, 20% CP, 6% ADF (CON), 2) a blend of 85% starter and 15% CSH, 18% CP, 15% ADF (CON + CSH), 3) starter and MOS (CON + MOS), 4) starter with CSH and MOS (CON + CSH + MOS), 5) starter and live yeast (CON + YST), and 6) starter with CSH and live yeast (CON + CSH + YST). Starter diets were offered from 1 d and daily amounts were increased by 0.09 kg when ors were 0 kg. Weekly measurements included body weight (BW), wither height, hip width, and dry matter intake from starters (DMI).

Daily measurements included rectal temperatures, fecal, and respiratory scores. Twelve steers (2 per treatment) were sacrificed for rumen tissue samples. Data were analyzed for the main effects of CSH, YST, and MOS. Average DMI was greater for calves consuming CSH diets (0.41 kg) than diets without CSH (0.34 kg). Calves fed CSH treatments (54.9 kg) had greater BW than those fed diets without CSH (53.3 kg) (P<0.05). Average daily gain was greater for calves fed CSH diets (0.58 kg/d) than diets without CSH (0.51 kg/d) (P<0.05). However, calves fed diets without CSH had a greater feed efficiency (0.67 kg feed/kg BW gain) than those fed CSH diets (0.73 kg feed/kg BW gain) (P<0.05).

There were no significant effects of YST or MOS on DMI, gain, or feed efficiency (P>0.05).

Key Words: Cottonseed hulls, Yeast


Two experiments were conducted to evaluate using CIDR® inserts for estrus synchronization in dairy heifers. Our objective in Experiment 1 was to compare day 6 versus day 7 prostaglandin F₂α (PGF₂α) injections used with CIDR® inserts (Exai-Breed™, CIDR™, Pharmacia & UpJohn Company, Kalamazoo, MI) placed intravaginally for seven days. A total of 55 heifers were assigned to two treatment groups. All even numbered heifers were assigned to treatment 1 and received PGF₂α, (Lutalyse™, Pharmacia & UpJohn Company, Kalamazoo, MI, 5 mg; i.m.) on day 6. Odd numbered heifers were assigned to treatment 2 and received PGF₂α, on day 7 at the time CIDR® inserts were removed. In Experiment 1, 98.2% of the 55 heifers exhibited signs of estrus and were bred. Pregnancy was determined by rectal palpation on day 35 and 53.7% of the 54 were pregnant. Fifteen out of 26 heifers (57.7%) injected with PGF₂α, on day 6 and 14 of 28 heifers (50.0%) injected on day 7 were pregnant (P>0.05). In Experiment 2, our objective was to evaluate using estradiol cypionate (ECP®) or gonadotropin releasing hormone (GnRH) in a timed artificial insemination (TAI) protocol using the CIDR® insert for 7 days followed by PGF₂α, on day 7. Sixty-nine heifers were randomly assigned to three different treatment groups. In treatment 1, 2, and 3, CIDR® inserts were inserted for 7 days followed by removal and injection of PGF₂α. Heifers in treatment 2 were injected with ECP® (Pharmacia & UpJohn Company, Kalamazoo, MI, 0.5 mg; i.m.) on day 8. Heifers in treatment 3 were injected with GnRH (Factred®). Fort Dodge Animal Health, Fort Dodge, Iowa, 2 mg; i.m.) on day 9. All heifers were bred by timed artificial insemination (TAI) on day 10. In Experiment 2, 50.7% of the 69 heifers were pregnant on day 39. A total of 56.5% of 23 heifers timed bred with only CIDR® inserts and PGF₂α, 45.5% of the 22 injected with ECP®, and 50.0% of the 24 injected with GnRH were pregnant (P>0.05). In both experiments, a total of 124 CIDR® inserts (100.0%) were retained.

Key Words: CIDR, Estrus synchronization, Dairy heifers

125 Implantation of a pellet containing TGF-β increases BrdU-labeling in mammary stromal cells of prepubertal heifers. S. Musters*, T. McFadden, T. Mulvey, K. Coughlan, R. Maple, and K. Plaut, University of Vermont, Burlington, VT USA.

In vitro and in vivo studies in mice have shown that transforming growth factor-β (TGF-β) inhibits mammary epithelial cell growth and stimulates proliferation of mammary stromal cells. However, studies have been conducted to measure the effects of exogenous TGF-β in vivo in cows. Our objective was to determine if TGF-β1 inhibits mammary epithelial and stromal cell proliferation during mamogenesis in 9 month old heifers (approximately 225 kg body weight). Slow release pellets, containing 5 μg TGF-β1 and 20 mg BSA, were implanted in the parechnyma of the right rear quarter of 4 heifers. A control pellet containing 20 mg of BSA was implanted in the left rear quarter. Bromodeoxyuridine (BrdU), used to measure DNA synthesis, was administered intravenously 4.5, 12 and 22 hours after implantation at a concentration of 2.25 mg/kg body weight. The heifers were slaughtered 24 hours after implantation and the mammary glands were recovered. Tissue samples were taken from an area within 0.6 cm around the pellet, fixed for 4 hours, embedded in paraffin, sectioned and stained for immunohistochemistry with a BrdU monoclonal antibody. Total number of epithelial cells, stromal cells, BrdU-labeled epithelial cells and BrdU-labeled stromal cells was quantified. An average of 3000 epithelial cells and 3000 stromal cells was counted per TGF-β treated and control quarters. Exogenous TGF-β1 increased the percentage of stromal cells in S-phase from 3.3% to 5.8%, approaching significance (P<0.01), supporting previous data that TGF-β1 increases DNA synthesis of stromal cells. We observed no significant difference in the percentage of BrdU-labeled epithelial cells for the TGF-β treated tissues in comparison to the control tissues. However the numbers of cells in S-phase were...
very low. We conclude that exogenous TGF-β1 increases proliferation of mammary stromal cells in prepubertal heifers.

**Key Words:**  TGF-β, Mammary gland, Proliferation

### 126 Behaviors of transition dairy cows and heifers.


Management strategies are critical for a successful transition period and may differ for cows and first calf heifers. The objective of this study was to compare behaviors between transition cows and heifers, emphasizing feeding behaviors and the relationship of these behaviors with DMI and milk yield. Five multiparous Holstein cows (C) and five Holstein heifers approaching first calving (H), were housed in tiestalls from 28d prior to expected calving and provided feed ad libitum. The C and H were videotaped 24 h/d, using time-lapse video recording, beginning 15d prior to expected calving until 14d after calving. On d-6, d-2, d2 and d8 relative to actual calving the durations of the following behaviors were measured: standing (S), lying (L), resting (Re), feeding (F), ruminating (R) and ruminating while lying (RL). Daily DMI and postpartum milk yield were recorded. The model selected for analyses included effects of parity group (C and H), day and interactions. There were no significant differences between C and H in L or F or RL. For both parity groups, L (P<0.01) differed across days and there were day by parity group interactions for F (P<0.05) and RL (P<0.01). For all animals, L decreased through d2 and then increased on d8. For C, F decreased through d2 and then increased on d8 whereas for H, F increased until d2 decreased at d2 and then increased on d8. Through d2, RL did not decrease until d2 and then increased on d8. As expected, C had greater milk yield (P<0.05) and DMI (P<0.01) than H. Milk yield on d8 was significantly affected by Re on d-6 (P<0.01). The DMI on d8 was significantly affected by F on d2 (P<0.01). Behaviors, DMI and milk yield differed for transition C and H, indicating that managing them differently during the transition period may be beneficial.

**Key Words:**  Dairy cattle, Transition, Behavior

### 127 Relationship of dystocia to dairy cow health and productivity.


The objectives of this study were to evaluate dystocia rates on Colorado dairies and the subsequent health and production effects on cows. A total of 6,528 calvings were recorded on 3 well-managed Front Range Colorado dairies from October 2001 to October 2002. Each cow was assigned a dystocia score (standard 1 to 5) based on calving ease. Cows were followed for health events, milk production and reproduction parameters that occurred subsequent to the calving event. Data collection will continue until all cows have completed the current lactation or leave the herd for any reason. Odds ratios were calculated for cow health events for animals with no assistance at calving (score 1) compared to animals with any assistance at calving (scores 2 to 5). Productivity parameters were evaluated using a logistic regression analysis. For the regression analysis, animal with dystocia scores of 4 and 5 were combined.

#### Productivity parameters were evaluated using a logistic regression analysis.

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<th>Item</th>
<th>CON</th>
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<th>HF</th>
<th>CAO</th>
<th>OM</th>
<th>SEM</th>
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<td>DMI, kg/d</td>
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<td>27.8ab</td>
<td>28.4ab</td>
<td>26.4b</td>
<td>23.8bc</td>
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<td>Milk yield, kg/d</td>
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<td>45.2ab</td>
<td>45.3ab</td>
<td>43.1bc</td>
<td>42.3bc</td>
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<td>Milk fat, %</td>
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<td>3.11bc</td>
<td>3.51bc</td>
<td>3.01bc</td>
<td>2.85bc</td>
<td>0.119</td>
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<tr>
<td>Milk Protein, %</td>
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<td>3.11bc</td>
<td>3.05bc</td>
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<td>g/100g milk fat</td>
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<td>61.3b</td>
<td>67.7c</td>
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<td>g/100g milk fat</td>
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<td>25.8ab</td>
<td>22.3b</td>
<td>25.3a</td>
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<td>g/100g milk fat</td>
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<td>0.84bc</td>
<td>0.41b</td>
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<td>0.65bc</td>
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</tr>
</tbody>
</table>

**Key Words:**  Dystocia, Cow health, Cow productivity

### 128 Effects of grazing fresh forages on milk fat CLA.

S. J. Freeman*, J. A. Bertrand1, T. C. Jenkins, B. W. Pinkerton2, and D. L. Falmquast1, 1 Clemson University, Clemson SC / USA, 2 Ohio State University, Columbus OH / USA.

The objective was to determine effects of grazing different forages on concentrations of cis-9, trans-11 conjugated linoleic acid (CLA) in milk fat of Jersey and Holstein cows. Two treatment groups were utilized for each of three studies: control (C) or pasture (P). Cows on C were fed a total mixed ration (TMR) and P cows grazed pasture and supplemental feed, which was limited to 60% of ad libitum dry matter intake (DMI). In Experiment 1, Holstein and Jersey cows on P grazed ryegrass pasture. Milk samples from each cow were taken at the end of two three-week periods for four consecutive milkings. In Experiment 2, Holstein and Jersey cows on P grazed dwarf hybrid pearl millet pasture. Weekly milk samples were taken at four consecutive milkings for the six-week study. In Experiment 3, Jersey cows on P grazed ryegrass pasture. Weekly milk samples were taken at four consecutive milkings during two five-week periods. Linolenic acid (C18:3) content was higher in P diets compared to C (31% and 4%, respectively). Saturated fatty acid content (C16:0 and C18:0) was higher in C diets than P (51% and 30%, respectively). For all three forages, C18:3 was the fatty acid in highest concentration, ranging from 48% of total fatty acids (TFA) in dwarf hybrid pearl millet, 49% in ryegrass, to 57% in rye. Palmitic (C16:0) and linoleic (C18:2) acids concentrations were each approximately 11% of TFA. DMI from pasture ranged from 54% to 77%. Milk fat CLA as a percentage of TFA were significantly higher for P cows in all experiments. In Experiment 1, milk fat CLA for cows on P was 0.47% of TFA for Holsteins and 0.42% for Jerseys. In Experiment 2, milk fat CLA for cows on P was 0.57% of TFA for Holsteins and 0.45% for Jerseys. In Experiment 3, milk fat CLA for cows on P was 0.44% of TFA. Substitution of fresh forage for a portion of TMR in dairy cows significantly increases CLA concentrations to twice that of the control, as well as differences between Jersey and Holstein breeds. Cows responded similarly to all three forages.

**Key Words:**  Pasture, CLA, Dairy cows

### 129 Lactation performance and milk fatty acid composition of Holstein cows fed various forms of oleic acid.


The objective of this study was to evaluate the effects of feeding various forms of oleic acid on dry matter intake, milk yield, and milk fatty acid (FA) content. Twenty-five Holstein cows were paired according to milk yield (50 kg/d), and DIM (85d), and used in a 5 x 5 Latin square design. A control group (CON) was fed a total mixed ration (TMR) with no added fat (17.5% CP, 39% NSC, 33% NDF, 2.9% fat). Four forms of oleic acid were mixed into a TMR to target 400 grams of oleic acid intake/cow/d (18.2% CP, 36% NSC, 32.5% NDF, 5.3% Fat). Fat treatments included canola oil (CO), hydrogenated fat (HF), calcium salts of oleic acid (CAO), and oleamide (OM). Dry matter intake was lower for OM than all other treatments, and CAO was lower than for CON, CO and HF. Milk yield was lowest for OM compared to all other treatments. Milk fat percentage was reduced for CO and CAO compared to CON and HF and was depressed in cows fed oleamide. Saturated fatty acids in milk were reduced by 22% and 13% for OM and CAO, compared to CON. Milk C18:1 was increased 31% and 36% for OM and CAO respectively compared to CON. Milk CLA was increased in CO and CAO compared to CON with an intermediate increase with OM. Feeding CAO and OM decreased saturated fatty acids and increased CLA in milk, however DMI and milk yield were reduced.
130 Effect of cereal grain characteristics on production performance of lactating dairy cattle. J. A. Meier1, P. Yu2, J. J. McKeown1, and D. A. Christensen1, 2University of Saskatchewan.

The objective of the study was to evaluate the feeding of two different cultivars of barley (cv. Harrington and Valier) and oat (cv. Derby and Assiniboia) grain on feed intake, milk yield and milk constituents. As secondary objective was to investigate particle size and starch characteristics of the Harrington and Valier barley. Eight lactating cows (86 17 DIM) were assigned one of four treatments using a double 4x4 Latin square design. Dietary treatments consisted of Valier Barley (VB), Harrington Barley (HB), Derby Oats (DO) or Assiniboia Oats (AO). The treatment grains constituted 50% of the cereal grain in the concentrate of the TMR. Data was analyzed for significance (P<0.05) using the Mixed Procedure of SAS. Milk yield for the DO and AO were significantly higher than VB. Milk fat was significantly decreased in the Assiniboia treatment compared to all other treatments. In general, it appears that oats may be a suitable replacement for barley grain in the concentrate of dairy diets. Bushel weights of the HB and VB were similar (56 lb/bu and 57 lb/bu respectively) and of the kernel size did not appear different. Particle size analysis was conducted on dry rolled (0.533 mm gap) on HB and VB using the ASAE Ro-tap method (Screen gap sizes of 4.00, 2.362, 1.70, 1.40, 1.19, and 0.84 mm). Particle size data was analyzed using as a completely randomized design using the GLM of SAS. Significant differences (P<0.05) were noted between treatments for all screenings. VB had the highest percentage (77%) of particles on the 2.362 mm screen, indicating that VB is much more resistance to processing than HB. This difference in particle size may lead to decreased availability for digestion and nutrient assimilation.

Key Words: Barley, Grain, Dairy

131 Tight junction (TJ) protein expression during engorgement of rat and bovine mammary glands. C. V. Cooper*, V. C. Farrow*, 1V. C. Farrow*, 2V. C. Farrow*, and S. R. Davis2, 3Dexcel Ltd., Hamilton, New Zealand, 4AgResearch, Hamilton, New Zealand, 5Massey University, Palmerston North, New Zealand.

The pattern of expression of TJ proteins was investigated during engorgement of rat and bovine mammary glands. An increase in mammary TJ permeability was previously shown to occur within 24 h of milk accumulation. The expression of occludin and claudin-1, the major integral transmembrane components of TJ, was determined in two experiments. In experiment 1, Sprague-Dawley rats at peak lactation (d 16) had three abdominal inguinal glands on one side sealed to induce mammary engorgement, the remaining glands were not sealed and acted as suckled controls. Mammary tissue was collected post-mortem at 0, 6, 12, 18, 24 and 36 h after teat sealing (n = 6 rats per time point). In experiment 2, alveolar mammary tissue was collected post-mortem from 42 mid-lactation Holstein Friesian dairy cows at 0, 6, 12, 18, 24, 36 and 72 h following the last milking (n = 6 cows per time point). Immunohistochemistry showed a characteristic multiple banding pattern for occludin between 60 and 80 kDa. The higher molecular weight (MW) bands were highly phosphorylated and resistant to NP-40 detergent extraction, suggesting they predominantly derive from the tight junction complex. Occludin expression declined during mammary engorgement in rat and bovine glands (P<0.05). Claudin-1 migrated in SDS-PAGE as two bands at 22 and 28 kDa. In rats, expression of the 28 kDa band declined within 12 h of mammary engorgement (P<0.05), while that of the 22 kDa band, along with lower MW degradation products, increased (P<0.05). Both bands were expressed at low levels by 36 h of mammary engorgement. In contrast, claudin-1 protein expression did not alter with engorgement in bovine mammary glands (P>0.05). Occludin and claudin-1 expression showed large individual animal to animal variation. Furthermore, the response to mammary engorgement was locally regulated as no changes were detected in suckled control rat mammary glands. Between species variation in the pattern of TJ protein expression suggest that the increase in TJ permeability during milk accumulation is regulated differently between rats and dairy cows.

Key Words: Tight junction, Lactation, Mammary engorgement


The purpose of this study was to examine effects of glucose concentration, epidermal growth factor (EGF), and hormones (FSH, LH, and estradiol 17 β) during bovine oocyte maturation on in vitro production of blastocysts. Oocytes from slaughterhouse ovaries were divided among the 12 factorial combinations of 3 glucose concentrations (0.5, 2.0, and 5.5 mM), presence or absence of 50 ng/ml of EGF, and presence or absence of LH, FSH, and E2 in CDM-1, a chemically defined medium similar to SOF. Oocytes were matured at 38.5°C in 5% CO2 in air for 23 h. After maturation, oocytes were fertilized at 1 X 106 sperm/ml in 6 replicates in F-CDM (0.5 mM glucose), and then cultured 2 days in CDM-1 (0.5 mM glucose) and 4 days in CDM-2 (2 mM glucose). Glucose concentration in maturation medium at 0.5, 2.0, and 5.5 mM had no effect on blastocyst rates per oocyte, 33%, 32%, and 31% respectively. However, 0.5 mM glucose resulted in a cleavage rate of 87%, higher than 81% seen for both 2 and 5.5 mM glucose (P=0.004). EGF and hormones independently expanded cumulus expansion, but there was no synergism between them, and they had no effect on cleavage or blastocyst rates. Both cleavage (P=0.0003) and blastocyst rates (P=0.02) were affected by which of 3 bulls was used for fertilization.

Key Words: Bovine, Embryo, Oocyte


The objective of this study is to investigate the effects of fiber in the form of cottonseed hulls (CSH) added to the starter and of live yeast (YST) or mannanoligosaccharide (MOS) added to milk, on growth, intake, rumen development, and health parameters in neonatal Jersey calves. Newborn Jersey bull and heifer calves (n=46) were assigned randomly at birth to one of six treatments and continued through 63 d. Bulls were elastrated at 14 d. Calves were fed 3.8 L of colostrum for the first 2 d once daily and then 2.8 L of whole milk supplemented with either no additive, 4g YST, or 3g MOS once daily through weaning at 42 d. Treatments included: 1) a corn/soybean meal based starter, 20% CP, 6% ADF (CON), 2) a blend of 85% starter and 15% CSH, 18% CP, 13% ADF (CON+C), 3) starter and MOS (CON + MOS), 4) starter with CSH and MOS (CON + CSH + MOS), 5) starter and live yeast (CON + YST), and 6) starter with CSH and live yeast (CON + CSH + YST). Starter diets were offered from 1 d and daily amounts were increased by 0.09 kg when ords were 0 kg. Weekly measurements included body weight (BW), wither height (WH), hip width (HW), and dry matter intake from starters (DMI). Daily measurements included rectal temperatures, fecal, and respiratory scores. Calves fed either YST or MOS had greater BW (37 kg) than calves fed no supplement (35 kg) (P < 0.05). There were no significant effects of CSH, YST, or MOS on DMI, BW, or HW (P > 0.05).

Key Words: Jersey calves, Cottonseed hulls, Yeast

134 Leptin, body condition, and intake regulation of lactating dairy cows in the transition phase. D. Kumar1, M. A. Froetschel1, T. D. Pringle1, D. Keisler2, and J. K. Bernard1, 1The University of Georgia, 2The University of Missouri.

Leptin may be responsible for decreased intake and milk production of lactating dairy cows fed fat during transition. Experimentation was conducted to correlate leptin with body fat and stage of lactation in dairy cattle, and investigate the role of leptin in intake regulation during transition. In the first experiment, jugular blood samples were obtained from, and body fat measured with ultrasonography, in 16 lactating dairy cows that varied in body condition score (n=8 < 2.5 BCS and n=8 > 3.5 BCS), and days in milk (range d 88 to d 725). Backfat (r²=0.64,
P < 0.01), rumdfat (r²=0.60, P < 0.01), and days in milk (r²= 0.48, P < 0.01) were positively related to serum leptin. In the second experiment, twelve Holstein cows, fed anionic salts 2 weeks before calving were given three levels of supplemental fat (0, 3, and 6% added fat using MEGALAC-R®) post-calving. Dry matter intake and milk production were measured for 4 weeks post-calving. Leptin was analysed on jugular blood samples taken two days before calving, two days after calving and at weekly intervals 1h before and 2h after feeding. Serum leptin increased (P < 0.01), 7.2% (4.54 vs. 4.87 0.07 ng/ml) in cows post-calving as compared to pre-calving. Leptin was negatively related to level of dietary fat(linear and quadratic, P < 0.01), decreasing 16.2 - 28.4% (4.75, 3.33, and 3.98 0.41 ng/ml). In the first four weeks after calving milk production decreased (linear, P < 0.01) 8.6% due to fat in the diet. Dry matter intake increased (quadratic, P < 0.05) from 1.5 to 7.0% and leptin tended to follow a similar trend (P < 0.14). DMI increased (linear, P < 0.01) from 18.1 to 23.6 kg/d and milk production increased (linear, P < 0.01) from 27.3 to 43.1 kg/d during the first four weeks of lactation. Serum leptin did not change during this period. Although serum leptin is correlated with body condition of dairy cattle, it remains to be identified as a major determinant of intake regulation in transition cows fed dietary fat.

Key Words: Leptin, Intake, Transition cow

135 The ability of amide versus calcium salts of soybean oil to increase unsaturated fatty acid concentration in omalass and continuous culture samples. F. P. Lundy III* T. C. Jenkins, W. C. Bridges Jr, and J. A. Bertrand, Clemson University, Clemson, SC, 29634.

Two studies were conducted to determine the ability of two forms of soybean oil to resist biohydrogenation by mixed ruminal microorganisms in vivo and in continuous culture. Four TMR consisting of forage and concentrate (1:1 DM basis) contained either: 1) soybean oil (SBO) added at 2.45% of DM, 2) amide of soybean oil (AMID) added at 2.75% of DM, 3) calcium salt of soybean oil (CAS) added at 2.75% of DM, and 4) a mixture (20:80, w/w) of the amide and calcium salts of soybean oil (MIX) added at 2.75% of DM. The four diets were fed ad-libitum to four multiparous lactating (103 DIM, SD 38) Holstein cows (fitted with ruminal cannules) in expt 1, and were fed (30 g/d) in expt 2 to four dual flow continuous culture systems in a 4X4 Latin square design. The ability of the fat supplements to resist biohydrogenation was expressed as C18:1 or C18:2 concentrations (mg/g DM) in omalass (expt 1) or fermenter outflow samples (expt 2) divided by their concentrations (mg/g DM) in the feed. For C18:2, the omalass/feed concentrations in expt 1 were 0.078, 0.098, 0.108, and 0.125 and in expt 2 were 0.187, 0.261, 0.283, and 0.337 for the SBO, MIX, CAS, and AMD diets, respectively. Similar results for C18:1 were 0.296, 0.32, 0.321 and 0.67 in expt 1 and 0.458, 0.52, 0.507, and 0.592 in expt 2. Concentrations of C18:1 and C18:2 were higher for the CAS and AMD diets when compared to SBO. In expt 2, the AMD diet had higher (P=0.016) concentrations of C18:2 in overflow contents than CAS (8.99 vs 6.62). The concentration of C18:1 was higher (P=0.018) in the omasum in expt 1 and higher in the fermenter outflow (P=0.016) in expt 2 for AMD vs CAS. These experiments demonstrate greater ability of fatty amides and calcium salts to increase the delivery and concentration of unsaturated fatty acids postruminally compared to triacylglycerols. Fatty amides generally provided greater protection of unsaturated fatty acids from biohydrogenation compared to calcium salts, which was more prevalent for oleic acid than for linoleic acid.

Key Words: Biohydrogenation, Amide, Calcium Salt


Our objective was to compare the efficiency and accuracy of three estrus detection systems on a large commercial dairy (1000 lactating cows) during the summer of 2002. At ~45 DIM, 282 cows were fitted with a HeatWatch (HW) device (HeatWatch®; DDa Inc., Boulder, CO), an activity (A) sensor (ALPRO34; DeLaval Inc., Kansas City, MO), and observed visually (V) twice daily. Indicators of estrus included three standing events within 4 h for HW an activity level of 3 for A, and observed standing to be mounted for V. Onset of estrus was the first standing event both for HW and V. For A, onset of estrus was the hour after 3 consecutive h of twice baseline activity for that cow during the previous 10-d period. Pregnancy status was determined by uterine palpation 35 to 49 d following AI. The effects of DIM, parity, physical activity, standing events, months, AI technician, and interval from onset of estrus and AI on % pregnant were determined using linear contrast and logistic regression. Efficiencies for detection of estrus, determined by comparing detected periods of estrus with a theoretical total of 694, were 49.9% (V), 34.4% (A) and 41.6% (HW). Efficiency for the combination of all three methods was 76.4%. Percentage of inseminations resulting in a pregnancy (±2E) by method of detection was 20.6±4.9 for HW, 20±5.6 for A, 9.8±2.6 for V, 16±5.6 for V & A, 30.3±5.3 for V & HW, and 23±4.5 for A & HW. For estrus periods detected by HW, the probability of pregnancy increased as DIM and standing events increased (P<0.05). Estrus periods having 4 to 9 standing events recorded by HW had a lower (P<0.05) pregnancy outcome (15.8±2.8) compared with cows with estrus periods consisting of >10 standing events (34.1±5.0%). For estrus periods detected by A, the interval from the onset of estrus to AI had a direct effect on the probability of pregnancy (P<0.05); the highest % pregnant occurred between 13 and 18 hours after the onset of estrus (38.5±7.9). The combination of all three systems resulted in ~75% efficiency and the highest % pregnant occurred with the combination of V & HW, which confirms that multiple systems enhance both the efficiency and accuracy of detection.

Key Words: Detection of estrus, Estrous detection efficiency, Heat stress

137 Evaluation of perennial ryegrass straw as a forage source for ruminants. M. J. Fisher*, D. W. Bohner1, C. J. Ackerman3, C. S. Schauer1, T. DeCurto1, A. M. Craig2, D. L. Harmon2, and N. F. Schrick4, 1Eastern Oregon Agriculture Research Center, Burns; 2Oregon State University, Corvallis; 3University of Kentucky, Lexington; 4The University of Tennessee, Knoxville.

We conducted a 25-d metabolism trial to evaluate digestion and physiological variables in steers offered perennial ryegrass straw containing increasing levels of lolitrem B. Sixteen ruminally cannulated Angus × Hereford steers (231 ± 2 kg BW) were blocked by weight and assigned randomly to one of four treatments (TIR). Steers were provided perennial ryegrass straw at 120% of the previous 5-d average intake at 0730. Prior to straw feeding (0700), soybean meal was provided to meet the estimated requirement for degradable intake protein (0.1% BW; CP basis). Mixtures of a low (L) and high (H) lolitrem B straw (100 and 1550 ppb, respectively) were used to formulate TIR diets. The TIR were Low (100 L), Low Mix (67 L:33 H), High Mix (33 L:67 H), and High (100 H). Intake and digestibility of DM and OM, along with ruminal pH and NH₃, were not affected by increasing lolitrem B concentration (P > 0.10). Ruminal indigestible ADF (IADF) fill increased linearly (P = 0.02) and IADF passage rate (%/hr) decreased linearly (P = 0.04) as lolitrem B level increased. Alkaloid concentration did not influence serum prolactin or heart rate (P > 0.31); however, a quadratic effect (P = 0.03) was noted for respiration rate, with the greatest values occurring with the Low Mix and High Mix diets. These data suggest that feeding perennial ryegrass straw containing up to 1550 ppb lolitrem B does not adversely affect nutrient digestion or physiological response variables.

Key Words: Lolitrem B, Perennial ryegrass, Straw

138 Risk factors associated with culling females in a composite beef herd. P. Rogers*, C. Gaskins1, K. Johnson2, and M. MacNeil2, 1Washington State University, 2USDA-ARS LARL.

Our goal was to identify factors affecting risk of a beef female being culled. Data were from the CGC composite herd (Red Angus, Charolais, Tarentaise) at Miles City, MT in which heifers were exposed as yearlings. Binary logistic regression was used to assess factors affecting probability of calving as a two-yr-old (PC(2)), including heifer (n =
1,756) phenotypes and breeding values (BV). March-born heifers were more likely to calve at two than heifers born thereafter (P < 0.01). As birth weight of the heifer increased P(C2) tended to decrease (P < 0.10). Conversely, P(C2) tended to increase as BV for cow weight increased (P < 0.10). Neither phenotype nor direct and maternal BV for preweaning gain affected P(C2) (P > 0.10). Relationships of age at culling with first calving measurements (n = 1,254) and genetic profiles (n = 1,382) of females were assessed in separate analyses using Cox regression. Independent variables were coded into evenly spaced categories. Records from pregnant cows that were sold and from cows in the herd in 2001 were treated as censored (33%). Age at first calving and birth weight and 200-d preweaning gain of her first calf did not influence age at culling (P > 0.10), but heifers experiencing dystocia were at 36% greater risk than cohorts that did not (P < 0.01). As BV for cow weight increased, risk of being culled decreased (P < 0.01). Cows with intermediate direct BV for preweaning gain were at lower risk of being culled than those with extreme BV (P < 0.01). On average, increasing maternal BV for preweaning gain increased risk of being culled (P < 0.01). Date of birth was more important than phenotype or genetic profile in determining whether or not a heifer calves at two years of age. Genetic profile of a female is a better indicator of age at culling than traits measured on her first calf.

**Key Words:** Longevity, Survival analysis, Beef cattle


Two LH-RH fusion proteins, thiorerodixin (TL) and ovalbumin (OL), each containing seven LH-RH inserts were tested. The objective was to evaluate immune and biological response from alternating the two fusion proteins in an immunization schedule. One hundred and ten heifers were equally divided into 11 groups. Control groups were spayed and intact non-treated animals. Heifers in the other nine groups were immunized on wk 0, 4 and 8. Treatments were immunizations of the same protein throughout or alternating the proteins in different sequence. Blood was collected weekly for 22 wk and serum assayed for progesterone and LH-RH antibody binding. At slaughter, reproductive tracts were removed from each heifer and weighed. Heifers withprogesterone ≥ 1 ng/ml were considered to have a functional corpus luteum and thus have estrous cycle activity. All LH-RH immunized groups of heifers had lower (P ≤ 0.05) numbers of cycling animals after wk 6 when compared to the intact non-treated control group. There was no difference (P ≥ 0.05) in number of heifers cycling between the immunized groups and the spayed heifers during wk 9 to 22. Luteinizing hormone releasing hormone antibody binding did not differ among immunized groups during wk 1 to 9 (P ≥ 0.05). Starting wk 10 and continuing through the conclusion of the study, there was an overall difference among treatment groups for LH-RH antibody binding (P ≤ 0.05). Uterine weights differed between treatments (P ≤ 0.05) with intact control animals having heavier uteri than all other groups (P ≤ 0.05). Uterine weights were significantly negatively correlated with LH-RH antibody binding (r = -0.51). In summary, these LH-RH fusion proteins were as effective as surgical spaying in suppression of estrous cycle activity, however, alternating the two proteins in an immunization schedule did not enhance the immunological or biological effectiveness of the vaccine.

**Key Words:** Immunization, LH-RH, Heifers

140 Effects of flunixin meglumine on embryonic loss in stressed beef cows. M. L. Merrill*, R. P. Anisotegui1, N. E. Wamsley2, P. D. Burns2, and T. G. Geary3, 1 Montana State University, Bozeman, MT, 2 Colorado State University, Fort Collins, CO, 3 USDA-ARS, Miles City, MT.

The objective of this study was to determine if flunixin meglumine reduces early embryonic death in cows subjected to stress. Approximately 14 d following synchronization of estrus and artificial insemination (AI), 97 cows were assigned to one of three treatments by AI sire, AI date, and AI technician. Treatments were control (CON), induced stress (S), and induced stress with flunixin meglumine (1.1mg/kg, i.m; SFM). Rectal temperatures were recorded and blood samples collected (caudal venipuncture) for measurement of cortisol, and PGF metabolites (PGFM) concentrations before and after induced stress. Control cows remained at the ranch with their calves and had access to water but not feed, while S and SFM cows were loaded on semi-trucks and transported for 4 h (mean ambient temperature 24°C). Cows were not exposed to clean-up bulls until after treatment. Transectral ultrasonography was used to determine AI pregnancy status 55 to 57 d post AI. Pregnancy rates to AI treated was (P = 0.17) to be higher among SFM cows (84%) than S cows (69%) while AI pregnancy rate of CON cows was intermediate (76%). Cortisol concentrations before and after treatment were 21 and 24 ng/ml, 23 and 17 ng/ml, and 18 and 8 ng/ml, for CON, S, and SFM cows, respectively. Change in cortisol concentration was different (P < 0.06) between CON and S or SFM, but not S versus SFM (P > 0.10). No changes (P > 0.10) in PGFM were detected among the three groups between the sampling periods. Body temperature decreased between the sampling periods for all treatments, but the change in temperature was greater (P < 0.03) for S and SFM cows compared CON. Across treatments, change in cortisol concentration between sampling periods did not influence (P > 0.10) AI pregnancy status, however, PGFM increased (P<0.09) 24.72 pg/ml or decreased 5.19 pg/ml in cows diagnosed open or AI pregnant. In summary, flunixin meglumine appears to decrease the stress-induced embryonic loss, but the role of PGF and cortisol remain unclear.

**Key Words:** Pregnancy, Stress, Cortisol

141 The effects of cattle gender on feedlot performance, carcass characteristics and muscle tenderness. W. T. Choat1, J. A. Paterson1, B. M. Rainey1, M. C. King2, R. J. Lipsey3, K. E. Beld3, and G. C. Smith1, 1 Montana State University, 2 American Simmental Association, 3 Colorado State University.

Effects of gender on rate of gain, carcass traits, shear force and trained sensory panel ratings of beef palatability were evaluated using 202 progeny of Angus or Simmental sires. Steers (n=99), heifers (n=57) and intravaginally spayed heifers (n=46) were commercially fed (161d). No implants were administered and heifers were not fed melengestrol acetate to suppress estrus. Steers had faster (P < 0.01) daily gains than spayed and intact heifers. The heavier (P < 0.01) final live weights of steers resulted in 25 kg heavier (P < 0.01) hot carcass weights at similar (P = 0.86) levels of fat thickness compared with heifers. Spayed heifers had a 5.7% smaller longissimus muscle area (P < 0.05) compared with steers and intact heifers, which were similar. Calculated yield grades and USDA quality grades were similar (P = 0.21) among treatments, although marbling scores were lower (P < 0.01) for steers compared to intact and spayed heifers. In order to directly examine gender effects on tenderness, shear force and sensory panel data were analyzed using an ANOVA model with marbling score as a covariate. Shear force values after 7 and 14 d of aging were lower (P < 0.01) for steers compared to intact and spayed heifers, which were not different from each other. Mean shear force values at 7 and 14 d of aging were 3.3 and 3.3 (steers) 3.8 and 3.6 (intact heifers) and 3.6 and 3.5 (spayed heifers), respectively, and did not differ (P = 0.11) among genders after 21 d of aging. A trained sensory panel evaluated steaks (aged 14 d postmortem) from 193 of the cattle for juiciness, muscle fiber tenderness, connective tissue amount and overall tenderness using an 8-point structured rating scale. Steaks from steers received more favorable ratings (P < 0.01) for muscle fiber tenderness, connective tissue amount and overall tenderness, compared with spayed and intact heifers. Under the genetic and environmental conditions of this experiment, steers had faster daily gains and produced heavier carcasses at similar levels of subcutaneous fat, compared to heifers. Intact and spayed heifers produced strip loin steaks that had higher average shear force values (i.e., were less tender) and lower average ratings for sensory panel overall tenderness than those for steaks from steers.

**Key Words:** Cattle, Gender, Tenderness

142 Influence of protein supplementation frequency on cows consuming low-quality forage: performance, grazing time, distance traveled, distance from water, and distribution. C. S. Schaier1, D. W. Bohner1, and D. C. Ganskopp2, 1 Eastern Oregon Agriculture Research Center, Oregon State University, Burns, OR, 2 Eastern Oregon Agriculture Research Center, ARS-USDA, Burns, OR.

Our objective was to determine the influence of CP supplementation frequency (SF) on cow performance, grazing time, distance traveled, maximum distance from water, and cow distribution within three 810-ha pastures. One hundred-twenty pregnant (approx. 60 d) cows (467 ±
4 kg BW) were used in a 3 x 3 Latin square for one 84-d period in each of three years. Cows were stratified by age, body condition score (BCS), and weight and assigned randomly to one of three pastures. Treatments (TRT) included an unsupplemented control (CON), daily supplementation (D; 0.91 kg/d; DM basis), and supplementation once every six d (6D; 5.46 kg/6d; DM basis). Cottonseed meal (45% CP; DM basis) was provided as the supplemental CP source. Water, mineral/salt, and supplement placement within each pasture were maintained in the same location each year of the study. Four cows from each treatment (each year) were fitted with global positioning system collars to estimate grazing time (hr/d), distance traveled (m/d), maximum distance from water (m/d), and cow distribution may be not affected by CP supplementation or SF.

Key Words: Protein supplementation, Frequency, Distribution

143 Livestock response to rest-rotation, deferred-rotation, or continuous grazing systems on forested rangeland. L. G. Wood*, K. C. Olson, R. D. Wiedmeier, and J. E. Bowens, Utah State University, Logan, UT.

A 6-yr study was conducted to evaluate the influence of rest-rotation, deferred-rotation, and continuous grazing on the performance of cow-calf (Bos taurus) and ewe-lamb (Ovis aries) units on mountain rangeland in southern Utah. Treatments were arranged in a 3 grazing method (continuous, deferred-rotation, or rest-rotation) by 6 yr factorial using a randomized-complete block design with 2 blocks. All animals were individually weighed and cows received a body condition score (BCS) at the beginning, mid-point, and end of each grazing season. Average daily gain (ADG) was greater (P>0.05) for calves, lambs, and ewes grazed continuously (1.12, 0.26, and 0.065 kg d−1, respectively) than in continuous-rotation grazing (1.06, 0.24, and 0.077 kg d−1, respectively). There was no difference in ADG for calves, lambs, or ewes grazed continuously or with deferred-rotation (P>0.05). Cows grazed more (P<0.05) in continuous pastures (0.71 kg d−1) than in deferred-rotation (0.58 kg d−1) or rest-rotation (0.54 kg d−1) pastures. COW ADG was similar (P>0.05) in continuous- and deferent-rotation pastures. Change in BCS by cows was similar among grazing treatments (P>0.05). Calves, lambs, and ewes gained more per ha (P<0.05) in continuous (9.95, 18.43, and 4.52 kg ha−1, respectively) and deferred-rotation pastures (9.84, 17.11, and 4.21 kg ha−1, respectively) than in rest-rotation pastures (7.98, 12.95, and 2.61 kg ha−1, respectively). Gain per ha was similar (P>0.05) between continuous and deferred-rotation grazing for calves, lambs, and ewes. Cows gained more per ha (P<0.05) in continuous (6.21 kg ha−1) than rest-rotation pastures (4.18 kg ha−1). Cow gain ha−1 under deferred-rotation (5.07 kg ha−1) was intermediate and similar (P>0.05) to both continuous and rest-rotation. Rest-rotation grazing reduces animal production per ha and weaning weights of calves and lambs, resulting in lower profits for livestock operations.

Key Words: Beef Cattle, Sheep, Grazing Systems


Over a two-year period, crossbred, multiparous beef cows (n=164/year) were used to determine the effect of trace mineral supplementation from 90 d prior to parturition through 120 d post parturition on cow performance. Cows were blocked by expected calving date, body weight, body condition score, and liver mineral status, and assigned to one of three treatments: 1) control (no supplemental copper (Cu), zinc (Zn), or manganese (Mn)); 2) ORG (50% organic and 50% inorganic Cu, Zn, and Mn); and 3) ING (100% inorganic CuSO4, ZnSO4, and MnSO4).

Mineral treatments were provided ad libitum in free choice mineral feeders. At the end of year one, liver Cu, Zn, and Mn concentrations were higher (P<0.01) in supplemented relative to control cows and liver Cu concentrations were higher (P<0.01) in ORG relative to ING cows. At the end of year two, supplemented cows had higher liver Cu (P<0.01) and Mn (P=0.02) compared to controls. Overall, liver Cu concentration tended (P=0.10) to be higher for supplemented cows relative to controls. A year by treatment interaction was present (P<0.05) for pregnancy rate to artificial insemination (Al). In year one, there was a trend (P=0.07) for ORG cows to have a higher pregnancy rate to AI than ING cows. In year two, supplemented cows had higher (P<0.05) pregnancy rates to AI vs. control cows. When AI was based on estrus, supplemented cows had higher pregnancy rates (P<0.05) than control cows. From this large, two-year study it can be concluded that trace mineral supplementation and source has an effect on fertility if Cu, Zn, and Mn are not supplemented for more than one year.

Key Words: Trace mineral supplementation, Beef cattle, Performance


Three-year-old Angus × Gelbvieh rotationally crossed beef cows (n=36) nutritionally managed to achieve a body condition score (BCS) of 4.2 ± 0.3 (BW = 481.2 ± 29.3 kg) or 6.0 ± 0.3 (BW = 554.3 ± 39.3 kg) at parturition were used to determine the effects of dietary supplemental fat on production and adipose tissue fatty acid metabolism. With increased age, and beginning of postpartum, cattle were randomly assigned to be individually fed native grass hay (CP = 8.7%) and a low fat control supplement (C) or supplements consisting of high-linoleate saflower seeds (L) or high-oleate saflower seeds (O) until d-60 of lactation. Saflower seeds were cracked and supplements were formulated to provide 5% DMI as fat. Rations were formulated to be isonitrogenous and isocaloric. Adipose tissue biopsies were collected near the tail-head region of cows on d-60 and d-60 of lactation. Body condition score was not affected (P=0.43) by dietary treatment, nor did BCS change (P=0.53) from d-3 to d-60 of lactation; however, cows were heavier (P=0.04) at d-30 than d-60. Milk production (P=0.24) and milk fat percentage (P=0.80) were not influenced by dietary treatments. Milk protein percentage was greater (P<0.05) at d-60 than d-60 than BCS 4.2. Dietary treatment did not affect (P ≥ 0.12) adipose tissue lipogenesis. Rates of palmitate incorporation into diacylglycerol and acetyl-CoA carboxylase activity were greater (P=0.001) at d-30 than d-60, suggesting a proclivity for greater substrate esterification and biosynthesis by adipose tissue at d-30 of lactation. Lipoprotein lipase activity (P=0.01) and palmitate incorporation (P=0.02) into triacylglycerol were greater in L compared to O. Hence, cows in sub-optimal condition retained a higher propensity to incorporate circulating triacylglycerol into stored adipocyte lipid.

Key Words: Beef cows, Fat supplementation, Lipid metabolism


Twelve Angus crossed cattle (avg BW = 504 ± 44.4 kg) fitted with ruminal and duodenal cannulae were used in a 4 x 4 Latin square double cross-over designed experiment to determine intestinal supply of essential amino acids (EAA) when consuming restricted amounts of forage plus a ruminally undegradable protein (RUP) supplement. Cattle were fed chopped (2.54 cm) bromegrass hay (11.4% CP; 57% NDF) at 30, 55, 80, or 105% of maintenance. Cattle fed below maintenance were given increasing amounts of RUP supplement (6.8% blood meal, 24.5% feather meal, and 68.7% fish meal; DM basis) in an effort to equalize duodenal EAA flow to that of the 105% of maintenance diet. Experimental periods were 19 d in length with 17 d of adaptation followed by 2 d of intensive sample collection. Due to greater amounts of supplemental RUP provided to cattle as forage intake decreased, total and individual EAA intake increased linearly (P < 0.0001) as forage intake decreased to 30% of maintenance. However, total duodenal flow of EAA did not differ (P = 0.39) across all levels of forage intake. The variation
in duodenal EAA proportions ranged from as low as 11.1 to 11.2% of total EAA for phenylalanine to 12.3 to 14.3% of total EAA for lysine. Although profile of EAA (individual EAA as a % of total EAA) reaching the duodenum differed \((P = 0.02)\) for all 10 of the EAA, duodenal flow did not differ \((P = 0.10 \text{ to } 0.65)\) for 8 out of the 10 EAA. Specifically, duodenal flow of arginine increased linearly \((P = 0.01)\) whereas duode-nal flow of tryptophan decreased linearly \((P = 0.002)\) as forage intake decreased from 105 to 30% of maintenance. Our results demonstrated that balancing intestinal essential amino acid supply in beef cattle can be accomplished with proper RUP supplementation.

**Key Words:** Restricted intake, Amino acids, Supplementation

### Breeding & Genetics: Dairy cattle breeding for production traits

**147 Individual curve fitting of Italian Simmental cow milk test day data.** N.P.P. Maccìotta\(^1\), D. Vicario\(^2\), G. Pulina\(^3\), and A. Cappio-Borlinio. \(^1\) Università di Sassari, \(^2\) Italian Association of Simmental cow Breeders.

The evolution of milk production over time can be modelled by several mathematical linear and non-linear functions. Observed differences in fitting of average lactation curves of homogeneous groups of animal for the most commonly used lactation models are rather small. On the other hand, a very wide range of goodness of fit can be observed for individual lactation pattern, essentially due to the random biological variation between cows and not to the inadequacy of the mathematical model used. Therefore, in order to study the effects of some systematic environmental factors on the shape of lactation curves, it is more useful to fit a simple model whose parameters possess a clear, technical significance to curves that are not too far from the typical lactation pattern. In this study, the incomplete Wood’s gamma function \(y = a(b \exp(c \tau))\) was fitted to 13,739 lactations of Italian Simmental cows, with at least 7 records each and with the first recorded test day within the 15th days in milking, of six parity classes \((1 \text{ to } 6)\). The overall mean adjusted \(r\)-square was 0.71. A reduced data set of 6830 regular lactation curves was extracted with the constraints of having the \(b\) parameter positive and the adjusted \(r\)-square greater than 0.75. Values of parameter \(a\), \(b\), and \(c\) were analysed with a linear model in order to evaluate the effect of herd, parity, year and season of calving on the lactation curve shape. Purity affected all the three parameters, with primiparous cows having the lowest values for the \(a\) \((12.82)\) and \(c\) \((-0.00417)\) parameter, thus indicating a lower level of production and a higher persistency of lactation in comparison with older cows. Also calving season affected all the parameters, with highest values of the scale parameter \(a\) for cows calving in March and April. Finally an increasing trend for the level of production and lactation persistency has been observed during the period considered \((1989-1999)\).

**Key Words:** Lactation curve, Italian Simmental

**148 Estimates of genetic parameters and lactation curves with a cubic spline model for Holstein cows treated with bovine somatotropin.** B. J. DeGroot\(^1\), J. F. Keown\(^1\), S. D. Kachman\(^1\), and L. D. Van Vleck\(^2\). \(^1\) University of Nebraska, Lincoln, NE, \(^2\) USDA, ARS, USMARC, Lincoln, NE.

The objective was to estimate genetic parameters and response to bovine somatotropin (bST) from individual test-day milk yields with a cubic spline model for first three lactations. A total of 263,034 test-day milk records of Holstein cows treated with bST and 405,265 test-day records of untreated cows that calved between 1996 and early 2002 were obtained from Dairy Records Management System, Raleigh, North Carolina. Estimates of \(co\)variances for a cubic spline with five knots were obtained with REML. Estimates of heritabilities for test-days and estimates of genetic and phenotypic correlations between test-days were obtained from estimates of variances and covariances from the cubic spline analysis. Genetic parameters were estimated at 23 average days within each of the ten 30-d test-day intervals. The cubic spline model included herd test-day, age at first calving, treatment, and treatment by linear as fixed effects and treatment by spline as random effects. Cubic splines were fitted for the overall lactation curve within treatments, additive genetic effects, and permanent environmental effects. The cubic splines used five intervals determined by days 0, 50, 135, 220, and 310. The treatment differences were measured for bST treated and untreated cows. Estimates of heritability for test-day one to test-day ten ranged from 0.09 to 0.16, 0.10 to 0.17, and 0.10 to 0.18 for lactations one, two, and three. Estimates of genetic correlations for milk yield at pairs of test-days further apart were very close to those obtained in a previous study where lactation length was limited to 305 days. The largest genetic variance was in the middle of the lactation while residual and permanent environmental variances mostly decreased during the lactation. The resulting heritability ranged from 0.17 to 0.37. For a large part of the lactation genetic correlations were higher than 0.90. For both the genetic and permanent environmental variances, the first two eigenvalues represented more than 90% of the total variation. The corresponding eigenvectors seemed to make sense biologically. They were used as covariables to estimate the genetic


Environmental sensitivity of genetic merit for milk, fat and protein yield was estimated using a random regression model to evaluate the effect of combining these traits in an economic index for different herd environments. To describe herd environments fourteen environmental parameters were defined based on the data available. Variance components and breeding values of sires for milk, fat, and protein yield were modeled as a function of an environmental parameter. Up to the third order polynomial random regressions were applied. Fixed linear and quadratic regressions were included for age at calving and fixed effects to account for herd-year-season groups. A fixed polynomial regression was applied to the environmental parameters, to account for the average level in each herd. The residual variance was modeled for ten different groups, to account for heterogeneous residual variances in the model. ASREML was used for all analyses. Herd-year peak date of calving, herd average protein, body condition score, calving interval and age at calving gave most environmental sensitivity, mainly resulting from a change in scale of the genetic and residual variances for extreme herds and little re-ranking. The sire variances of milk, fat and protein yield followed more or less the same pattern across the environmental scale. Most genetic correlations across environments were close to unity for each individual trait. The change in variances had a large scaling effect on the economic weights, but the effects were similar for milk, fat and protein yields. Therefore, also very little re-ranking occurred based on the economic index, but the use of high merit bulls seemed more beneficial in herds with peak date of calving in the fall or winter, high average protein, high body condition score, short calving intervals and young age at calving.

**Key Words:** Environmental sensitivity, Random regression model, Environmental parameter

**150 Estimation of genetic parameters for test-day records of French Holstein cows with an AI-REML algorithm.** T. Druet*, F. Jaffrezic, and V. Ducrocq, Station de Génétique Quantitative et Appliquée, INRA.

Genetic parameters for lactation test-day records of French Holstein cows were estimated as a first step towards the implementation of a national genetic evaluation with a test-day model. Test-day records were considered up to 355 days in milk. The fixed part of the lactation curve was modeled with regression splines with 6 knots. Genetic parameters were estimated with an Average Information REML algorithm where the average information matrix and the first derivatives of the likelihood functions were pooled over 10 samples. This approach made it possible to handle larger data sets. The logarithm of the residual variance was modeled with several parametric functions of days in milk such as polynomial function or regression splines. Quartic Legendre polynomials were used to estimate \(co\)variances of random effects. The estimates were within the range of most other studies and were very close to those obtained in a previous study where lactation length was limited to 305 days. The largest genetic variance was in the middle of the lactation while residual and permanent environmental variances mostly decreased during the lactation. The resulting heritability ranged from 0.17 to 0.37. For a large part of the lactation genetic correlations were higher than 0.90. For both the genetic and permanent environmental variances, the first two eigenvalues represented more than 90% of the total variation. The corresponding eigenvectors seemed to make sense biologically. They were used as covariables to estimate the genetic

**Key Words:** Heritability, Genetic correlations, Milk yield

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parameters in the three first lactations. Flexible functions were used to model the residual variance in order to take into account the extra residual variation not explained by the eigenvectors. Resulting genetic correlations among lactations were high.

Key Words: Genetic parameters, Test-day model

151 Estimation of genetic correlations among production, body size, udder, and productive life traits over time in Holsteins. S. Tsuruta1, I. Misztal1, T. J. Laval2, and L. Klei2, 1University of Georgia, Athens GA, 2Holstein Association USA Inc., Brattleboro VT.

Genetic parameters can change over time for several reasons. The use of a random regression model allows us to account for changes in a large number of variances and covariances over time and does not require any prior assumptions about how the parameters will change. Genetic correlation among milk, fat, productive life, body size, and udder traits in 40,838 Holsteins were estimated over a 15 year time period (cows born from 1979 to 1993). The model included registration status, herd-year, age group, and stage of lactation as fixed effects; additive genetic effects with random regressions on year of birth using the third order Legendre polynomials; and residual effects with heterogeneous variances using the interval method via Gibbs Sampler. Additive genetic variances for milk, fat, and body size increased over time while those for productive life and udder traits were constant. Residual variances for milk, fat, body size, and udder traits also increased over time, but those for productive life were relatively constant. As a result, heritability estimates for milk, fat, productive life, and body size were constant, and those for udder composite slightly decreased. Genetic correlations between milk production with fat yield and productive life have decreased, while the correlation of milk with body size and udder composite has increased over the years. Genetic correlations between productive life and the other traits decreased for the last decade. These changes can largely be explained by changes in selection emphasis that has taken place within the Holstein breed.

Key Words: Genetic parameters, Random regressions, Selection

152 Identification of environments for AI progeny testing schemes that yield the highest heritability and correlation with second-crop evaluations for yield and type traits. N. R. Zwald* and K. A. Weigel, UW-Madison, Madison, WI.

The objective of this study was to determine if differences in heritability and correlation with second-crop evaluations existed between progeny-test environments, and to identify optimal herd characteristics for testing of AI young sires. Without a proper environment, animals may not be given the opportunity to express their true genetic potential and genetic evaluations of sires progeny tested in these environments could be inaccurate. Missing and inaccurate identification adds to this problem in some herds. To examine this problem, data from all first classifications of young sire daughters were examined from 1993 to 2001. Data from 480,927 animals in 20,650 herds from 16,844 AI sires were used for this analysis. Only 254,891 animals (47%) had a sire-identified dam, and only 132,953 (27.6%) had a classified dam. Herd average phenotypic score was divided into three equal groups, defined as high phenotypic average score (> 80 points), intermediate phenotypic average score (74-80), and low phenotypic average score (< 74 points). Correlations between sire PTAT and actual daughter score for the three environments were (0.15, 0.11, 0.09) respectively. Actual daughter classification scores were regressed on sire PTAT to determine the differences between environments. Regression coefficients were (1.05, 0.78, 0.48) respectively. This research shows that there are considerable differences between progeny testing environments and that every effort should be made to progeny test bulls in environments with acceptable herd average phenotypic score. This will allow animals to more fully express their genetic potential. The current situation favors bulls proven in environments with a higher herd average phenotypic score.

Key Words: Progeny test, Type evaluation, Genotype by environment interaction


The addition of foreign daughter data to domestic dairy bull genetic evaluations has been shown to improve prediction of future domestic evaluations in a study of mainly US bulls. This study evaluates the accuracy of Interbull evaluations, based only on foreign daughters, in predicting the latest US yield evaluations, based only on US daughters, thus focusing on foreign bulls. February and August Interbull evaluations from 1995 through 2002 were used. For 652 Holstein bulls, the most recent Interbull evaluations solely from foreign daughter data were matched with February 2003 USDA evaluations based only on US daughters, thus providing a pair of evaluations based on different daughters. For the Interbull evaluations, mean reliability on the US scale was 84% and the mean US reliability for February 2003 evaluations was 78%. Correlations between these Interbull and US evaluations were .88, .82, and .88 for milk, fat, and protein, respectively. Interbull evaluations overestimated the US PTA by an average of 34, 0.4, and 0.7 kg, with standard deviations of the difference of 197, 7.5, and 5.5. Considering only those 153 bulls with US reliability of 90% or higher, correlations were similar to those seen overall for milk (.87) and protein (.88), but higher for fat (.87). Expected correlations were .81 for all 652 bulls and .91 for the 153 bulls. Thus, the actual correlations were higher than expected for all bulls but lower than expected for bulls with the highest US reliabilities. For the higher US reliability bulls, Interbull evaluations underestimated milk, fat, and protein by an average of 7, 0.3, and 0.4 kg, respectively, with standard deviations of differences of 197, 6.2, and 4.6. None of these mean differences between evaluations from foreign and US daughters are large and the correlations indicate that Interbull evaluations based solely on foreign daughters are good predictors of the US evaluations for yield.

Key Words: Genetic evaluation, Interbull, Evaluation accuracy

154 Standardization of lactation records for variance of Mendelian sampling to reduce bias in evaluations of bull dams. G. R. Wiggans*, P. M. VanRaden, and J. L. Edwards, Agricultural Research Service, USDA, Beltsville, MD.

Evaluations of bull dams may be biased upward because of preferential treatment or contemporaries with extremely low yields. Variance of Mendelian sampling (MS) was standardized to determine if such an adjustment of lactation records could improve accuracy of estimated breeding values (EBV) of bull dams. For Holstein data included in February 2003 USDA evaluations, MS variances were calculated within herd and 5 yr of first calving group. To regress estimates for small herds, the population estimate was included with a weight of 20. The ratio of the population MS standard deviation to the within herd-5 yr group value was used to adjust phenotypic yields. This ratio was limited to a maximum range of 0.5 to 2.0, with the range further limited based on mean herd yield to avoid over adjustment. To minimize effect of unreliable evaluations of females, MS was calculated using maternal grandsire EBV instead of dam EBV. At each round of iteration, this male index was subtracted from current EBV, and the result was adjusted for amount of information. To assess effect of the MS variance adjustment, EBV were calculated excluding records from calvings after 1997. Means of parent EBe were calculated for recent bulls using subset EBV with and without MS variance adjustment. Correlations (r) between February 2003 bull EBV and parent mean for the subset were higher with adjustment. Similarly, regression (b) of EBV on parent mean was closer to 1 with adjustment, and mean EBe minus parent mean (bias) was lower. Mean EBe of the top 100 cows was reduced with adjustment. Twenty percent in the top 50,000 cows for milk yield were different with adjustment. The largest drop was 1324 kg EBV. Standardization of MS variance improved accuracy of EBV.

Key Words: Genetic evaluation, Interbull, Evaluation accuracy

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Key Words: Heterogeneous variance adjustment, Evaluation bias, Mendelian sampling
155 Development of a selection index for the Reggiana dairy cattle breed. M. Fioretti1, V. Palucci1, and F. Miglior1,
1Associazione Italiana Allevatori, Rome, Italy, 2Agriculture and Agri-Food Canada, CDN, Guelph, ON, Canada.

The Reggiana population is a dairy cattle breed reared in the province of Reggio Emilia, located in the Italian Po Valley. Milk from this breed has been mainly used for the production of Parmigiano Reggiano cheese.

The Reggiana breed has shrunken from 84,000 cows in 1940 to 200 animals in 1984, having been replaced by more productive Friesian cows. Thanks to government support the breed was recovered in the last two decades, and currently close to 1000 cows are milk recorded. Selection has been based mainly on milk yield and produced moderate genetic progression for production (60 kg milk/yr, 2.5 kg fat/yr and 1.5 kg protein/yr) and phenotypic and genetic decrease for protein percent.

In order to invert the negative genetic trend for protein percentage, a selection index was developed that accounted for milk price for cheese production. The new index with economic weights of -26%, +7% and +67% emphasis for milk, fat and protein yield respectively, was found to increase protein percentage 10-yr genetic progress, and to greatly increase protein yield genetic progress (3.3 kg/yr), leaving milk and fat yields at current levels (61 kg milk/yr and 2.5 kg fat/yr).

Key Words: Dairy cattle, Selection index


The purpose of this study was to evaluate parameters of alternative models for analysis of test day milk under various levels of heat stress. Data included 81,674 first parity milk test days on 10,162 cows in FL. Also available were daily temperature-humidity indices (THI) from public weather stations in FL. Models included the effects of herd-test day, age class, days in milk class, frequency of calving, and additive and permanent environment implemented as linear random regressions. Models differed by the choice of covariables used in random regressions. The choices were: a) THI during the test day measured at the nearest public weather station, b) average THI across all weather stations for the month of test day, and c) solutions of month of test-day computed in a fixed model. The last model would correspond to a norm reaction model. Lowest production in models a) and b) corresponded to July, and lowest production in model c) corresponded to August-September. Constant terms in the random regression could be interpreted as regular effects, and linear terms as heat-tolerance effects. Genetic correlations between the constant and linear additive effects were -0.42 for a), -0.46 for b), and -0.76 for c). Correlations between additive effects in a) and b) were 0.96 (regular) and 0.94 (heat-tolerance). The same correlations in a) and c) were 0.95 and 0.56. Genetic variance for the heat-tolerance effect corresponding to the peak of heat stress was 20% higher for c) than for b).

For genetic analyses of heat tolerance, average monthly THI per state provided comparable information to daily THI from nearby weather stations. The heat tolerance effect in the norm reaction model accounts not only for the effect of heat stress due to current THI, but also for additional factors such as accumulated effects of heat stress or varying forage quality over time.

Key Words: Dairy cattle, Heat stress, Random regression


First-parity Holsteins (n = 247), Holstein-Jersey crossbreds (n = 97), and Holstein-Normande crossbreds (n = 68) were compared for milk, fat, and protein production and SCS during the first 150 days of lactation. Cows were housed in six commercial dairies in California and calved from June 2001 to December 2002. Independent variables for analysis were test-day observations from DHI. Independent variables were breed composition (H, HxJ, HxN), random effect of cow within breed composition, stage of lactation (4-30 d, 31-60 d, 61-90 d, 91-120 d, or 121-150 d), herd (1 to 6), milking frequency (2X or 3X), and interaction of breed composition and milking frequency. Breed composition was significantly different for milk and fat production and approached significance for protein production; however, there was not a significant difference of breed composition for SCS. Least-squares means for test-day milk production were 32.7 kg (H), 30.3 kg (HxJ), and 29.1 kg (HxN). For test-day fat production, least-squares means were 1.13 kg (H), 1.20 kg (H), and 1.09 kg (HxN). Least squares means for protein production were 0.96 kg (H), 0.95 kg (HxJ), and 0.93 kg (HxN). Although not significantly different, least squares means for SCS were 2.3 (H), 2.8 (HxJ), and 2.5 (HxN).

Key Words: Crossbreeding, Production, SCS

Dairy Foods: Processed cheese, milk powder, and microbiology

158 Comparison of pilot-scale and RVA process cheese manufacture. L. E. Metzger*, P. Lehtola, and R. Kapoor, MN-SD Dairy Foods Research Center, University of Minnesota, St. Paul, MN.

Numerous formulation and processing parameters influence the functionality of process cheese. Consequently it is sometimes difficult to predict the functionality of process cheese based on the formulation used. However, a small-scale manufacturing and analysis method could be used to evaluate the influence of formulation parameters on the functionality of process cheese. The objective of this study was to compare process cheese produced on a small scale (20 g) in a Rapid Visco Analyzer (RVA) to process cheese produced on a pilot-scale (4.5 kg) Blentech twin screw (BTS) cooker. Three different formulation of process cheese (PC) and process cheese food (PCF) were produced in a RVA and in a BTS cooker. Each formulation was produced in triplicate in the RVA and in duplicate in the BTS cooker. In the RVA the temperature of the heating block was maintained at 80°C and the stirring speed was sequentially increased from 0 rpm to 300 rpm in two minutes. The RVA was stopped 1 min or 2 min after an increase in viscosity was observed for the short and long manufacturing profiles respectively. In the BTS cooker each formulation was heated to 80°C in 3 min and held an additional 4 min. A screw speed of 120 rpm or 140 rpm was used for the PC and PCF respectively. Texture profile analysis (TPA) and the RVA melt test were performed on all PC and PCF produced. The formulation used had a significant (P<.05) effect on the TPA hardness, hot viscosity, and melt time of the PC and PCF produced in the RVA and in the BTS cooker. However, the PC and PCF produced in the RVA had a significantly (P<.05) higher TPA hardness and melt time as compared to PC and PCF produced in the BTS cooker. The RVA manufacturing time (short vs long) did not have a significant (P>.05) effect on any parameter for the PCF. However with the PC, the long manufacturing time significantly (P<.05) increased hot viscosity and melt time. Future research will focus on identifying RVA manufacturing profiles that produced PC and PCF that matches the functionality of process cheese produced on a pilot scale.

Key Words: Process Cheese

159 Salt whey ingredient. V. V. Mistry* and M. R. Acharya, South Dakota State University.

A method for manufacturing a salt whey ingredient (SWI) was developed (patent pending). Approximately 110 kg of salt whey was obtained for each of three replicates from salted curd that had been placed in barrels for draining and separated by centrifugal separation at 35°C. The skimmed salt whey was pasteurized at 60°C for 30 min, cooled to 20°C and condensed in a rising-film single-stage evaporator. The concentrate was spray dried in a single-stage spray drier to 3.3% moisture, 1.97% fat, 10.1% protein, 40.1% salt and 39.8% lactose and used in the manufacture of pasteurized process cheese and cheese spreads. The pasteurized process cheese formulations consisted of a blend of young (1- to 2-mo old) and aged (4- to 6-mo old) Cheddar cheese in equal proportions as follows: control pasteurized process cheese, control with 10% emulsifier; cheese with 2% SWI; cheese with 1.7% SWI but no emulsifier. For the cheese spread there were two formulations: control Provolone cheese...
spread; and Provolone cheese spread with SWI. For cheeses with emulsifier 3% disodium phosphate dehydrate was used. The targeted salt (NaCl) content was 2%. All cheeses were manufactured using a single-auger lay-down cooker with direct steam injection and a batch size of up to 15 kg, packaged in 2-kg containers, sealed and stored upside down at 4°C. Pasteurization was at 74°C for 2 min. All pasteurized process cheeses contained approximately 42% moisture. Cheeses with the SWI were smoother than those without. Cheeses with the SWI but without emulsifier exhibited excellent stretch properties. The pH of cheeses without emulsifier was lower (3.8) than those with emulsifier (6.1) and the SWI had no impact on pH. Cheeses with the SWI and without emulsifier melted more (70 mm) than the corresponding control (64 mm) but the former released more free oil. There were no differences in hardness among cheeses with emulsifier but in the absence of emulsifier, the cheeses with added SWI were softer (10.5 kg) than the controls (15.5 kg). The spreads averaged 57% moisture and the composition of the control and SWI cheeses was similar. The flowing and melting characteristics of cheese with SWI were excellent.

**Key Words:** Salt whey, Drying, Cheese

### 160 Comparison of the melting properties of process cheese using a Rapid Visco Analyzer (RVA) and the Schreiber melt test.

L. A. Rosenberg* and L. E. Metzger, MN-SD Dairy Food Research Center, University of Minnesota, St. Paul, MN.

The melt characteristics of process cheese are an important functional attribute. Currently, there remains a need for a fast, accurate and low cost test to evaluate cheese meltability. The objective of this study was to determine if the RVA melt test could distinguish differences between commercial and process cheese samples and to compare this test to the Schreiber melt test. The melt properties of fifty-five commercial process cheese samples from four different manufacturers were analyzed with the RVA and Schreiber melt test. Three replicates using the RVA and five replicates using the Schreiber melt test were performed. In the RVA melt test 15 g of ground cheese and 1 g of propylene glycol were used. The sample was subjected to a heat, holding, cooling profile during continuous mixing, and an apparent viscosity vs. time curve was obtained. The melt time, hot viscosity and solidification time were determined from each apparent viscosity vs. time curve. In the Schreiber melt test, samples with a 34 mm dia. and 7 mm height were placed into a forced draft oven at 100°C for 7 minutes. After removal from the oven the diameter was measured. The RVA melt test had a lower coefficient of variation and of the 55 samples analyzed six had a CV greater than 5 whereas with the Schreiber melt test 50 of the 55 samples had a CV greater than 5. There was low correlation (r=0.50) between the Schreiber melt test and the individual RVA parameters. Additionally the correlation varied substantially depending on the manufacturer. The lack of correlation between the Schreiber melt test and individual RVA parameters may be a result of the high CV observed with the Schreiber melt test. Also eight of the samples analyzed had a low Schreiber melt value (<38 mm) and could not be distinguished, whereas these samples had significantly (P<0.05) different RVA melt parameters. These results indicate that the RVA may be a more sensitive technique for measuring meltability as compared to the Schreiber melt test.

### 161 Effect of rice bran oil as a natural antioxidant on the storage stability of whole milk powder.

L. F. Osorio*1, J. U. McGregor*2, and N. Farkye1, 1 Escuela Agrícola Panamericana, Zamorano, Tegucigalpa, Honduras, 2Food Science and Human Nutrition Dept., Clemson University, Clemson, SC, 2Food Science Dept., LSU Ag Center, Baton Rouge, 2Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.

As the world economic conditions continue to improve, the demand for whole milk powder (WMP) will continue to increase. There is a need to increase production of WMP to satisfy the U.S. market and enhance potential for export. Oxidation drastically reduces the shelf life of WMP due to the production of off-flavors and odors. The objective of this study was to evaluate the use of rice bran oil (RBO) containing 5 percent oryzanol as an antioxidant in WMP produced using commercial and pilot scale spray drying systems. WMP was obtained by three different drying technologies; commercial spray, pilot spray and pilot pulse. RBO at 0.1 percent w/w of the original milk was added before and after drying in pulse, pulse and pilot spray drying and after drying in commercial spray drying. Samples were stored at 45°C for 50 days in an incubator to accelerate oxidation. Samples were tested every 10 days for oxidation progress. RBO proved to be an effective antioxidant regardless of drying method and regardless if RBO was added before or after drying. RBO significantly slowed oxidation as shown by TBA, peroxide value, and hexanal production. Significantly lower concentrations of malonaldehyde (mg/kg) were obtained when RBO was added before drying, compared to RBO added after drying. Trained sensory panelists were not able to detect the presence of RBO added before or after drying. Small levels of RBO addition have the potential to extend the shelf-life and functional properties of high fat containing milk powders by acting as an antioxidant.

**Key Words:** Whole milk powder, Oxidation, Rice bran oil

162 Flavoir stability of skim and whole milk powder.

M. E. Cauncho Whetstine*, M. A. Drake, Y. Karagul-Yuceer, and Y. K. Avsar, 1North Carolina State University

Skim and whole milk powder (SMP, WMP) are widely used as food ingredients and for direct consumption. Since milk powders may be stored, flavor stability and changes in flavor profiles during storage can impact quality and saleability. Hexanal concentrations have been used to follow quality degradation in milk powders. However, specific sensory changes and other volatile compound changes during storage are not well-characterized. The objectives of this study were to characterize flavor changes in SMP and WMP throughout 1 year storage at 21°C using sensory and instrumental methods. Composite 25 kg commercially packed samples of SMP and WMP (2 bags each) were started from four different production locations. Powders were dropped overnight and received within 48 h of production. Flavor of rehydrated milk pow- der samples was characterized every three months by sensory and instrumental methods. Descriptive sensory analysis (n=7) was used to determine flavor profiles of the milk powders. Solid phase microextraction (SPME) and solvent extraction with high vacuum distillation in conjunction with gas chromatography-mass spectrometry were used to characterize volatile compounds. Fresh SMP were characterized by cooled and sweet aromatic flavors while WMP exhibited cooked, caramelized, and milkfat flavors. These flavors were linked to specific volatile compounds. A wide variety of aroma-active volatiles were isolated from powders. WMP, in general, exhibited higher intensities of lactones and sugar degradation products (maltool, furfural). WMP developed grassy, piny, and fatty flavors with storage time; SMP developed cardboard/fatty flavors. Aldehydes increased in SMP and WMP with storage time. Flavor of SMP was more stable than WMP, but flavor and flavor stability differed between the two SMP and the two WMP.

**Key Words:** Milk flavor, Aroma extract dilution analysis, Sensory analysis

163 The effects of composition and processing on milk foaming characteristics as measured by steam frothing.

M. Levy1, J. U. McGregor2, and W. Prinyawiwatkul3, 1 Chef John Folse and Company, Gonzales, LA, 2Clemson University, Dept. of Food Science and Human Nutrition, Clemson, SC, 3Food Science Dept., LSU Ag Center, Baton Rouge.

Steam frothing of milk is required to produce an acceptable foam for many espresso coffee drinks (i.e. cappuccinos). Specific aspects of composition and processing may affect the foaming properties of milk. The aim of this study was to determine the effect of fat content, heat treatment, free fatty acid addition and storage time on the frothing properties of milk. The four treatments included: fat content (0.08 percent and 0.5 M concentration) and storage time (1 and 10 days). The steam froth values (SFV) and received within 48 h of production. Flavor of rehydrated milk pow- der samples was characterized every three months by sensory and instrumental methods.

**Key Words:** Milk powder flavor, Aroma extract dilution analysis, Sensory analysis

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There was also a significant difference for all testing procedures between all free fatty acid levels between treatments.

Key Words: Cappuccino, Coffee, Milk

164 Distribution of milk protein at air interfaces in ice cream examined by transmission electron microscopy and immunogold labeling. H. D. Goff* and Z. Zhang, University of Guelph, Guelph, ON Canada.

This study investigated the distribution of β-casein and β-lactoglobulin at air interfaces in ice cream by the combined use of freeze substitution transmission electron microscopy and immunogold labeling. When there was no added emulsifier, the fat globules appeared as discrete with clear dark protein edges and did not directly attach to air interfaces. Air interfaces mainly contained casein micelles, β-casein and a minor part of whey proteins, among which β-lactoglobulin was detected. Dissociation of casein micelles was evident by the presence of free β-casein and deformed casein micelles, especially for those adsorbed to fat and air interfaces. Addition of EDTA to ice cream led to thicker protein lines surrounding fat globules and air bubbles. The fact that less casein micelles but considerable free β-caseins were found adsorbed to either air or fat interfaces indicated more dissociation of casein micelles induced by EDTA. When mono and di-glycerides (MDG) were introduced to ice cream, the protein border between fat globules became discontinuous and partial coalescence of fat took place. Partially coalesced fat, individual fat globules, casein micelles, β-caseins and β-lactoglobulins were found attached directly to air interfaces.

Key Words: Ice cream, Protein, Foam

165 Effect of pH and ionic strength on competitive protein adsorption to air bubbles in aqueous foams made with mixed milk proteins. Z. Zhang* and H. D. Goff, University of Guelph, Guelph, ON, Canada.

Quantitative analysis of competitive milk protein adsorption to aqueous foam was performed by capillary zone electrophoresis (CZE). Foams were made by whipping protein solutions, in which skim milk powder (SMP) and whey protein isolate (WPI) were dissolved in various proportions and with various pH and concentration of NaCl. Adsorption of β-casein into foam phases was most preferential under all solution conditions. Enrichment of caseins into the foam phase was more apparent that of whey proteins and more so when samples contained less proportion of SMP and more WPI. The foamability of WPI increased when the concentration of NaCl rose from 0 to 0.1 M, and deceased when NaCl concentration increased further. The foambility of SMP demonstrated a continuous improvement when ionic strength increased from 0 to 0.8. NaCl at low concentration (<0.4 M) did not show significant effect on competitive adsorption among milk proteins, indicating electrostatic interactions do not play a key role in competitive adsorption. NaCl at higher concentration, e.g. at 0.6 M, retarded whey proteins from adsorption to the foam made from 50:50 mixtures of SMP and WPI. The whippability of WPI was highest at pH 4.5 and lowest at pH 3, and that of SMP was exactly the opposite. More α-lactalbumin was adsorbed to foam when the protein solutions were acidified from pH 6.6 to pH 3. The proportions of β-lactoglobulin and α-lactalbumin in the foam phase were obviously higher at basic pH and lower at acidic pH, compared with that at natural pH of WPI. The whippability of SMP was slightly improved when pH of SMP increased to 7 and 8.

Key Words: Protein, Foam, Capillary electrophoresis

166 Elucidation of the mechanisms of casein micelle stabilization by carrageenans extracted from Gigartina lancaeta red seaweed. D. W. Everett* and Y. Hemar, 1 University of Otago, Dunedin, New Zealand, 2 Massey University, Palmerston North, New Zealand.

The stabilization mechanisms of carrageenans on casein micelles were examined using diffusing wave spectroscopy (DWS). Carrageenans were extracted from the male, female, and tetrasporophyte life-cycles of a red seaweed, Gigartina lancaeta, native to southern New Zealand. The seaweed was boiled in 0.5M NaCl for 15 minutes, filtered through a coarse cloth and Whatman #113 filter paper (2x), and cooled to 4°C. The carrageenan was precipitated by addition of two volumes of 2-propanol at #18°C to the filtrate, then freeze-dried. Solutions (1%) of isolated carrageenans were prepared and heated at 85°C for 30 minutes to hydrate the polysaccharides before use. Low heat skin milk powder was hydrated for 12 hours at 4°C and adjusted to pH 5.5 and 6.5. Carrageenans were mixed at concentrations of 0.01% to 0.5% in the 10% skim milk powder solution and the size of casein micelle aggregates measured by DWS. A 1% solution of λ-carrageenan was also prepared and used for comparison. The viscosity of the continuous phase was measured over a shear rate range 10 s⁻¹ to 50 s⁻¹ after ultracentrifugation of the mixture at 100,000g for 30 minutes to calculate aggregate size from DWS data. Casein micelle size at both pH values without carrageenan was 200±10 nm. DWS correlation curves suitable for analysis of the casein-carrageenan mixtures at pH 5.5 were obtainable up to 0.5% polysaccharide concentration for male and female extractions, and up to 0.2% for λ-carrageenan. Correlation curves for the mixtures at pH 6.5 were only obtainable up to 0.05% carrageenan. The size of the aggregates increased as the carrageenan concentration increased. Carrageenans are known to adsorb onto the surface of casein micelles, even though both are negatively charged, by interaction with the positively charged section of κ-casein. As the carrageenan concentration increases, bridging of micelles occurs followed by steric repulsion of micelles at higher carrageenan concentration, and finally depletion flocculation at the lower concentration of carrageenan, micelle surface saturation with adsorbed carrageenan. The DWS technique is suitable for determining the onset of depletion flocculation from the rapid increase in aggregate size.

Key Words: Carrageenan, Casein micelle, DWS

167 The lactose permease of Streptococcus thermophilus is phosphorylated by the doubly phosphorylated form of HPr, a phosphoprotein of the phosphoenolpyruvatesugar phosphotransferase system. A. Cochu, M. Frenette, S. Moineau, and C. Vadeboncoeur, GREB, Faculte de Medecine den-taire et Faculte des Sciences et de Genie, Universite Laval.

Streptococcus thermophilus (St) is used to make fermented milk products such as yoghurts and cheeses. Lactose, the main sugar in milk, is taken up by St via a permease called LacS. The sugar is then hydrolyzed inside the cell into glucose and galactose by the enzyme beta-galactosidase. The glucose moiety is metabolized via the glycolytic pathway, while galactose is released into the extracellular medium. LacS catalyses two modes of transport: proton-motive-dependent symport and lactose/galactose exchange. LacS possesses a hydrophilic carboxyl-terminal domain called IIA^LacS that can be phosphorylated on His-552 by HPr(His-P), a phosphocarrier protein of the phosphoenolpyruvate-sugar phosphotransferase system (PTS). Phosphorylation of IIA^LacS increases the rate of lactose/galactose exchange and, until now, has been reported to occur only at the expense of HPr(His-P). However, streptococcal cells possess significant amounts of a doubly phosphorylated form of HPr, HPr(Ser-P)(His-P), whose functions remain unclear. The goal of this study was to determine whether IIA^LacS could be reversibly phosphorylated by HPr(Ser-P)(His-P), and which functions remain unclear. The goal of this study was to determine whether IIA^LacS could be reversibly phosphorylated by HPr(Ser-P)(His-P), and whether the doubly phosphorylated HPr could transfer their phosphate group to HPr(Ser-P). In this study, we demonstrated that St does not expel galactose during growth on lactose, indicate that the rate of St IIA^LacS phosphorylation by HPr(Ser-P)(His-P), but not by HPr(His-P), was higher than the rate of St IIA^LacS phosphorylation by St proteins. Experiments performed with heterologous systems showed that this difference did not result from differences in the amino acid sequences of the HPr proteins. Lastly, we demonstrated that St and Sts IIA^LacS P could transfer their phosphate group to HPr(Ser-P). In conclusion, our results unequivocally demonstrate that both HPr(His-P) and HPr(Ser-P)(His-P) play a key role in the phosphorylation state of St and Sts lactose permease.

Key Words: Lactic acid bacteria, Lactose transport, Protein phosphorylation
Dairy Foods: Natural cheese and butter


The influence of brine temperature and salt gradients within blocks on lipolysis and proteolysis in Ragusano cheese was determined. Twenty six 3.8 kg blocks (15x15x15 cm) were made on each of 3 d. One block was analyzed prior to brining. Five blocks were placed into each of 5 different saturated brines at 12, 15, 18, 21, and 24°C. One block was removed from each brine after 1, 4, 8, 16, and 24 h, weighed, sampled, and analyzed for salt and moisture. Weight loss (net of moisture loss and salt uptake), salt uptake, and moisture loss after 24 d increased with increasing brine temperature. Current porosity and moisture content of the water phase within the pores influence the rate and extent of salt uptake during 24 d of brining. Previously, lower brine concentration (18 vs 24%) achieved higher surface porosity and faster salt uptake. In the present study, moisture loss occurred from all cheeses at all temperatures, mostly during the first 4 d. Moisture loss decreases surface porosity of the block and forms a barrier to salt penetration. Moisture loss increased with increasing temperature and this decreased surface porosity. If decreased porosity was the only factor influencing salt uptake at various brine temperatures, then the cheeses at higher temperature should have had lower salt content. However, the opposite was true (2.91, 3.05, and 3.36% salt after 24 d of brining at 12, 18, and 24°C, respectively). Brine temperature also influences the viscosity of the aqueous phase of the cheese. The higher phase of the brine temperature brine would have higher viscosity and slower salt uptake, even though the cheese at lower brine temperature would have a more porous structure (favoring faster salt uptake) than cheese at higher brine temperature. Therefore, reducing brine concentration at 18°C increased salt uptake by increasing cheese porosity, while decreasing brine temperature decreased salt uptake due to increased viscosity of the water phase of the cheese. Faster salt uptake and lower temperature will help control early gas development.

Key Words: Brine temperature, Salt uptake, Ragusano cheese

169  The influence of native pasture plants on aroma compounds in Ragusano cheese. S. Carpino1, G. Licitra1, P. J. Van Soest2, and D. M. Barbano3, 4

Raw milk from 13 cows fed TMR supplemented with native pasture and from 13 cows fed only TMR on one farm was collected separately 4 times with an interval of 15 d between collections and 2 blocks (14 kg each of cheese were made from each milk. Our objective was to determine the influence of consumption of native plants in Sicilian pastures on the aroma compounds present in Ragusano cheese. Qualitative differences in the types of odor active compounds in the cheese were detected using GC-O. Out of 31 odor active compounds found in the cheeses, 18 were detected only in cheeses produced from milk of cows consuming pasture. Of the 18 compounds 10 were also found in at least one of 14 plant species selected out of 40 in the pasture. Selected plant species from the genera: Anthemis, Beta, Calendula, Cerinthe, Diplotaxis, Erodium, Euphorbia, Fumaria, Geranium, Malva, Medicago, Rumex, Scorpiurus, and Sinapis was known to be selected by the cows and represented pasture diversity. For example Calendula arvensis, a Compositae, was one of the most abundant plants, while Euphorbia helioscopia, (well known for secondary compounds) was consumed in small amounts. The following compounds were found in all cheeses produced from milk of cows consuming pasture and not in cheeses from TMR milk (numbers in parenthesis indicate plant species containing the compound): delta decalactone (14), 2-2-nonenal (13), citronellol (11), vanillin (9), phenylacetaldehyde (6), 1-carvone (4), ethyl 2-methyl butyrate and (E, E) 2,4 octadienal (2), geranyl acetate (1), while 2,4′ decadienal, 3-hydroxy-2-butanone, 2-nonanone, methionol, 2,6-dimethyl pyrazine, dimethyl disulfide, (E)-methyl jasmonate and dodecanal were not found in the 14 plants species. Compounds found uniquely in pasture cheeses, but not found in the 14 plant species may have been present in other pasture plants not analyzed.

Key Words: Aroma, Pasture, Ragusano cheese

170  WITHDRAWN .

171  Lipolysis and proteolysis within blocks of Ragusano cheese at different brine temperatures. C. Melliti1, D. M. Barbano2, M. Manenti1, J. M. Lynch3, S. Carpino1, and G. Licitra1, 5

The influence of brine temperature and salt gradients within blocks on lipolysis and proteolysis in Ragusano cheese was determined. Twenty six 3.8 kg blocks (15x15x15 cm) were made on each of 3 d. One block was analyzed prior to brining. Five blocks were placed into each of 5 different saturated brines at 12, 15, 18, 21, and 24°C. One block was removed from each brine after 1, 4, 8, 16, and 24 h of brining. Each block was divided into four portions of approximately equal weight representing, sequentially, the exterior surface to the center. Total (copper soap method) and individual (GLC) free fatty acids (FFA) and pH 4.6 and 12% TCA soluble nitrogen (SN) were measured. The pH 4.6 SN (5.12 to 7.37%, 12 vs 24°C) and 12% TCA SN (1.79 vs 4.27%, 12 vs 24°C) as a percent of TN at 24 d increased with brine temperature and they were higher in the block center and lower at the surface at all temperatures. Total FFA content increased with increasing brine temperature (ca. 76 to 221 mg/100 g; 12 vs 24°C) for all portions and the total FFA content across all temperatures was higher at the exterior 25% of the block than the interior 75% (ca. 180 to 115 mg/100 g, respectively) at 24°C. Higher total FFA content at the surface of the block was not expected and was the opposite of the behavior of SN. The average C4 as a percentage of total FFA increased (13.0, 27.9, and 38.2% at 12, 18, and 24°C, respectively) with increasing brine temperature at 24 d. The opposite behavior of total FFA content from the surface (i.e., high salt/low moisture) to the center of the block (low salt/high moisture) vs SN content may be due to a different direct effect of salt on enzyme and substrate interaction during lipolysis or a combination of this effect and movement of low molecular weight-soluble FFA from the interior to the surface of the block with moisture movement during brine salting.

Key Words: Brine temperature, Lipolysis, Proteolysis

172  Impact of pH during aging on proteolysis, texture and melting characteristics of Mozzarella cheese. M.A.S Cortez1, M. M. Furtado1, M. L. Gigante2, and P. S. Kindstedt3, 4

Previous studies demonstrated that the calcium distribution and apparent viscosity of newly made and aged Mozzarella cheeses were altered when the pH was altered using a novel post-manufacture approach. This study evaluated the effect of pH modulation on the proteolysis, unmelted texture and melting characteristics of Mozzarella cheese during aging. On four separate occasions, cultured LMPS Mozzarella cheeses were obtained from a commercial producer on the day after manufacturing. Cheeses were sectioned into samples that were randomly assigned to two groups. Samples in Group 1 were shredded, subdivided, and exposed to either ammonia vapor to increase the pH by ca. 0.3 pH units or HCL vapor to decrease the pH by ca. 0.2 pH units. The samples were then vacuum packaged, stored at 4°C, and analyzed for pH 4.6 and 12% TCA soluble N, apparent viscosity, free oil and water soluble calcium on d 5, 12, 22 and 40. Group 2 samples were exposed to either ammonia vapor to increase the pH by ca. 0.6 pH units or HCL vapor to decrease the pH by ca. 0.25 pH units. The samples were then vacuum packaged, stored at 4°C for 15 d to allow the pH within samples to equilibrate, and then analyzed for TPA hardness and springiness, meltability, and pH 4.6 and 12% TCA soluble N on d 17, 29 and 41. Data were analyzed by ANOVA according to a split-plot design. Increasing the pH resulted in significantly higher TPA hardness and apparent viscosity and lower meltability and water soluble calcium values throughout aging. Decreasing the pH had the opposite effects. The rate of increase in pH 4.6 and 12% TCA soluble N during aging was not significantly affected by pH treatment. Thus, differences in cheese pH did not affect proteolysis rates over the ranges studied during 40 d of storage at 4°C. The significant...
173 Purchasing and consumption behaviors, attitudes and expectations of Taiwanese urbanites toward cheese. I. M. Tsai* and M. R. McDaniel, Oregon State University.

Purchasing and consumption behaviors, attitudes and expectations of Taiwanese urbanites toward cheese were investigated. Four focus groups involving a total of 25 international Taiwanese students were conducted first, followed by a consumer survey in which 793 native Taiwanese urbanites participated. The focus group results provided good predictions and explanations of survey findings. Both studies found that in Taiwan cheese was treated as an ingredient in foods and that subjects lacked knowledge about cheese. Taiwanese consumed cheese at restaurants more frequently than at home. Chinese culture played an important role in subjects’attitudes and behaviors relating to cheese. Sensory, health and usage concerns, packaging, and marketing factors influenced purchasing decisions. A moderate cheese price, low fat, low cholesterol, high calcium, and individually wrapped slices were expected by subjects. Important sensory expectations were the presence of stringiness (appearance and texture) and creaminess (aroma) and the absence of oiliness (appearance and flavor), stickiness (appearance) and bitter and sour aftertaste. Finally, suggestions were offered to assist successful cheese export to the integrated Chinese marketplace, a high potential import market in Pacific Rim Asia.

Key Words: Taiwanese, Cheese consumption, Expectation

174 Gas chromatographic profile of volatiles in cheese induced by different fat globule surface coatings. D. W. Mettler1, J. Crownshaw1, A. A. Rod, M. Leullier2, and P. Dufour1, 1 University of Otago, Dunedin, New Zealand, 2 Ecole nationale supérieure de biologie applique a la nutrition et l’alimentation, Dijon, France.

The effect of fat globule coating material on the production of volatile compounds in cheese slurries was examined by solid phase microextraction (SPME) coupled with gas chromatography (GC)-flame ionization detection and mass spectrometry. To prepare the slurries, skim milk was concentrated 2.5× by ultrafiltration. Anhydrous milk fat (40°C) or soy oil (room temperature) was homogenized at 75 MPa with casein, two types of spray-dried commercial buttermilk powder, or freeze-dried milk fat globule membrane (MGFM) isolated by ultracentrifugation of fresh butter milk. The emulsions or the control cream sample were added to concentrated skim milk to form slurries with a fat to casein ratio of 4:3. 

Macor mazeli rennet protease was added to a second series of other identical slurries. The slurries were cultured with Lactobacillus bulgaricus and Streptococcus thermophilus at 31°C until pH 5.5 was reached, then stored at 12°C until GC analyses at 30 and 120 d. Duplicate samples were heated at 50°C for 60 min to extract low boiling point compounds in the headspace by adsorption onto carboxen/polydimethylsiloxane (PDMS) fibers. The e.s. plate count of the four milk powders used for emulsifying the fat in the slurries was less than 10^5 cfu/g at 32°C. Sensory analysis showed that the cream control slurry had a yogurt and cheese aroma with slight lipolytic overtones. The MFGM slurry had a low acid cheese aroma. The two buttermilk and the casein slurries had no detectable cheese aroma. GC analysis showed that 3-hydroxy-2-butanone and octanol were only detectable in the cream control. Compounds not detectable in the cream control, but present in the other slurries, included butanal, 2-heptanone, 2-octenol, 2,4,2-heptadienal, and 1-octen-3-ol. Compared to the others, the MFGM slurries contained a higher concentration of 2,3-pentadione and 2-heptanone whereas hexanal was not detectable. Benzaldehyde was only detectable in the cream and MFGM slurries. Nonanol was not detectable in the cream or MFGM slurries. The rennet protease had no significant effect on GC peak profiles of homogenized slurries. One factor in the development of cheese volatiles is evidently the nature of the fat globule membrane.

Key Words: Gas Chromatography, Cheese, Flavor


In previous work, milk preacidification with citric and acetic acids increased proteolysis in Mozzarella cheese during storage. Our objective was to preacidify cheese milk, but not have residual acetic or citric acid in the cheese. Half of the pasteurized whole milk was injected with CO₂ in- line after the cooling section of the pasteurizer. The amount of added CO₂ was about 1600 ppm. Cheddar cheese was produced three times with a milked curd process. Make procedure, starter and coagulant addition, and rate of salt application were the same for both treatments. No effect of treatment on cheese moisture (grand mean = 37.25%) was detected, but salt content was higher and calcium lower (p ≤ 0.05) for the CO₂ treatment. Both pH 4.6 and 12% trichloroacetic acid (TCA) soluble nitrogen (SN) increased with age for both treatments. Cheese made from CO₂ treated milk had a higher (p ≤ 0.05) amount of pH 4.6 SN as a percentage of TN (e.g., 18.57 vs. 16.41% at 3 mo) indicating a greater extent of primary proteolysis. An increase (p ≤ 0.05) in TCA SN was also observed (e.g., 8.33 vs. 7.68% at 3 mo). More proteolysis was observed for the CO₂ cheese, in spite of its higher (p ≤ 0.05) salt-in-the-moisture (0.96 vs. 3.92%). The protein content of the expressible serum (ES) removed from the control and CO₂ curd prior to salting was not different, but the protein content of the ES was higher (3.05 vs. 5.67%) for CO₂ cheeses immediately after pressing. No difference in intact casein content (by SDS-PAGE) of the ES from curd prior to salting was detected, but immediately after pressing the amount of intact casein in the ES (removed at 25°C) was higher for the CO₂ cheeses. Several factors may have increased primary proteolysis in the CO₂ cheeses:1) higher chymosin retention due to lower whey draining pH, 2) the lower calcium content in the cheese (2.08 vs. 2.82%), and 3), the higher casein content in the whey phase during storage providing a greater accessibility of casein to chymosin.

Key Words: Proteolysis, Carbon Dioxide, Cheddar


Work done previously in our laboratory with preacidification of milk for Mozzarella cheese with acetic and citric acids demonstrated that preacidification altered the serum phase of the cheese. The intent of this investigation was to achieve a similar change in the serum phase of the cheese without residual citric or acetic acid in the cheese. Two vats of milked curd Cheddar were made in the same day with and without CO₂ added to the milk. CO₂ was injected in-line after the cooling section of the pasteurizer. The mean level of added CO₂ in the cheese milk was about 1600 ppm. All cheese making conditions were kept the same for the two treatments to determine the effect of added CO₂ on milk component recoveries and yield. Weights of the pasteurized milk, whey, salt whey, and cheese were recorded and the compositions determined for three days of cheese making. The pH of whey at draining was lower for the CO₂ treatment (5.96 vs. 6.35). Total make time (rennet addition to milling at pH 5.3) was shorter for the treatment compared to the control (161 vs.176 min). No differences in cheese moisture and protein content were detected, but cheeses made with CO₂ treatment had lower (p ≤ 0.05) fat and calcium content and higher salt (2.24 vs. 1.44%) and pH (5.0 vs. 5.00). The amount of salt added per weight of curd was the same for both treatments but the retention of salt was much higher in the CO₂ treatment. No significant difference due to CO₂ was detected in total accountability for fat, protein, calcium and total solids or protein recovery in cheese. There was a lower (p ≤ 0.05) recovery of fat and calcium in the cheese made from milk with added CO₂ (87.57 vs. 93.08% and 43.56 vs. 59.75%, respectively). The lower recovery of calcium was expected due to the difference in pH of the whey at draining. The decrease in cheese yield efficiency due to higher fat and mineral loss in whey caused by the use of CO₂ was estimated to be 4.4 and 0.3%, respectively.

Key Words: Cheese Yield, Cheddar, Carbon Dioxide
Effect of supplemental dietary fish oil and soy oil on production and composition of milk and properties of butter from cows with low and high atherogenic index.

F. E. Shahroudi, Ferdowsi University of Mashhad, Mashhad, IRAN.

The atherogenic index (AI), defined as AI = [%C12:0 + 4 × %C14:0 + %C16:0] × [%unsaturated fatty acids], characterizes the atherogenicity of dietary fats. Cows with higher AI are assumed to be more detrimental to the human health. Previously, we demonstrated that properties of butter differ between cows on the same diet that produce milk fat with high and low AI. Butter from low AI milk fat was more spreadable. The objective of this experiment was to determine whether the addition of urea and sulfuric acid decreased the atherogenic index of milk fat. The effects of urea are relevant to its chemical composition as a source of nitrogen; on the other hand, urea reduces heating, discoloration and visible molds in silage. Simultaneously use of urea and sulfuric acid decreased pH to the optimal range. It seems that positive effect of acid on reducing nitrogen and increasing protein efficiency in silage. So, it has concluded that sulfuric acid can be used as a good preservative in alfalfa silage.

Key Words: Atherogenicity, Butter, Soy oil

Forages & Pastures: Silages, forage composition

Evaluating chemical characteristics of mixed corn plant and tomato pomace silage using experimental silos. R. Rahimi, E. V. Watts,2 A. L. Singleton.1 

The aim of this study was to compare chemical characteristics of mixed corn plant and various amounts of wet tomato pomace and to examine whether corn plant will ferment properly with various amounts of wet tomato pomace or not. Whole corn plants were chopped from a single field and mixed with 0% (T1), 7.5% (T2), 15% (T3) and 100% (T4) (DM basis) wet tomato pomace and ensiled in 5-gallon plastic containers. The silos were packed with a hydraulic press, which permitted all silages to be made at similar densities. All containers were opened 60 days later and dry matter (DM), pH, ammonia-nitrogen (N-NH3), crude protein (CP), ash, calcium (Ca), phosphorus (P), Acid detergent fiber (ADF), Neutral detergent fiber (NDF) were determined. Tomato pomace used in this experiment had 40.1 ± 3.8% moisture vs. 27.8 ± 2.7% for alfalfa silage. The atherogenic index (AI), defined as AI = [%C12:0 + 4 × [%C14:0 + %C16:0] × [%unsaturated fatty acids], characterizes the atherogenicity of dietary fats. Cows with higher AI are assumed to be more detrimental to the human health. Previously, we demonstrated that properties of butter differ between cows on the same diet that produce milk fat with high and low AI. Butter from low AI milk fat was more spreadable. The objective of this experiment was to determine whether the addition of urea and sulfuric acid decreased the atherogenic index of milk fat. The effects of urea are relevant to its chemical composition as a source of nitrogen; on the other hand, urea reduces heating, discoloration and visible molds in silage. Simultaneously use of urea and sulfuric acid decreased pH to the optimal range. It seems that positive effect of acid on reducing nitrogen and increasing protein efficiency in silage. So, it has concluded that sulfuric acid can be used as a good preservative in alfalfa silage.

Key Words: Atherogenicity, Butter, Soy oil


Two corn hybrids (Golden Harvest EX313 and H216) selected for high grain and high DM yield were harvested at two different stages of maturity (1: one third milky line or 2: two third of the milky line from the top of the kernel). The objective of this experiment was to evaluate the corn hybrids to determine potential differences in nutritive value of whole plant corn silage. Hybrids were grown in 2 plots of 5 Ha each in Bachiva, Chihuahua, Mexico on April 2001, harvested, and translated to the University Animal Nutrition Research Laboratory for evaluation. Samples of the plots were ensiled with or without corn silage inoculants (Control, Sill All®, Bio Sil®, and Urea) on 2 kg lab scale silos. Whole plant samples of EX313 had a lower (P < 0.05) percentage of lignin, IVDMD, and lactic acid. No significant differences were found on NDF, ADF, hemicellulose, or cellulose. Inoculation drastically affected the pH and lactic acid content of corn silage. There was no difference (P > 0.05) between Control, Sill All, and Bio Sil on pH values for early and late harvest. The pH values for Urea-inoculated corn silage were higher (P < 0.05) for early and late harvest for EX313 and H216. Also, the lactic acid content was higher (P < 0.05) for silage inoculated with Sill All versus the other treatments for both hybrids and treatment period milk fat with low AI (n=6) and high AI (n=6) were fed for three 3-week feeding periods with either a control diet (3.66% fat) or diets that contained additionally 1% fish oil and 1% soy oil as roasted beans, respectively. Feed intake and milk production was recorded during the third week on each diet. Milk samples were collected twice during the third week and analyzed for milk fat, protein, lactose, total solids, somatic cell count, and fatty acid composition. Furthermore, butter was made and analyzed for penetration distance and creep. Cows were selected for a low AI of milk fat maintained a lower AI than did cows with a high AI (P ≤ 0.05). Feeding additional soy oil decreased the AI and increased the penetration distance in comparison to the control diet (P ≤ 0.05), whereas feeding additional fish oil had no significant effect (P ≥ 0.05). Feeding additional soy oil and fish oil increased numerically the difference in the response of AI and penetration distance, but the interactions were not statistically significant (P ≥ 0.05). Dry matter intake, milk production, and milk composition were not affected by AI or diet (P ≥ 0.05). We conclude that feeding additional soy oil and selecting cows with low AI act additively to produce a lower saturated milkfat that can be used to produce a more spreadable butter.

Key Words: Atherogenicity, Butter, Soy oil

Chemical characteristics of alfalfa silage treated with urea and sulfuric acid. E. Khafipour, M. D. Mesgaran*, and E. F. Shahroudi, Ferdowsi University of Mashhad, Mashhad, IRAN.

This study was conducted to determine whether the addition of urea and/or sulfuric acid to alfalfa before ensiling would alter fermentation patterns. Second cut alfalfa (about 27% DM) was harvested, left for 8 h until got 33% DM, then ensiled with urea (0.0 and 1% of DM) and/or sulfuric acid (0.0,0.3,0.9,1.5 and 2.1% of DM) in a complete randomized design, using small laboratory silos (4 silos per each treatment). The Chemical composition of silages was determined by the standard procedures, 45 days after ensiling. pH and N-NH3 were determined in the each silage extraction, CP and NPN in dry samples. Alfalfa silages containing urea, compared with the others, had significantly higher pH (4.28 vs 4), CP (205.9 vs 177.0 g/kg, DM) and NPN (18.7 vs 15.8 g/kg, DM) for 0.0, 0.1 and 0.5. Using sulfuric acid caused to decrease pH (4.6 vs 3.56) and N-NH3 (13.56 vs 8.18 mg/dl), but increased CP (183.4 vs 197.5 mg/kg) for 0.0 and 2.1% sulfuric acid respectively. It has been indicated that urea, as an additive, for alfalfa silage, increased pH, CP and NPN. The effects of urea are relevant to its chemical composition as a source of nitrogen; On the other hand urea reduced heating, discoloration and visible molds in silage. Simultaneously use of urea and sulfuric acid decreased pH to the optimal range. It seems that positive effect of acid on CP content is relevant to its prohibitive function on proteins degradability in silage. Reduction in N-NH3 content of the acid treated silages is another reason for prohibitory function of acid on proteins degradation to soluble nitrogen and increasing of protein efficiency in silage. So, it has concluded that sulfuric acid can be used as a good preservative in alfalfa silage.

Key Words: Alfalfa silage, Additives, Chemical composition

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Forages & Pastures: Silages, forage composition

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Key Words: Tomato pomace, Corn silage, Experimental Silos

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maturities. No other measures of nutritional value were affected by the silage inoculants. The hybrids evaluated in this study affected DM, CP, IVDDM, and lignin of corn silage and the use of all silage inoculants except urea improved the pH and lactic acid content of corn silage.

**Key Words:** Corn silage, Hybrids, Silage inoculants

181 Practical methodology for applying edible coverings to bunker silos. L. L. Berger* and J. R. Sewell, University of Illinois-Urbana.

The goal of this research was to develop a commercially feasible application method to cover bunker silos with an edible covering. In addition to easy application, the edible covering must provide effective protection, be a source of essential nutrients, be palatable, and cost effective. In previous research a starch-salt mixture had been applied by hand using a cement trowel. The previous formulation had a bread dough consistency, and had to be reformulated so that it could be sprayed. Also wheat flour was replaced with wheat ground through a 0.48 cm screen. A commercial CEJICO concrete model, CSS 2489 with a vertical shaft mixer and screw pump was used in this experiment. This unit was chosen because it could be powered by the hydraulic system of a farm tractor. A commercial air compressor was used to atomize the matrix as it was sprayed on the bunkers. The starch-salt matrix was applied at 30.3% moisture with a targeted thickness of 1.5 cm. Six mini-bunker silos 2.14 X 7.32 m with a packed limestone base and plywood walls were used. Approximately 5727 kg of chopped alfalfa (48.4% DM) were packed into each of six silos. The chopped alfalfa was packed with a small tractor and lawn roller. The three treatments were, uncovered, 6-mil polyethylene plastic (weighted with 15 cm corn forage), or covered with the sprayed starch-salt matrix. After the starch-salt matrix was applied an edible wax emulsion was sprayed on the covering to seal it. The silos were sealed on August 3 and opened beginning November 17, 2002 after 106 days of ensiling. During the last week of the trial, digestibility of ADF was higher (P < 0.01) between variety and cutting height due to higher intakes with 31G20 LOW and 31K61 HI compared to the other treatments. Although differences have been observed in the in vitro and in situ digestibility of corn varieties, no advantage was observed in milk production and composition among varieties reported to differ in nutrient digestibility in the current study. Although cutting height reduced the fiber content and increased IVDMD of the resulting silage, no clear advantage was observed for increasing cutting height.

**Key Words:** Corn silage, Milk yield, Nutrient digestibility


A Pioneer hybrid, (38K06; RM 93 d) was planted on May 4, 2001 on four plots, harvested at three stages of maturity (30%, 35%, and 40% theoretical whole plant DM content), and processed using three chopping methods: (1) chopped at 0.95-cm theoretical length of cut (TLC) and unprocessed; (2) chopped at 1.91-cm TLC and processed with 3 mm roll clearance; and (3) chopped at 1.91 cm TLC and processed with 1-mm roll clearance. Chopped forages were analyzed for particle size distribution using the Penn State Separation method. Fractions from each sieve were weighed, dried at 60°C to determine percent particle distribution on DM basis. Physically effective NDF (peNDF) was determined as percentage of dry forage retained on a 1.18-mm screen. Forage samples (200 g) were weighed, dried, and separated into three categories: (1) whole kernels, with no visible damage or fragmentation; (2) fragmented kernels ≤ 2 mm; and (3) fragmented kernels < 2 mm. Fractions were expressed on DM basis. In summary, processing increased proportion of fine particles and broken kernels, decreased medium particle and peNDF, but had no effect on coarse particles. Increase in maturity increased proportion of fine particles and peNDF and decreased medium particles but had no effect on coarse particles. Maturity by processing interaction showed that kernel breakage was increased without reducing whole forage peNDF when DM of forage was 40% and 1 mm processor roll clearance was used.

<table>
<thead>
<tr>
<th>Particle Size Distribution (%) of DM</th>
<th>&lt; 0.01</th>
<th>0.01 - 0.25</th>
<th>0.25 - 0.40</th>
<th>&gt; 0.40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small fragments (≤ 0.40 mm)</td>
<td>83.2</td>
<td>79.8</td>
<td>75.5</td>
<td>70.0</td>
</tr>
<tr>
<td>Medium fragments (0.40 - 0.80 mm)</td>
<td>14.4</td>
<td>18.0</td>
<td>24.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Large fragments (&gt; 0.80 mm)</td>
<td>2.4</td>
<td>2.2</td>
<td>1.5</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Key Words:** Corn silage, Hybrid silage, Silage inoculants

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184 Chloride fertilization of corn grown for silage affects mycotoxin concentrations. D. P. Casper1, D. Spangler1, D. Schaff1, G. Clark2, and D. T. Wicklow3, 3Agri-King, Inc., Fulton, IL, 2University of Illinois Extension, 3USDA-ARS, Peoria, IL.

Dairy cattle fed mycotoxin contaminated forages can experience many different performance problems. Fusarium (FUS) molds can invade forages in the field up to feeding by producing the mycotoxins zearalenone and vomitoxin. Chloride (Cl) fertilization is reported to increase plant disease resistance. To evaluate if Cl fertilization of corn could reduce mycotoxin concentrations in silage, 4 application rates of Cl (0, 56, 112, and 224 kg/ha) and 2 FUS challenge rates (non-inoculated versus inoculated) were arranged in a 4 by 2 factorial design. Three blocks of 8 treatments were randomly assigned to plot sizes of 4.6 m × 2 m. The corn variety was Syngenta N4R8V planted at the rate of 12,141 kernels/ha. Potassium chloride was applied within 3 d of planting, while FUS challenge was accomplished by inserting non-cultured and cultured (Fusarium graminearum) toothpicks into ears at mid-silk and the corn plants were harvested for silage 30 d later. Corn plants were harvested by hand, chopped, and silage packed into sealed mini silos. Silos were stored for 60 d and then subjected to nutrient and mycotoxin analyses. Chloride fertilization resulted in a significant (P<0.01) linear increase in Cl concentrations of corn silage (20.30.38, and .52% DM, respectively for 0, 56, 112, 224 kg Cl/ha). An interaction of Cl × FUS was detected (P<.02) for zearalenone, but the interaction was nonsignificant (P>-.10) for vomitoxin. When corn was inoculated with FUS, zearalenone concentrations (303, 237, 75, and 106 ppb) were greatest for 0 kg/ha Cl and lowest for 112 kg/ha Cl (P<.05). The main effect of Cl demonstrated greater (P<.05) mycotoxin concentrations (3.66, 5.11, 1.78, and 3.41 ppm) for 56 than 112 kg/ha with other Cl rates being intermediate.

Interactions between Cl and FUS were detected (P<.05) with the exception of myriocistone (P>0.05, Cl14:1). TOXIC and MAXQ had similar (P>0.05) content of Cl14:1 in GB and SQ, whereas Cl14:1 was higher (P>0.05) in the IM from MAXQ than TOXIC. Total lipid content was unaffected (P>0.05) by endophyte type. Adipose tissues from TOXIC cattle had higher (P<0.05) proportions of palmitoleic and oleic acids than MAXQ. The percent of saturated fatty acids (SFA) was higher (P<0.05) and monounsaturated fatty acids (MUFA) lower (P<0.05) for TOXIC than MAXQ. Endophyte type did not alter (P>0.05) the percent of polyunsaturated fatty acids (PUFA) and total conjugated linoleic acid (CLA), or the polyunsaturated:saturated (P:S) and omega-6:omega3 (n-6-n-3) fatty acid ratios. However, MAXQ tended (P<0.10) to have a higher proportion of CLA isomer c9t11 than TOXIC (9.8 vs. 8.4 mg CLA/g lipid). GB and IM had higher (P<0.05) concentrations of SFA, MUFA, and CLA c9t11; and lower (P<0.05) concentrations of PUFAs and P:S ratio than SQ fat. Presence of alkaloids in SQ fat from TOXIC cattle was detected by ELISA. Adipose tissues from TOXIC showed greater degree of saturation and accumulation of alkaloids than MAXQ. Fescue toxicosis appears to influence fatty acid metabolism, which may be involved in the occurrence of fat necrosis. Finishing cattle on tall fescue pastures showed potential to enhance the fatty acid profile of beef including CLA and omega-3 fatty acids from a human health perspective.

Key Words: Crop maturity, Processing, Particle size distribution

187 WITHDRAWN...

Weanling pigs (n=36, 24 d of age, and 6.6 kg BW) were used in a 7-wk experiment to evaluate the effects of three dietary n-6/n-3 fatty acid ratios (n6/n3) on performance and immune function. Three diets contained either 5% menhaden oil, corn oil, or a combination resulting in n6/n3 ratios of 0.8, 6.7, and 39.8, and 1.0, 7.4, and 43.5 for the 4-wk nursery and 3-wk grower phases, respectively. Diets contained 1.22 and 0.95% lysine for the nursery and grower, respectively, and other nutrients met or exceeded NRC (1998) requirement estimates. Pigs were allotted two per pen minimizing weight and age differences across pens within a block. Pig weights and feed intake were recorded weekly. Colonic lymphocyte proliferation assays were performed prior to and 4 wk after treatment allotment. Plate conditions were 1 x 10^6 cells/ml, with 6.8% autologous serum, 16, 32, and 64 µg/ml for concanavalin A and 1, 5, and 25 µg/ml for pokeweed mitogen (PWM). Additionally, a primary and secondary killed H1N1 influenza A vaccination was administered after 2 and 5 wk with serum specific antibody analysed at Wk 2, 5, and 7. ADG and ADFI (0.58 and 1.04 kg, respectively) did not differ (P > 0.10) among dietary treatments. However, a linear tendency (P < 0.07) in F/G occurred with increasing n6/n3 (1.79, 1.76, and 1.83, respectively). No lymphocyte proliferation differences among treatments occurred (P > 0.10) in response to either mitogen. However, lymphocyte proliferation decreased (P < 0.01) from Wk 0 to Wk 4 in cultures stimulated with 1 (1.30 and 1.17, respectively) and 5 (1.34 and 1.17, respectively) µg/ml PWM. Only the secondary vaccination produced detectable antibody to the influenza vaccine with no differences (P > 0.10) among dietary treatments. The dietary n6/n3 did not influence ADG, ADFI, lymphocyte proliferation, or humoral immune response but tended to improve F/G with declining n6/n3 in the diet.

Key Words: Pigs, Fatty acids, Immunity

189 Inclusion of oat hulls in diets for piglets based on native or cooked cereals. E. Lopez1, M. A. Latore1, D. G. Valenc1a, R. Lazaro1, and G. G. Mateos1*,1 Universidad Politecnica de Madrid. Spain.

A trial was conducted to study the influence of main cereal (50% rice vs 50% corn), heat-processing of the cereal portion of the diet (native vs cooked at 97 ± 2 °C for 45 min), and inclusion of cooked oat hulls (0 vs 2%) on nutrient digestibility and productive performance of young pigs weaned at 21 d of age. Each treatment was replicated six times (five piglets per pen) and the trial lasted 35 d. The experimental diets were formulated to have similar nutritive value and were supplied in meal form. They contained 12% full-fat soybeans, 5 to 8% fish meal, and 20% milk products but no antibiotics were included. Apparent faecal nutrient digestibility was determined at 33, 43, and 49 d of age using 0.5% celite as additional indigestible marker. From 21 to 49 d of age piglets fed rice ate 20.5% more feed (P < 0.001), grew 19.1% faster (P < 0.001), tended to have less incidence of diarrhoea (P = 0.12), and had similar feed conversion than pigs fed corn. The improvements in feed intake and daily gains observed were maintained at 56 d of age. Cooking the cereal portion of the diet did not affect piglet performance at any age. From 35 to 49 d of age, the inclusion of 2% oat hulls in the diet reduced feed intake (P < 0.05) and tended to improve feed conversion (P < 0.10) but no significant effects were detected at 56 d of age. Digestibility of organic matter and gross energy did not differ markedly with age but was higher for rice than for corn diets. Nitrogen retention, however, was not affected by main cereal of the diet. Also, oat hull inclusion tended to reduce nutrient digestibility (P < 0.10) but heat processing of the cereal did not have any effect. It is concluded that the use of rice in substitution of corn improves nutrient digestibility and piglet performance and that the inclusion of moderate amount of oat hulls does not impair productivity and in fact might improve feed conversion in early stages of piglet life.

Key Words: Oat hulls, Piglet performance, Cooked cereals

190 Oat hulls in diets for young pigs based on cooked rice or corn without antibiotics. F. Martin1, M. A. Latore2, J. M. Gonzalez-Alvarado1, R. Lazaro*3, and G. G. Mateos1, 1Universidad Politecnica de Madrid. Spain.

A trial was conducted to investigate the influence of cereal source (53% of cooked and rolled corn vs cooked rice) and inclusion of cooked oat hulls (0, 2, and 4%) on productive performance, apparent faecal nutrient digestibility of nutrients, and incidence of diarrhoea in piglets weaned at 20 d of age. Each treatment was replicated eight times (five piglets penned together) and the trial lasted 34 d. From 20 to 41 d of age, piglets were fed their respective experimental diets that included 13% full-fat soybeans, 8% fish meal, and 15% milk products without terres-trial animal proteins or antibiotics. The corn and rice used were cooked at 97 ± 2 °C for 45 min (Amandus Kahl). From 41 to 54 d of age, all piglets received a common starter diet based on corn, barley, and soybean meal. Digestibility of nutrients was determined at 27 and 37 d of age using 0.5% celite as additional indigestible marker. From 21 to 41 d of age, piglets fed rice ate 15.0% more feed (P < 0.01) and grew 12.3% faster (P < 0.05) but had similar feed conversion than piglets fed corn. Most of the improvement in productive performance observed with rice feeding at 41 d were maintained at the end of the trial (659 and 623 g/d for feed intake; P < 0.01, and 447 and 418 g/d for daily gains; P < 0.01, for rice and corn diets, respectively). In general, digestibility of nutrients (organic matter, gross energy, NDF, and ether extract) increased with age and was higher for rice than for corn diets but nitrogen retention was not affected by main cereal used. Increasing the level of oat hulls in the diet did not affect performance or nutrient digestibility but reduced the incidence of diarrhoea from 21 to 41 d of age (P < 0.05). We conclude that cooked rice is an ingredient of choice in feeds for young pigs. Also, the use of moderate amounts of oat hulls might help to reduce the incidence of diarrhoea without impairing nutrient digestibility or piglet performance.

Key Words: Cooked cereals, Oat hulls, Piglet performance

191 Rice vs wheat feeding and protein level of the diet on performance of piglets from 10 to 16 kg BW. J. Bonet1, J. Coma1, M. Cortés2, P. Medel2, and G.G. Mateos3*, 1Vall Companys Group, Spain, 2Imasde Agropecuaria, S.L., Spain, 3Universidade Politecnica de Madrid, Spain.

The use of feeds without antibiotics has resulted in an increase in the incidence of diarrhoea in piglets. Two possibilities to improve productivity are the inclusion of more digestible cereals and the reduction in the protein content of the diet. Two trials were conducted to evaluate the influence of cereal (cooked wheat vs cooked rice) and protein level of the diet (LP; 15.5%; HP; 21%) on performance of piglets from 46 to 63 d of age. The origin of the piglets was a farm with high (trial 1) or low (trial 2) health status. In each trial 416 piglets weaned at 21 d and distributed in the replicates at 25 d were used. Each treatment (2 x 2 factorial) had four replicates of 25 piglets. All diets contained 2.5 Mcal NE/kg and 1.38 % total lysine and were based on soybean meal, soy oil, and 60 to 74 % cooked cereal. Data were analyzed by GLM procedure of SAS using body weight at 25 d post weaning as a covariate. In trial 1 piglets fed rice diets ate more (588 vs 513 g/d; P < 0.01), grew faster (400 vs 339 g/d; P < 0.01), and had better feed conversion (1.47 vs 1.55 g/g; P < 0.05) than piglets fed wheat diets. Piglets fed HP diets ate more (569 vs 532 g/d; P < 0.01), grew faster (413 vs 326 g/d; P < 0.01), and had better feed conversion (1.37 vs 1.60 g/g; P < 0.01) than piglets fed LP diets. In trial 2, piglets fed rice grew faster (349 vs 317 g/d; P < 0.01) than piglets fed wheat, but no differences were observed for feed conversion. Also, piglets fed HP diets grew faster (379 vs 286 g/d; P < 0.01) and had better feed conversion (1.37 vs 1.60 g/g; P < 0.01) than piglets fed LP diets. An interaction cereal x protein level of the diet was observed for productive traits in both trials: the beneficial effects of HP diets were more evident in piglets fed wheat than in piglets fed rice (P < 0.01). We concluded that rice could be used advantageously in diets for piglets. Also, the use of 21% CP instead of 15.5% CP is recommended in diets for piglets of this age.

Key Words: Piglet performance, Cooked cereals, Protein level

Nicholas turkey pouls (n = 80; 1 d of age) were allotted to a 2 x 2 factorial design. Treatments consisted of 1) challenge or no challenge and 2) Innax® (INX; spray-dried bovine serum) treated water or untreated water. Tap water was mixed with 0 or 1.30, 0.65, 0.325, and 1.30% (wt/wt) INX on d 0-7, 8-14, 15-21, and 22-29, respectively. Water was mixed daily and provided ad libitum. Pouls were fed commercial turkey starter and grower feed ad libitum. Pouls were challenged on d 35 by swabbing the tonsils with 3.0 x 108 cfu of Pasteurella multocida Type III. Intake (feed and water), BW gain, feed efficiency and mortality were determined. Consumption of INX (d 0 to 7) increased ADG (P < 0.03), water intake (P < 0.10), and feed efficiency (P < 0.10); while total BW gain and feed intake were unaffected (P > 0.10) by treatment. No treatment differences (P > 0.10) were noted in ADG, total BW gain, feed or water intake, and feed efficiency from d 0 to 35. After the challenge (d 35), INX did not impact (P > 0.10) ADG, water or feed intake; while INX increased total BW gain (P < 0.10) and gain/feed (P < 0.003). Innax® improved (P < 0.03) survival (d 35 to 49) of challenged pouls consuming untreated water (63.2% survival). These data suggest that the addition of INX to drinking water systems will increase ADG, water intake, and feed efficiency of pouls the first week post placement. Furthermore, addition of INX to drinking water reduces mortality in turkeys exposed to Pasteurella multocida.

Key Words: Turkeys, Serum, Pasteurella multocida

193 Effects of different levels of spray dried egg and lactose on the performance of weaned pigs. C. M. Shao1,*, B. G. Harmon2, and M. A. Latour2. 1Wellthope Agri-Tech Co., Beijing, China, 2Purdue University, West Lafayette, IN.

Spray Dried Egg (SDE) is an alternative source of immuno-globulin in phase 1 diets for weaned pigs. Three trials were conducted to study the effects of feeding SDE to pigs weaned at less than 18 days of age. In the first two trials, SDE was fed at 0 or 5% in diets containing a constant level of ME, lysine, methionine/cystine, threonine and tryptophan. Diets contained a constant amount of dried whey, poultry by-product meal (trial 1), meat and bone meal (trial 2) and fish meal. In the first trial, 168 pigs and in trial 2, 140 pigs were weaned at 14 to 18 days of age, blocked by weight, and randomly allotted to treatment in 10 day trials. Daily gain (ADG) was significantly greater in pigs receiving 5% SDE (244 g/day vs. 204 g/day in trial 1 and 244 g/day vs. 181 g/day in trial 2). Feed intake (FI) was significantly greater in pigs receiving 5% SDE (236 g/day vs. 204 g/day in trial 1 and 263 g/day vs. 253 g/day in trial 2). Feed efficiency (FE) was not different between treatments. In trial three, SDE and lactose were added at 62% ratios to provide 0, 5, and 10% of the mixture to a basal diet containing 5% whey in treatments 1, 2 and 3. Whey was omitted in fourth diet containing 15% of the combination, SDE/lactose. The trial was conducted for 14 days each in phase 1 and phase 2 with 160 pigs used in the study. In phase 2, diets contained either 5% dried whey or 5% SDE/lactose. During phase 1, ADG improved from diet 1 to 4 (60.4, 64.9, 79.9, and 79.0 g, respectively P<0.05), when lactose and SDE levels were increased. FE was not different across treatments. There were no differences in gain or efficiency when the SDE/lactose combination was fed at 10% of the diet compared to 15% SDE/lactose and removal of dried whey from the diet. The 5 heavy weight replications had much greater ADG compared to the 5 light weight replications (70.8 vs. 40.9, 76.3 vs. 45.4, 94.0 vs. 84.4, 88.1 vs. 63.6 g, respectively). Performance was greatest in pigs receiving 10% of the SDE/lactose combination. The addition SDE alone or in combination with lactose improved the performance of weaned pigs.

Key Words: Spray-dried egg, Lactose, Pigs

194 Effect of the substitution of feed growth promoter by plant extracts on the performances of broilers. D. Eclache1, and M. Besson2, 1GENIOUL, 2PHODE, France.

The protection of the consumers imposes the reduction if not the suppression of numerous growth promoters in broiler feeds. The effect of incorporating a product based on natural plant extracts (Ololiobiotic®) on growth performance, was evaluated on yellow Ross broilers during the rearing period up to slaughter (39 days). The trial took place on a french research farm with high health status. Dietary treatments were: a positive control using the growth promoter avilamycin at 10 ppm (CON+); an OLEO group at 0.1% and a negative control without additives (CON-). chicks (n=1500) were allotted to 5 pens per treatment with 100 chicks per pen (50 males, 50 females). During the fattening period, the growth rate was improved with OLEO compared to CON- (P<0.10, Table 1). There was no significant difference among the 3 diets for feed conversion rates during the 39-day period. In this trial, the supplementation of the feed with a plant extract allowed to obtain a significant increase in growth rate compared to the unsupplemented group and similar performance compared to the growth promoter group.

Table 1: Effect of a herbal extract product on the performance of broilers.

<table>
<thead>
<tr>
<th>Period</th>
<th>Measure</th>
<th>CON+</th>
<th>CON-</th>
<th>OLEO</th>
<th>P-value</th>
</tr>
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<tbody>
<tr>
<td>1-7 day</td>
<td>ADG, g/d</td>
<td>13.3a</td>
<td>14.3a</td>
<td>14.9b</td>
<td>0.01</td>
</tr>
<tr>
<td>1-7 day</td>
<td>FCR</td>
<td>0.97b</td>
<td>0.86a</td>
<td>0.89a</td>
<td>0.01</td>
</tr>
<tr>
<td>1-14 day</td>
<td>ADG</td>
<td>21.3a</td>
<td>21.2a</td>
<td>22.9b</td>
<td>0.01</td>
</tr>
<tr>
<td>1-14 day</td>
<td>FCR</td>
<td>1.29</td>
<td>1.29</td>
<td>1.27 ns</td>
<td></td>
</tr>
<tr>
<td>1-27 day</td>
<td>ADG</td>
<td>40.0a</td>
<td>40.0a</td>
<td>42.1b</td>
<td>0.01</td>
</tr>
<tr>
<td>1-27 day</td>
<td>FCR</td>
<td>1.58b</td>
<td>1.56ab</td>
<td>1.53a</td>
<td>0.05</td>
</tr>
<tr>
<td>1-34 day</td>
<td>ADG</td>
<td>50.7b</td>
<td>49.5a</td>
<td>51.4b</td>
<td>0.10</td>
</tr>
<tr>
<td>1-34 day</td>
<td>FCR</td>
<td>1.60</td>
<td>1.62</td>
<td>1.62 ns</td>
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<tr>
<td>1-39 day</td>
<td>ADG</td>
<td>51.7b</td>
<td>50.3a</td>
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<td>0.10</td>
</tr>
<tr>
<td>1-39 day</td>
<td>FCR</td>
<td>1.78</td>
<td>1.79</td>
<td>1.80 ns</td>
<td></td>
</tr>
</tbody>
</table>

ns: non significant (P>0.10). a,b: value with the same superscript did not differ (P>0.10).

Key Words: Broiler, Plant extract, Growth promoter

195 Bioefficacy of B. coagulans in broiler and piglet diets: a comparative study. E. Esteve1, A. E. Espínell1, C. Pifarre2, J. Gasa3, M. Cortes3, and P. Medel4. 1IRTA, Spain, 2Norel, Spain, 3PigCHAMP, Spain, 4UBA, Spain, 5Inmasde Agropecuaria, Spain.

Two trials were performed to determine the efficacy of dietary supplementation with the probiotic B. coagulans CECT 5940 containing 106 UFC/g on performance of both broilers and piglets. In Trial one (T1), 576 male chickens were fed and there were four treatments, a control diet based on barley, corn and soya, and three levels of inclusion of the probiotic: 10, 100 and 1000 g/t. The experimental unit was a flat deck battery cage containing 12 chicks, and there were 12 reps per treatment. The experimental design was applied to both pelleted diets. Both experiments were analyzed as a completely randomized block design by using the GLM procedure of SAS. In T1, feed efficiency was significantly improved by the probiotic inclusion from 21 to 42 d, and for the overall period (1.803, 1.786, 1.783 and 1.782 g/g for 0, 10, 100 and 1000 g/t of probiotic, respectively, P<0.05). In T2, piglets fed the diet supplemented at the dose of 1000 g/t showed better feed conversion than remaining treatments, both in the Starter and in the overall period (1.51, 1.52 and 1.47 for 0, 100 and 1000 g/t of probiotic, respectively, P<0.05). In conclusion i) the probiotic B. coagulans CECT 5940 improved feed conversion in both broilers and piglets, ii) the feed conversion improvement was found for the second and for the overall period in both trials.

Key Words: Probiotic B. coagulans, Piglets, Broilers

OLEO, Phodé, France) on growth performance, was evaluated on yellow Ross broilers during the rearing period up to slaughter (39 days). The trial took place on a french research farm with high health status. Dietary treatments were: a positive control using the growth promoter avilamycin at 10 ppm (CON+); an OLEO group at 0.1% and a negative control without additives (CON-). Chicks (n=1500) were allotted to 5 pens per treatment with 100 chicks per pen (50 males, 50 females). During the fattening period, the growth rate was improved with OLEO compared to CON- (P<0.10, Table 1). There was no significant difference among the 3 diets for feed conversion rates during the 39-day period. In this trial, the supplementation of the feed with a plant extract allowed to obtain a significant increase in growth rate compared to the unsupplemented group and similar performance compared to the growth promoter group.
A total of 192 pigs (average initial BW of 6.8 kg and 21 d of age) were used in a 35-d experiment to determine the effects of a heat-stable yeast product on growth performance of nursery pigs fed diets without and with antibiotics. There were six pigs per pen and eight pens per treatment. Treatment diets were formulated to: 1.7% lysine, 0.9% Ca, and 0.8% P for d 0 to 7; 1.5% lysine, 0.8% Ca, and 0.7% P for d 7 to 21; and 1.3% lysine, 0.75% Ca, and 0.65% P for d 21 to 35. Treatments were arranged as a 2 x 2 factorial with main effects of antibiotic (without and with carbadox at 55 g/metric ton) and yeast (without and with 0.2% of the heat-stable yeast product). All diets had 3,000 mg/kg total Zn for d 0 to 7 and 250 mg/kg total Cu for d 7 to 35. For d 0 to 7 and 7 to 21, the diets were pelleted and for d 21 to 35, the diets were fed as mash. Feed and water were consumed on an ad libitum basis throughout the experiment. Rate of gain was greater (P < 0.01) in pigs fed the antibiotic for d 0 to 21 and overall (d 0 to 35). Also, the antibiotic improved efficiency of gain for d 0 to 7 and 0 to 21 (P < 0.04). However, there were no effects of the yeast product on growth performance (P > 0.15) and there were no interactions among antibiotic and yeast additions in any phase of the experiment (P > 0.08). In conclusion, the antibiotic was effective as a non-specific growth promoter but the yeast product had minimal effect on growth performance of nursery-age pigs.

**Key Words:** Pigs, Antibiotics, Yeast

**Efficacy of Bio-Mos® in the nursery pig diet: A meta-analysis of the performance response.** J. C. Miguel*, S. L. Rodriguez-Zas, and J. E. Pettigrew, *University of Illinois at Urbana-Champaign, Urbana, IL/USA.*

A meta-analysis of all available data was conducted to evaluate the efficacy of Bio-Mos® on immediate post-wean, nursery pig performance. Fifty-five comparisons from 29 separate experiments and 21 research teams were utilized in the analysis. When Bio-Mos®, a mannann oligosaccharide product (Alltech Inc.), was supplemented in the nursery diet there was an overall improved response (P<0.01) in growth rate (4.15%), feed intake (2.08%) and feed efficiency (-2.34%) compared to the performance of pigs fed a control diet. Several production factors were incorperated as independent variables into a statistical model with dependent variables of percentage response of growht measures to Bio-Mos®, to identify factors that affect the response to Bio-Mos®. The ADG response to Bio-Mos® was similar in publicly available data (5.44%) to that in the data from Alltech’s files (3.34%), so all further analyses were done with the full data set. Growth rate of control pigs during the first 7 to 15 days after weaning was taken as an imperfect indicator of health. Pigs that grew more slowly during this period (less healthy pigs) responded more sharply (P<0.01) to Bio-Mos® (data shown as early ADG, g% response in overall ADG: <180/7.18%; 180-280/2.67%; >280/1.50%). The ADG response also suggests that Bio-Mos® is most effective during the first four weeks post weaning (6.68%) compared to dietary inclusion longer than four weeks (2.98%). In addition, the ADG response to Bio-Mos® is larger in pigs weaned at an early age of 17-18 d (6.25%) compared to those weaned at 20-21 d (4.72%) and 24-28 d (3.51%). The optimal concentration of Bio-Mos® in the nursery diet was 0.2%. The ADG response to Bio-Mos® was similar in the presence (4.80%) or in the absence (4.87%) of antibiotics in the diet, with the response being additive when Bio-Mos® was supplemented in combination with antibiotics. These data indicate that Bio-Mos® supplemented to the diet of nursery pigs can improve their growth performance.

**Key Words:** Mannann oligosaccharide, Nursery pigs, Performance

**Use of fermented soybean meal in nursery diets.** S. W. Kim, R. L. McPherson*, and F. Ji, *Texas Tech University.*

One hundred ninety two nursery pigs were weaned on d 19.2±0.2 and allotted into one of three dietary treatments: CON (control), FS3 (soybean meal fermented by Aspergillus Orizae, replacing 3% of normal soybean meal), and FS6 (replacing 6%). Fermented soybean meal contained live Aspergillus Orizae from the fermentation process. The CON contained 21% soybean meal and the FS3 and FS6 replaced soybean meal with fermented soybean meal by 3% and 6%, respectively. All diets contained 15% dried whey, 3% protein, and 51% corn providing 1.43% lysine and 3.28 Mcal/kg ME. Each treatment had 8 replicates with 8 pigs per pen- replicate. Pigs were fed the experimental diets for 4 wk. Weight and feed intake of pigs were measured weekly. Diarrhea score was measured daily during the first 14 d. Pigs fed the FS3 tended to grow faster (P = 0.062) than pigs fed the CON during the wk-1. There was no difference in feed intake of pigs among the treatments during the wk-1. Gain/feed of pigs fed the FS3 and FS6 was greater (P < 0.05) than that of pigs fed the CON during the wk-1. During the wk-2 and -3, pigs fed the FS3 and FS6 had a greater (P < 0.05) gain/feed than pigs fed the CON whereas there was no difference in ADG of pigs among the treatments. Pigs fed the CON had a greater (P < 0.05) feed intake than pigs fed the FS3 and FS6 during the wk-2. During the wk-1 to -3, pigs fed the CON had a greater (P < 0.05) feed intake than pigs fed the FS6 whereas ADG of pigs was the same among the treatments. Pigs fed the FS3 and FS6 had a greater (P < 0.01) gain/feed than pigs fed the CON during the same period. During the wk-4, there was no difference in gain/feed, ADG and feed intake among the treatments. During the entire experimental period (wk-1 to -4), pigs fed the FS3 and FS6 had a greater (P < 0.01) gain/feed than pigs fed the CON. However, there was no difference in ADG and feed intake of pigs among the treatments during the entire experimental period. Pigs fed the CON had a greater (P < 0.05) incidence of diarrhea than pigs fed the FS3 during the wk-1 whereas there was no difference during wk-2. In conclusion, the use of fermented soybean meal with Aspergillus Orizae replacing conventional soybean meal up to 6% in nursery diets can improve growth performance and reduce the incidence of diarrhea.

**Key Words:** Nursery pigs, Growth, Fermented soybean meal

**Use of probiotics and fermented soybean meal in lactation diets.** J. Fei* and S. W. Kim, *Texas Tech University.*

Forty primiparous lactating sows and the litters were used to determine the effect of dietary supplementation of probiotics and fermented soybean meal on lactation performance. Primiparous sows were moved to individual farrowing crate on d 105 of gestation and allotted to one of four dietary treatments: CON (control), PA (probiotics-A containing Aspergillus Orizae, supplemented 0.2%), PB (probiotics-B containing Aspergillus Orizae and Bacillus Sp, supplemented 0.2%), and FS (fermented soybean meal by Aspergillus Orizae, replacing 2% of normal soybean meal) based on their body weight on d 105 of gestation. Fermented soybean meal contained live Aspergillus Orizae from the fermentation process. Sows received the experimental diets from d 105 of gestation until the weaning on d 21 of lactation. All lactation diets contained 17.5% CP (9.94% lysine) and 3.28 ME Mcal/kg. Sows were fed 2 kg/day until farrowing and fed ad libitum during lactation. Litter size was set to 10 pigs within 48 h postpartum (10±3±4 kg). Weight and backfat of sows and weight of litters were measured weekly until weaning. Feed intake of sows was measured daily. All the litters were weaned on d 21 of lactation and sows were returned to gestation stalls. Numbers of days return to estrus were measured. Voluntary feed intake of sows did not differ among the treatments during the entire experimental period. Pigs fed the CON had a greater (P < 0.05) ADG and feed intake among the treatments during the entire experimental period. Pigs fed the FS3 tended to be higher than that from the PA sows (P = 0.061). However, there was no difference in weight gain of nursing pigs between the CON and other treatment groups. Weight loss of the FS3 sows (6.7 kg) during the 21-d lactation was lower (P < 0.05) than that of the CON sows (16.6 kg). Weight loss of the PA and PB sows did not differ from that of the CON sows. Greatest difference (P < 0.05) in weight loss between the FS sows and the CON sows happened during the third week of lactation. Changes in backfat thickness of sows among the
Physiology: Estrus synchronization


This experiment compared progestin-GnRH-PGF2α (PG) based protocols for estrus synchronization in postpartum beef cows. Cows were assigned by age, body condition score (BCS), and days postpartum (dpp) to one of two treatments. The MGA Select treated cows (T1; n=109) were fed melengestrol acetate (MGA; 0.5mg·hd−1·d−1) for 14 d, injected with GnRH (100 µg i.m.) Cystorelin) 12 d after MGA withdrawal, and PG (25 mg i.m. Lutalyse) 7 d after GnRH. The 7-11 Synch treated cows (T2; n=111) received MGA for 7 d, PG on day 7 of MGA, GnRH 4 d after PG, and PG 7 d after GnRH. Mean BCS (4.7 ± 0.1, T1; 4.7 ± 0.1, T2) and dpp (41 ± 1, T1; 41 ± 1, T2) did not differ (P > 0.1) between treatments. Blood samples were collected 8 d and 1 d prior to MGA to determine pretreatment cyclicity [progesterone, P4 > 1ng/mL; 10/109 (9%), T1; 12/111 (11%), T2; P > 0.1] and again on the day of PG to predict treatment response [81/109 (74%), T1; 84/111 (76%), T2; P > 0.1]. Serum concentrations of P4 at PG differed (P < 0.01) between treatments [3.3 (T1) vs. 1.7 (T2) ng/mL]. Heat Watch® was utilized for 7 d after PG to detect estrus and AI was performed 12 h after the onset of estrus. Estrous response was similar (P > 0.1) between treatments [100/109 (92%), T1; 101/111 (91%), T2]. The mean interval to estrus (65 ± 2 h, T1; 52 ± 2 h, T2) and synchrony of estrus (analyzed by ratio of variance, F-test) differed (P < 0.01) between treatments. Synchronized conception and pregnancy rates [61/100 (61%), 61/109 (63%), T1; 71/101 (70%), 71/111 (64%), T2] and final pregnancy rate [97/109 (89%), T1; 98/111 (88%), T2] did not differ (P > 0.2) between treatments. This study demonstrates that estrous response and fertility are similar among cows assigned to the MGA Select or 7-11 Synch protocols. Synchrony of estrus, however, may be improved following treatment with the 7-11 Synch protocol. These data will be used to facilitate methods of fixed-time AI in beef cattle. (Supported by grants from Select Sires, Inc., and USDA-NRI 2000-02163.)

Key Words: Estrus synchronization, Progestin, GnRH


The objective of this study was to compare two fixed-time AI protocols for postpartum beef cows. Cows at two locations (location 1, n = 113; location 2, n = 95) were stratified by age, days postpartum (dpp), and body condition score (BCS), and randomly assigned to one of two fixed-time AI protocols. The two treatments included: 1) 7-11 Synch (n = 103) cows were fed melengestrol acetate [MGA; 0.5mg·hd−1·d−1] for 7 d followed by prostaglandin F2α, [PG; 25 mg i.m. Lutalyse] on d 7 of MGA, GnRH [100 µg i.m. Cystorelin] on d 11, and PG on d 18, with fixed-time AI 60 h after the last PG and GnRH at AI; and 2) CO-Synch plus EZAI-BREED™ CIDR (CIDR; n = 105: GnRH was administered at the time of CIDR insertion [CIDR was in place for 7 d]; PG was administered at the time of CIDR removal), with fixed-time AI 48 h after PG and GnRH at AI. One AI sire was used for all inseminations. Pregnancy rate to fixed-time AI was determined by ultrasonography between 50 and 60 d after AI. Quantitative data were analyzed by ANOVA and qualitative data were compared by Chi-square and logistic regression analyses. There were no differences attributed to location for any of the variables considered in the analyses. Results were, therefore, pooled, for the respective treatments. Mean age (5.8 ± 0.2 vs. 5.8 ± 0.2), dpp (50.3 ± 1.7 vs. 51.5 ± 1.7), and BCS (5.6 ± 0.1 vs. 5.6 ± 0.1) were not different (P > 0.10) between the 7-11 Synch and CO-Synch plus CIDR groups. Pregnancy rate to fixed-time AI did not differ (P > 0.10) between the 7-11 Synch (85/103, 63%) and CO-Synch plus CIDR (58/105, 55%) groups. These data indicate that the 7-11 Synch and CO-Synch plus CIDR protocols provide significant opportunity to AI cows at a fixed time with resulting high fertility, eliminating the need to detect estrus. Duration of treatment and cost of these protocols provide flexibility for beef producers in choosing the protocol that matches a specific management scenario. (Supported by USDA-NRI 2000-02163)

Key Words: Estrus synchronization, Progestin, GnRH

202 Effects of CIDR in the Ovsynch protocol on AI pregnancy rate in crossbred beef cows. H. K. Baitis1, A. Garcia1, W. D. Whittier1, and J. M. DeJarnette2, 1Virginia Polytechnic Institute and State University, Blacksburg, VA/United States, 2Select Sires, Inc., Plain City, OH/United States.

Failure of the follicle to respond to the first GnRH injection in a synchronization protocol results in premature estrus (PE) in 8-10% of treated animals. The objective of this experiment was to determine if the addition of an intravaginal progesterone-releasing insert (CIDR) to the Ovsynch protocol would alter AI reproductive performance in postpartum beef cattle. Crossbred beef cows were subjected to synchronization of estrus and ovulation. Cows were managed in a typical commercial cow/calf operation at three locations in Virginia. A total of 379 mature beef cows were randomly allotted to receive either 50µg GnRH (Cystorelin, Abbott Laboratories) on d 0, PGF2α on d 7 (25 mg dinoprostone), 100µg GnRH on d 9 (OV; n=188) or 50µg GnRH and CIDR on d 0, PGF2α on d 7 with CIDR removal, 100µg GnRH on d 9 (CIDR; n=190). Estrous activity was monitored with both Kamar (Kamar, Inc., Steamboat Springs, CO) and visual detection methods. Cows that exhibited PE were bred 12-16 h after estrus. All cows not detected in estrus were bred AI at 12-16 h after PGF2α. Pregnancy was diagnosed via trans-rectal ultrasonography 35-40 d post insemination. Data were analyzed using the Proc GLM (SAS) procedures. A higher pregnancy rate (P<0.05) was obtained in cows receiving a CIDR device (66%) compared with OV treatment alone (52%). Pregnancy rate to AI was not affected (P>0.05) by location, inseminator, or sire. In conclusion, addition of a CIDR to the Ovsynch protocol results in increased AI pregnancy rates in crossbred, mature beef cattle.

Key Words: Estrus synchronization, CIDR, Postpartum


Melengestrol acetate (MGA® Premix) and PGF2α (LUTALYSE® Sterile Solution) were used to synchronize estrus in Bos taurus × Bos indicus heifers in 3 replications. Replications 1 (n = 139) and 2 (n = 146) were conducted at the same location in consecutive years, while replication 3 (n = 410) was conducted at a separate location. All heifers were administered MGA for 14 d at a rate of 0.5 mg head−1·d−1. In replications 1 and 2 heifers were randomly distributed to receive either 25 mg PGF2α i.m. 19 d following MGA or 12.5 mg PGF2α i.m. on d 19 and 20 following MGA. In replication 3, heifers received the same PGF2α treatments and were randomly divided into two groups with PGF2α treatments initiated either 18 or 19 d following MGA. Visual detection of estrus was conducted in the AM and PM for 72 h after PGF2α administration. Heifers not observed in estrus by 72 h following PGF2α were timed-AI and received GnRH (100 µg i.m.; FERTAGYL®) at such time. Pregnancy was diagnosed by ultrasonography 50 to 60 d following the synchronized breeding within each replication. Within each replication, during treatment to PGF2α administration did not effect any treatment variables analyzed, so data were combined. There were no significant treatment x replication effects for any variable analyzed so data were pooled. Heifers receiving a split dose of PGF2α (50.1%; n = 341) had a greater (P < 0.05) three-day estrous response compared to the single dose (43.2%; n = 345) of heifers. Most heifers receiving the single dose of PGF2α from a single to a split dose also increased (P < 0.05) timed-AI pregnancy rates (23.9 vs 33.5%), and overall AI pregnancy rates (34.5 vs 42.5%), respectively. In
204 Fixed-time artificial insemination of postpartum beef cows at 72 or 80 hours after treatment with the MGA Select protocol. J. E. Steger*, J. F. Bader, F. N. Kojima, M. R. Eilersiek, M. F. Smith, and D. J. Patterson, University of Missouri.

This study was conducted to determine the appropriate timing of fixed-time AI following administration of the MGA Select protocol. Cows at two locations (location 1, n = 114; location 2, n = 97) were assigned to fixed-time AI at 72 or 80 h by age, body condition score (BCS), days postpartum (dpp), AI technician, and sire. All cows were estrus synchronized with the MGA Select protocol [melengestrol acetate, MGA (0.5mg·hd−1·d−1) for 14 d, GnRH (100 µg i.m. Cystorelin); day 26] 12 d after MGA withdrawal, followed in 7 d with PGF2α (PG; 25 mg i.m. Lutalyse; day 33)]. Cows were inseminated at 72 h (n = 108) or 80 h (n = 110) after PG with a second injection of GnRH at AI. There were no differences among treatments for days to estrus, variableestrus (P > 0.1), estrous interval (P > 0.1), number of estrous periods (P > 0.2) between the variables for all cows studied in the analyses. The results are, therefore, pooled for the respective treatments. Mean BCS (5.2 ± 0.1, 72 h; 5.3 ± 0.1, 80 h) and dpp (34 ± 2, 72 h; 35 ± 2, 80 h) did not differ (P > 0.1) between treatments. Blood samples were collected 7 d and 1 d prior to MGA to determine pretreatment cyclic periods, and on the day of PG to determine treatment response [progesterone > 1 ng/mL; (33/108, 31%, 72 h vs. 32/103, 31%, 80 h; P > 0.8, pretreatment); (74/108, 69%, 72 h vs. 69/103, 67%, 80 h; P > 0.9, at PG)]. Pregnancy rates were higher (P < 0.05) among cows inseminated at 72 h (69/108, 64%) versus 80 h (52/103, 50%) following administration of the MGA Select protocol. Pregnancy rates at the end of the breeding season did not differ (P > 0.2) between treatments [98/108 (91%), 72 h; 88/103 (85%), 80 h]. These data indicate that pregnancy rates resulting from fixed-time AI are improved when postpartum beef cows are inseminated at 72 versus 80 h following administration of the MGA Select protocol. (Supported by grants from Select Sires, Inc., and USDA-NRI 2000-02163.)

Key Words: Fixed-time AI, Beef Cows, Progesterin


The 7-11 Synch protocol for synchronization of estrus in beef cows results in a tightly synchronized estrous response that generally peaks at 54 h following treatment. The objective of this study was to determine the optimum timing of fixed-time AI using the 7-11 Synch protocol. Cows were stratified by age, days postpartum (dpp), and body condition score (BCS), and randomly assigned to fixed-time AI at 48 or 60 h following the 7-11 Synch protocol. All cows were synchronized with the 7-11 Synch protocol and fed melengestrol acetate (MGA; 0.5mg·hd−1·d−1) for 7 d followed by prostaglandin F2α (PG; 25 mg i.m. Lutalyse) on d 7 of MGA, GnRH (100 µg i.m. Cystorelin) on d 11, and PG on d 18. Fixed-time AI was performed either at 48 (n = 122) or 60 h (n = 122) after the last PG injection, and GnRH was administered at AI. One AI sire was used for all inseminations. Pregnancy rate to fixed-time AI was determined by ultrasonography 50 d after AI. Quantitative data were analyzed by ANOVA and qualitative data were compared by Chi-square and logistic regression analyses. Mean age (5.5 ± 0.3 vs. 5.4 ± 0.3), dpp (46.8 ± 1.5 vs. 47.5 ± 1.5), and BCS (5.3 ± 0.1 vs. 5.3 ± 0.1) were not different (P > 0.10) between 48 and 60 h fixed-time AI groups. Pregnancy rate to fixed-time AI did not differ (P > 0.10) between cows that were inseminated at 48 (64/123, 52 %) or 60 h (72/122, 59 %) following the 7-11 Synch protocol. These data indicate that the 7-11 Synch protocol provides flexibility to AI cows at fixed times between 48 and 60 h following administration, resulting in high fertility and eliminating the need to detect estrus. Further research is needed to confirm results from this study and more precisely determine the most effective timing of AI following administration of the 7-11 Synch protocol. (Supported by grants from Select Sires Inc., and USDA-NRI 2000-02163.)

Key Words: Bos indicus, Progesterin, Synchronization


The objective of this study was to examine the effect of timing of fixed-time AI (TAI) in the CO-Synch protocol on pregnancy rates in cows not displaying estrus by 48 h after prostaglandin. Postpartum beef cows (n = 825) from four herds were synchronized with an injection of GnRH (100 µg, Cysterolin) on d 0 followed by PGF (25 mg, Lutalyse) on d 7. Estrus detection was performed twice daily from d 6 to d 9. Cows detected in estrus (HD) were bred by AI 12 h after estrus. At 48 h after PGF, all cows not detected in estrus were randomly assigned by parity and days postpartum (74.5 ± 0.5 d) to TAI at 48 h (TAI48) or 64 h (TAI64). All TAI48 and TAI64 cows received an injection of GnRH (100 µg) at AI. Body condition score (BCS; 5.2 ± 0.02) was recorded at initiation of synchronization. Pregnancy was determined by ultrasonography between d 45 and d 60 post AI. Pregnancy rates to TAI were different across herds (herd x TAI, P < 0.05). In three herds, pregnancy rates were similar (P > 0.3) between TAI48 and TAI64 cows; whereas, in one herd pregnancy rate was greater (P < 0.002) in TAI64 than TAI48 cows. Across all herds, pregnancy rates were greater (P < 0.001) in cows bred after HD (66.8 %; 129/193) compared to cows bred TAI48 (40.7 %;129/317) or TAI64 (41.3 %; 190/315). Overall pregnancy rate for all AI times was 47.0 % (388/825). The percentage of cows bred after HD was influenced by herd (P < 0.01) with a range of 5.3 to 26.6 %. Pregnancy rate to timing of AI was not affected (P > 0.10) by BCS or days postpartum. We conclude that, in the CO-Synch protocol, TAI with GnRH at 48 h or 64 h after PGF results in acceptable AI pregnancy rates for cows not detected in estrus. Because TAI at 64 h would allow more cows to be inseminated following a detected estrus, heat detection + TAI64 may improve overall AI pregnancy rates.

Key Words: Estrus synchronization, Timed insemination, Beef cows

207 A timed insemination program for first service based on the use of estradiol cypionate (ECP) in lactating dairy cows. S. M. Pancari, A. Arteche, F. Silvestre, S. Kamimura, and W. W. Thatcher*, University of Florida, Gainesville, FL, USA.

Objective was to determine if ECP may replace the first GnRH injection of a HeatSynch protocol based upon a measurement of pregnancy rate in lactating dairy cows. Primiparous (n=182) and multiparous (n=237) Holstein cows were assigned randomly to either a HeatSync protocol or a Double-ECPSync protocol following a pre-synchronization program in which PGF2α (25 mg, i.m.) was given at 35 ± 3 and 49 ± 3 dpp. Cows assigned to the HeatSync protocol (n=212) received an injection of GnRH (100 µg, i.m.) at 14 d after the second PGF2α injection of the pre-synchronization sequence (63 ± 3 dpp). Seven days later (70 ± 3 dpp) PGF2α was administered followed 24 h later (71 ± 3 dpp) with an injection of ECP (1 mg, i.m.) and a timed AI at 48 h after ECP (73 ± 3 dpp). Cows in the Double-ECPSync protocol (n= 207) received an injection of GnRH (100 µg, i.m.) at 14 d after the second PGF2α injection of the pre-synchronization sequence (i.e., 56 ± 3 dpp). Ten days later (66 ± 3 dpp) PGF2α was injected followed 24 h later (67 ± 3 dpp) with an injection of ECP (1 mg, i.m.) and a timed AI at 48 h after ECP (69 ± 3 dpp). In both treatment groups, cows that were detected in heat at 24 h after ECP (1 mg, i.m.) injection were inseminated at that time. Pregnancy rates at 28 ± 1 and 63 ± 3 days following insemination did not differ between HeatSync (44.8%, 37.3%) and Double-ECPSync (39.1%, 28.0%) protocols. Risk of losing pregnancy between days 28 ± 1 and 63 ± 3 after the first service tended (P < 0.06) to be lower for the HeatSync protocol (16.8%) than the Double-ECPSync protocol (28.4%). Among cows that were not pregnant to the first service (n=230), 139 (60.4%) were re-inseminated following visual signs of estrus prior to pregnancy examination at day 28 ± 1. In conclusion, comparable pregnancy rates were achieved between Double-ECPSync and HeatSync programs in...
lactating dairy cows. However, further studies are needed to reduce pregnancy losses.

Key Words: Estradiol cypionate, Timed insemination, Pregnancy rate


Synchronization of ovulation and timed insemination with the Ovsynch protocol is a widely adopted reproductive management program in lactating dairy cattle. The probability of pregnancy is increased if a follicle is ovulated following the first injection of GnRH. In other contexts, there are some data to suggest possible positive dose response effects of GnRH. Our objective was to measure the effect of the higher than usual doses of GnRH in the Ovsynch program on first insemination pregnancy risk in dairy cows. In 6 commercial herds over 1 yr, 537 Holstein and Jersey cattle received timed first insemination between 54 and 114 DIM (median 74 DIM) following the Ovsynch protocol. All cows received GnRH, PGF2α (500 µg cloprostenol) 7 d later, followed by GnRH 48 h later and AI the next day. At each injection of GnRH, cows were randomly and blindly assigned to receive either 100 or 200 µg gonadorelin acetate i.m., resulting in 4 treatment groups denoted by dose of GnRH: 100/100, 100/200, 200/100, and 200/200. Pregnancy was diagnosed by rectal palpation > 35 d after AI. The probability of pregnancy following treatment was modelled with multivariable logistic regression, accounting for the correlation of cows within herd. Overall, there was no difference in pregnancy risk among groups (overall mean 32%). However, there was a treatment by DIM interaction. Parity and calving season covariates were not significant. Among cows bred before 75 DIM, pregnancy risks were: 100/100, 106%; 100/200, 28%; 200/100, 40%; 200/200, 24%; P = 0.01. Cows that received 200 µg GnRH at the first injection were more than 3 times more likely to be diagnosed pregnant than control cows (odds ratio = 3.4; 95% confidence interval, 1.5 - 7.5; P = 0.03); other groups did not differ from the 100/100 group. Among cows bred ≥ 75 DIM, there were no significant differences in pregnancy risk between treatment groups. We speculate that among cows bred earlier, the higher first dose of GnRH may have resulted in more cows ovulating in response to the injection, favouring the success of the Ovsynch program.

Key Words: Ovsynch, Gonadotropin releasing hormone, Postpartum

209 Resynchronization of ovulation using Ovsynch to induce second timed artificial insemination service in lactating dairy cows. P. M. Fricke1,2, and M. L. Welle3, 1University of Wisconsin-Madison, 2Miltrim Dairy, Athens, Wisconsin.

Lactating Holstein cows (n=711) received a modified Presynch protocol to initiate first postpartum (pp) timed artificial insemination (TAI) service as follows: 25 mg PGF2α, i.m. (d 183; d 233; d 463 pp); 50 µg GnRH (d 693 pp); 25 mg PGF2α, i.m. (d 673 pp) and 50 µg GnRH+TAI (d 693 pp). At first TAI service, cows were randomly assigned to initiate the first GnRH injection of Ovsynch (50 µg GnRH, i.m. 0; 25 mg PGF2α, d 7; 50 µg GnRH+TAI, d 9) at 19 d (D19), 26 d (D26), or 35 d (D35) post-TAI to induce second TAI service (Resynch) for cows failing to conceive to Presynch. All D19 cows received a GnRH injection at 19 d post TAI and continued the Ovsynch protocol only if diagnosed nonpregnant using ultrasonoson 26 d post TAI. Cows in the D26 and D35 groups initiated Ovsynch only if diagnosed nonpregnant using ultrasonoson at 26 or 33 d post-TAI, respectively. Overall conception rate to Presynch was 40.2% (857/2161) and was greater (p<0.01) for D19 (46.0%, 108/235) and D26 (42.1%, 101/240) cows than for D35 cows (32.6%, 77/236). Overall conception rate to Resynch was 32.0% (123/384) and was greater (p<0.01) for D26 (33.9%, 41/121) and D33 (37.8%, 54/143) cows than for D19 cows (23.3%, 28/120). Resynch conception rate was greater (p<0.05) for D19 cows with (27.5%, 25/91) than for cows without (10.3%, 3/29) a CL at the PGF2α injection of Ovsynch, whereas Resynch conception rate tended to be greater (p=0.09) for D26 + D33 cows with (38.7%, 75/194) than for cows without (28.6%, 20/70) a CL at the first GnRH injection of Ovsynch. For cows diagnosed pregnant to Presynch, overall pregnancy loss to d 68 of gestation was 23.4% (67/286) and was greater (p<0.01) for D19 cows with (30.8%, 30/98) than for cows without (10.3%, 3/29) for D33 cows (11.7%, 9/77). Although administration of GnRH to pregnant cows 19 d after first TAI service did not appear to induce iatrogenic embryonic loss, initiation of Ovsynch 19 d after first TAI service resulted in a lower conception rate compared with initiation of Ovsynch 26 or 33 d after first TAI service.

Key Words: Resynch, Ovsynch, Presynch


Holstein cows received a non-degradable GnRH-agonist implant (Deslorelin, 5mg) within 1 to 4 d postpartum (n=120), between June 25 to Aug. 8, for 4 comparison control cows (n=127). Enrolment consisted of normal cows with a BCS ≥ 2.75. Cows were assigned weekly and injected with PGF2α, 7 d later. Implants were removed on Aug. 28 and Sept. 4 with implant exposure ranging from 28 to 67d. Ultrasonography (US) monitored numbers of ovarian follicles and CL at 7, 28, 35, 45 and 56 and 66d of treatment or days postpartum in sub-samples of cows. At 31d after implant removal, cows enter a Pre-synch/Ovsynch protocol: GnRH on d0, PGF2α on d7, GnRH on d17, PGF2α on d24, GnRH on d26 and TAI 16h later. Cows were re-inseminated at estrus within 26d after TAI. Pregnancy rate (PR) was evaluated at 26d (US) after TAI. Blood samples were collected at: PGF2α, pre-synch, subsequent GnRH, at TAI and 8d after TAI. The implant increased number of Class 1 (3-5 mm) follicles (21.03 ± 0.66 ≤ 11.27 ± 0.58; < 0.01) and decreased numbers of Class 2 (6-9 mm; 0.08 ± 0.17 ≤ 1.93 ± 0.15 < 0.01); Class 3 (> 10 mm) follicles (0.01 ± 0.10 ≤ 1.81 ± 0.09; < 0.01), and CL (0.09 ± 0.06 < 0.7 ± 0.05; < 0.01). The implant induced delay in delivery of postpartum-heat stress damaged follicles compared to control may have contributed to lower PR. Rate of depletion of heat stressed damaged follicles may affect PR.

Key Words: Deslorelin implant, Heat stress, Fertility

211 Effect of ovulatory follicle size at time of GnRH injection or standing estrus on pregnancy rates and embryonic/fetal mortality in beef cattle. G. A. Perry1*, M. F. Smith1, M. C. Lucy2, A. J. Roberts3, M. D. MacNeil4, and T. W. Geary5, 1University of Missouri, Columbia, MO, 2USDA-ARS, Fort Keogh LARRL, Miles City, MT.

Use of GnRH in AI protocols results in ovulation of a wide range of follicle sizes. Our objective was to determine the effect of ovulatory follicle size at GnRH-induced ovulation or standing estrus on pregnancy rates and embryonic/fetal mortality. Lactating beef cows (n = 273) received the CO-Synch protocol (100 µg GnRH, i.m. on d -9; 25 mg PG, i.m. on d -2; and 100 µg GnRH, i.m. on d 0 with timed AI) or were inseminated following detection of estrus using Heatwatch (electronic mount detectors). Ovulatory follicle size was determined by transrectal ultrasonography on d 0 (timed AI) or 12 h after detection in estrus. Pregnancy rates and fetal viability were determined by transrectal ultrasonography on d 27, 41, 55, and 68 after timed-insemination. On d 27 following GnRH-induced ovulation, there was a tendency (P = 0.07) for follicle size to effect pregnancy rates [13/45 (29%), 13/22 (59%), 18/39 (46%), 11/28 (39%), 13/20 (65%), and 7/19 (37%) for ≤ 11, 11.5 to 12, 12.5 to 13, 13.5 to 14, 14.5 to 15, and ≥ 15.5 mm follicles; respectively]; however, the d 68 embryonic loss in cows that were induced to ovulate at ≤ 11 mm follicles resulted in lower (P < 0.01) pregnancy rates (8/18; 45% vs. 18 cows in each of the other groups, which were unchanged from d 27. When ovulation occurred following standing estrus (37 d AI breeding season) there was no effect of follicle size (P = 0.18) on pregnancy rates at d 25 to 39 after insemination [11/14 (79%), 14/20 (70%), 28/35 (80%), 26/41 (63%), 21/25 (84%), and 25/38 (66%) for ≤ 11, 11.5 to 12, 12.5 to 13, 13.5 to 14, 14.5 to 15, and ≥ 15.5 mm; respectively], nor were embryonic/fetal mortalities affected by ovulatory follicle diameter.

The objectives of this study were to evaluate progesterone (P4), corpus luteum (CL) and follicular response in cows after insertion of a CIDR between d 5 and 21 of the estrous cycle. Seventeen Angus cows (75 to 110 days postpartum) were estrous synchronized with the Select-Synch (a 100 µg injection of GnRH followed by a 25 mg injection PGF2α, 7 d later). At artificial insemination (AI) all cows were body condition scored and randomly assigned to one of four treatments: 1) untreated controls (n = 5); 2) administration of a CIDR on days 5 to 14 after AI (n = 4); 3) administration of a CIDR on days 14 to 21 after AI (n = 4); and 4) administration of a CIDR on days 5 to 21 after AI (on d 14 after AI the first CIDR was removed and replaced with a new CIDR; n = 4). On d 79, and -2 to 26 relative to AI, blood was collected and serum harvested daily for determination of P4 concentration, plus transrectal ultrasound of the ovaries was performed to determine follicle and CL diameters. Cows were examined for pregnancy via transrectal ultrasound on d 28 and 56. One cow in each treatment was pregnant after initial AI. Six cows were observed in estrus and inseminated by AI between d 21 and 26 (3, 1, 2, 0 for treatments 1, 2, 3, and 4, respectively). On d 56, the number of pregnancies per treatment were 3, 2, 3, 1 for treatments 1, 2, 3, and 4, respectively. Between d 5 and 21 average CL volume was greater (P < 0.01) for treatments 2 (3.8 ± 0.2 cm³), 3 (3.5 ± 0.3 cm³), and 4 (8.6 ± 0.9 cm³) than 1 (2.6 ± 0.2 cm³) and average concentrations of P4 were greater (P < 0.01) for treatment 2 (3.2 ± 0.2 ng/mL) and 4 (3.4 ± 0.2 ng/mL) than 1 (2.6 ± 0.2 ng/mL), whereas 3 (2.9 ± 0.2 ng/mL) was intermediate. Regardless of treatment CL volume and concentrations of P4 correlated (r = 0.504; P < 0.001). During d 5 to 21 the average concentration of P4 was greater (P < 0.01) in cows with a CIDR (3.8 ± 0.2 ng/mL) than those without a CIDR (3.0 ± 0.2 ng/mL). In addition, daily concentrations of P4 tended (P = 0.11) to be greater in cows with a CIDR than those without. We conclude that inclusion of a CIDR during after AI increased concentrations of P4 and enhanced CL volume during diestrus. Inclusion of a CIDR did not appear inhibit embryonic survival.

Key Words: Beef Cows, Progesterone, Estrous synchronization.

214 Application of the Cornell Nutrient Management Planning System. T. P. Tylutki*1, D. G. Fox1, and M. McMahon2, 1Cornell University, Ithaca NY USA, 2McMahons EZ Acres, Homer NY USA.

The Cornell Nutrient Management Planning System (CuNMPS) is a collection of software tools that have been developed to implement integrated nutrient management planning on dairy farms. The CuNMPS consists of the Cornell Net Carbohydrate and Protein System (for evaluating rations), and Cornell CropWare (a crop nutrient management tool). A five-year project was conducted with a case-study dairy farm to determine if applying these tools had the desired impact on nutrient management. The case-study farm (625 mature Holsteins) is located approximately 55,000 people. The farm has a tillable land base of 450 ha with a mix of well drained valley land (corn:alfalfa rotation) with a high leachability. Cows were observed for estrus continuously during daylight from 0 to 4.5 d after PGF and inseminated by AI approximately 12 h after onset of estrus. Pregnancy status was determined by ultrasound approximately 50 d after AI. One-half of the heifers inseminated at Location 1 were randomly assigned to receive an injection of hCG (Chorulon 3,333 IU i.m.) 8 d after PGF and a blood sample was collected from all heifers 14 d after PGF for P4 analysis. One-half of the heifers inseminated at Location 2 were administered hCG on d 9 after PGF and a blood sample was collected from all heifers 17 d after PGF. Heifers at Location 1 had a 93% synchronization rate, exhibited estrus 2.46 ± 0.3 d after PGF and received hCG 5.8 ± 0.3 d after AI. Progesterone concentrations were greater (P < 0.01) for hCG treated heifers at both locations, 8.6 vs 4.6 ng/mL for treatment and control at Location 1 and 11.2 vs 5.6 ng/mL for treatment and control at Location 2. Coneption rates (65 vs 70% for treatment and control, respectively) were not different (P = 0.36) at Location 1. Conception rates tended (P = 0.11) to be increased with hCG treatment at Location 2, 61 and 50% for treatment and control, respectively. In summary, hCG administration approximately 5 d after AI increased progesterone concentrations in beef heifers and tended to improve AI conception rates at one location.

Key Words: Heifers, Progesterone, hCG

Production, Management, & the Environment


Sound nutrient management practices are essential to maximize the economic benefits of manure while simultaneously reducing the risk of adverse environmental consequences. New and existing regulations have been promulgated to find the balance between normal dairy operation practices and environmental protection. The National Animal Health Monitoring Systems Dairy 2002 study surveyed dairy operations in 21 states representing 82.8% of U.S. dairy operations and 85.5% of U.S. dairy cows. One specific objective of this study was to assess nutrient management practices used on U.S. dairy operations. Approximately 55% (S.E. 2.9) of operations reported using either a gutter scraper or
mechanical alley scraper (e.g. tractor) to handle a majority of the manure on the operation. Alley flush with fresh or recycled water was used on 1.9 % (S.E. 0.4) of operations. Most operations stored manure in a manure spreader (40.8% S.E. 2.1) or in an earth basin without treatment (22.5% S.E. 1.7). Just over 20% (S.E. 1.6) of operations managed manure for nitrogen, phosphorus or potassium. Thirty-nine percent (S.E. 2.1) of operations reported that they applied manure less than 200 feet from a body of water (lake, pond, stream or river), while 37.3% (S.E. 2.1) only applied manure 1,000 feet or more from a body of water. Individual operation nutrient management plans have become required under many state and federal regulations. However, only 30.6% (S.E. 1.8) of operations reported that a written nutrient management plan was in place on their operation. When asked how they would classify their operation under the concentrated animal feeding operation (CAFO) guidelines, 38.1% (S.E. 2.1) of respondents had never heard of CAFO. 20.5% (S.E. 1.8) were not sure how their operation would be classified, 33.3% (S.E. 2.0) believed their operation would most likely not be classified as a CAFO and 8.1% (S.E. 0.9) believed their operation would be classified as a CAFO.

Key Words: Nutrient management, Manure management

216 Culling rate and death loss associations with DHIA production values. A. J. Young1, S. C. Smith2, and S. P. Trippe1,2 Utah State University, Logan, 2DHIA Computing Service, Provo, UT.

The objective of this study was to examine the relationships between culling and death losses in herds in the Western United States. The DHIA Computing Service database was queried on January 30, 2003 for herds that had more than 100 total cows, had been on test for at least a year and were located in the western U.S. (Texas to the west coast). A total of 1,005 Holsteins herds were identified, and then split into groups that milked either two or three times per day (2X or 3X). There were 734, 2X-Holstein (2X-H) herds for a total of 365,823 animals with average RHA of 9818 kg, 7.00% death loss, and a 32% cull rate. There were 269, 3X-Holstein (3X-H) herds for a total of 237,976 animals with average RHA of 9668 kg, 7.75% death loss and a 34% cull rate. There were 121 Jerseys herds with a total of 40,182 animals that had a RHA of 7110 kg, 6% death loss and a 30% cull rate (herds were not divided into 2X or 4X). Correlations between herd summary production values and culling and death loss percentage were run for each group. For 2X-H herds, the correlation of % death loss with relative value of animal culled (RV) and RHA milk was $r = -0.234$ and $r = 0.155$, respectively. For the 2X-H herds, the correlation of percent culled with RHA milk and SCS was $r = 0.065$ and $r = 0.054$, respectively. The 3X-H herds had similar correlations of % death loss with RV ($r = -0.153$) and RHA milk ($r = -0.218$). For 3X-H herds, the correlations of percent culled with RV and SCS were $r = -0.220$ and $r = 0.140$, respectively. For Jersey herds the correlation of % death loss with RV was $r = 0.325$ and with SCS was $r = 0.226$. In addition, the correlation of percent culled with RHA milk protein% was $r = 0.280$ and with the milk protein to fat ratio was $r = 0.310$. For all groups, correlations between herd size and % death loss ranged from $r = 0.005$ to 0.043. We conclude that the percent culling and death loss are not associated with herd size, and are marginally or not at all associated with RHA, SCS or milk fat and protein percentage. The possible reasons for increased % death loss are not based on these variables.

Key Words: Culling, Death loss, DHIA

217 The simulated economic cost of extended calving intervals in dairy herds and comparison of reproductive management programs. P. D. French1 and R. L. Nebel2 1Oregon State University, Corvallis, 2Virginia Tech, Blacksburg.

A computer simulation was developed to estimate the economic loss associated with extended calving intervals and to evaluate the relative cost of estrus detection and ovulation synchronization programs. Weekly production, conception, and cull events were generated for individual cows in a typical herd. Data for 10 herds of 125 cows in milk were generated over 7 years for one of 189 scenarios in a 7 by 3 by 3 factorial arrangement of treatments. Main effects were days open (85, 100, 115, 130, 145, 160, or 175), peak milk yield (36, 42 or 49 kg), break-even milk yield (14, 18, or 23 kg/d), and days in milk when open cows were designated not to breed (301, 350, or 399). Days open was increased from 85 to 175 by decreasing heat detection rate. Data were averaged annually and analyzed by the MIXED procedure of SAS. Annual income was calculated as the difference between revenue (milk, calf, and cull) and expenses (feed, replacement heifers, interest, and other). Income increased as days open decreased, culm milk yield increased, milk yield increased, and do not breed increased. For a typical herd, the loss in income per day open for each additional day open beyond 85 days in milk was $0.42, 0.42, 1.14, 1.98, 3.12, and 4.95 for 100, 115, 130, 145, 160, and 175 days open, respectively. Reduced income as days open increased was due primarily to reduced milk revenue and increased replacement expense. The cost of two estrus detection systems (HeatWatch and pedometer) and two ovulation synchronization programs (ovsynch and presynch) were compared to visual estrus detection. Components included in the cost analysis were start-up and maintenance of the system. Cost was expressed as $/pregnancy and included adjustments for additional days open beyond 85 days in milk. HeatWatch resulted in the lowest cost per pregnancy followed by pedometer, presynch, ovsynch, and visual detection. These results indicate that losses from extended calving intervals have been previously underestimated.

Key Words: Days open, Economic efficiency, Estrus detection

218 Herd management and cow productivity information from an autoregressive test-day model applied in southeastern Sicily. G. Azzarò1, S. Ventura1, J. Carvalheira2, M. Rafforz01,1, G. Licitra1,1, and S. Porto, Vairao, Portugal, 2Universidade do Porto, Vairao, Portugal, 1D.A.C.P.A., Universit di Catania, Italy, 4Department of Animal Science, Cornell University, Ithaca, 14853 NY, USA.

Test-day (TD) models can account for environmental effects associated with each record, describe the trajectory of lactation for groups of animals, and provide reliable estimates of management factors affecting herd performance. An autoregressive multiple-lactation TD animal model with DFREML methodology was used to obtain estimates of genetic parameters for TD records, cow productivity and management information of Holstein, Brown Swiss and Modicana cows (a local breed) in southeastern Sicily. repe. records from the first three lactations (1994-2000) were used to estimate the genetic (co)variance components and parameters. The edited data were 214,650 (15,161), 44,768 (3,049) and 8,669 (660) records (cows) of milk, fat and protein for Friesian, Brown Swiss and Modicana breeds. Parameter solutions were applied using the model to routinely obtain monthly estimates of management factors for the 12 months preceding the current TD for all farms, including prediction of missing and future TD yields, cumulative 305-d lactations, management and lactation curves for each trait and breeds. These results are being used to develop management schemes. Management curves for milk and components reveal within-year variation in average daily yields and seasonal effects on quality, availability and cost of feed, thus facilitating evaluation of different management programs on a monthly basis. Comparison of lactation curves may also help identify limitations in nutrition and management. This monthly information, which is available online, is now a key extension tool in assisting farmer decision making.

Key Words: Test-day model, Management

219 Seasonality of productive life of dairy cows in Florida and Georgia. B. L. Butler4 and A. de Vries, Department of Animal Sciences, University of Florida.

Seasonality of cow performance has a concern to dairy producers in the Southeast. In the hot summer months cows produce less milk. Are more difficult to get pregnant, and may be at risk of being culled. This seasonality may have major implications for optimal management decisions concerning reproduction, milk production, or the time of purchase of new animals. Our objectives were to quantify the effects of season of first calving on productive life, lifetime milk production, and first lactation cull rate of dairy cows in Florida and Georgia. Productive life is defined as the time between first calving and culling. Lifetime milk is defined as the total amount of milk produced between first calving and culling. First lactation cull rate is the fraction of cows that do not calve for a second time. DHIA lactation records were obtained and limited to cows culled primarily in 2000 (n=52,620). Monthly average productive life of cows calved for the first time in January through December were respectively 41, 48, 57, 79, 93, 96, 84, 85, 80, 80, 90, 95, and 970 days. Corresponding lifetime milk productions were respectively 21688, 21558, 21641, 20339, 21249, 18549, 17802, 19168, 19621, 20773, 21312, 21918, 21968.
and 21646 kg. First lactation milk yields were respectively 27.1%, 28.7%, 28.2%, 29.1%, 27.8%, 37.4%, 39.7%, 33.3%, 33.4%, 29.1%, 27.8%, and 27.7%. The effect of month of first calving was not significant for the monthly milk yield of older lactations. We concluded that the month of first calving has significant effects on productive life, lifetime milk production, and first lactation milk yield. Cows calving for the first time in July had the shortest productive life, lowest lifetime milk production, and highest first lactation milk yield. These results will likely have implications for optimal scheduling of reproduction, milk production, and cow replacement in Florida and Georgia.

**Key Words:** Productive Life, Dairy, Seasonality

### 220 Association between production, feed and weather on a commercial dairy - a case study. A. J. Young* and S. P. Tripp*, 1 Utah State University, Logan, 2 DHI Computing Service, Provo, Utah.

The objective of this study was to determine the associations of production, DMI, weather and ration composition with daily income on a commercial dairy. Bulk tank milk yield and components, number of milk cows at DHI test, total DM intakes from the EZ-Feed feeding program, ration composition estimated by the nutritionist and income based on either on component prices from Federal Milk Marketing Order 135 or weekly 40#-block cheese prices from the Chicago Mercantile Exchange were used to compute daily milk and DMI per cow, value of product and income over feed costs (IOFC) for a commercial dairy. Daily temperature and humidity were collected and used to compute a temperature index (THI). The study period was from 8/20/01 to 1/13/03, and the mean milk/cow per day for the period was 32.9 kg on an average of 1751 milking cows. Mean milk fat and protein were 3.53% and 3.03%, respectively. The correlation between daily milk/DMI per cow and IOFC based on the price of cheese (ChS) or price of fat and protein (FP$) was r = 0.448 and 0.371, respectively. The correlation between ChS and FP$ was r = 0.911. Value of daily product based on FP$/cow was correlated with ration rumen undegradable protein (RUP)/(r = 0.5/78) and NDF (r = 0.501). Correlations between daily DMI/cow as predicted by the ration formulation and daily DMI/cow as fed was r = 0.033. Ration cost/day was correlated with ration RUP, soluble protein and ME (r = 0.474, r = -0.492 and 0.413, respectively). Milk/cow, ration ME, ration soluble protein, ration DM%, ration carbohydrate BI fraction and ration cost/day were correlated with maximum and minimum THI at the day of decline, relative to the day the illness was diagnosed, for activity and milk yield and milk yield was in the table below for cows clinically diagnosed with ketosis, left displaced abomasum, retained placenta, and digestive disorders. Daily milk yield of sick cows was approximately 15 kg/d less than the production of healthy cows. Considering these results, cows diagnosed with ketosis, left displaced abomasum, and general digestive disorders could be detected at least five to six days earlier based on changes in daily activity and milk yield.

**Key Words:** Walking activity, Fresh cow disorder, Pedometer


Objective was to determine effects of prepartum exercise of Holstein dairy cows on blood and liver metabolites, DMI, milk yield, and health disorders. Non-lactating, multiparous pregnant cows (n = 26) were allocated into two treatments: no exercise or exercise (walking [3.25 km/h] every other day for 1.25 h from d 70 to 40 before expected calving date, and then two times a day for 1.25 h from d 40 to 21 before expected calving date). The objective of this study was to determine effects of prepartum exercise of Holstein dairy cows on blood and liver metabolites, DMI, milk yield, and health disorders. Non-lactating, multiparous pregnant cows (n = 26) were allocated into two treatments: no exercise or exercise (walking [3.25 km/h] every other day for 1.25 h from d 70 to 40 before expected calving date, and then two times a day for 1.25 h from d 40 to 21 before expected calving date). The study period was from 8/20/01 to 1/13/03, and the mean milk/cow per day for the period was 32.9 kg on an average of 1751 milking cows. Mean milk fat and protein were 3.53% and 3.03%, respectively. The correlation between daily milk/DMI per cow and IOFC based on the price of cheese (ChS) or price of fat and protein (FP$) was r = 0.448 and 0.371, respectively. The correlation between ChS and FP$ was r = 0.911. Value of daily product based on FP$/cow was correlated with ration rumen undegradable protein (RUP)/(r = 0.5/78) and NDF (r = 0.501). Correlations between daily DMI/cow as predicted by the ration formulation and daily DMI/cow as fed was r = 0.033. Ration cost/day was correlated with ration RUP, soluble protein and ME (r = 0.474, r = -0.492 and 0.413, respectively). Milk/cow, ration ME, ration soluble protein, ration DM%, ration carbohydrate BI fraction and ration cost/day were correlated with maximum and minimum THI at the day of decline, relative to the day the illness was diagnosed, for activity and milk yield and milk yield was in the table below for cows clinically diagnosed with ketosis, left displaced abomasum, retained placenta, and digestive disorders. Daily milk yield of sick cows was approximately 15 kg/d less than the production of healthy cows. Considering these results, cows diagnosed with ketosis, left displaced abomasum, and general digestive disorders could be detected at least five to six days earlier based on changes in daily activity and milk yield.


The objective of this study was to determine if daily walking activity along with daily milk yields could be used as predictors of metabolic and digestive disorders early in lactation. The data, collected from 1996 through 1999, were from 1445 dairy cows in three Florida herds. Activity and milk yield were collected from the Special Agricultural Equipment Enterprises, Mason, MI, S.A.E. Afikim computerized dairy management system. Mixed model analysis was undertaken on cows prior to their first detected heat identified by the difference in activity. A healthy cow was one that did not have an occurrence of a metabolic or digestive disorder during a full lactation. A sick cow had an occurrence of these disorders at any time during the current lactation. Metabolic disorders included Bovine Viral Diarrhea, ketosis, milk fever, and retained placenta. Digestive disorders included displaced abomasum, indigestion, reduced feed intake, trauma gastric, acidosis and bloat. Individual diseases including ketosis, left displaced abomasum, retained placenta, and digestive disorders were analyzed to find when activity and milk yield decreased before these specific disorders were clinically diagnosed. The beginning day of decline, relative to the day the illness was diagnosed, for activity and milk yield is shown in the table below for cows clinically diagnosed with ketosis, left displaced abomasum, retained placenta, and digestive disorders. Daily milk yield of sick cows was approximately 15 kg/d less than the production of healthy cows. Considering these results, cows diagnosed with ketosis, left displaced abomasum, and general digestive disorders could be detected at least five to six days earlier based on

### Key Words: Walking activity, Fresh cow disorder, Pedometer
Steps/minute of a dancing cow, counted from videotape, were correlated with non-sinusoidal 8.1 to 14.6 mVp impulses recorded by oscilloscope from EKG patches on legs. PUC standards and use of shunt resistors in test circuits underestimate effects of non-sinusoidal, higher frequency voltage/current on rural power lines.

Key Words: Transients, Harmonics, Power quality


As dairy farm organizations increasingly rely on non-family employees, the need for effective human resource management (HRM) practices becomes more pressing. The goal of this research project was to gather information about human resource management practices used in progressive Pennsylvania dairy businesses. We collected a detailed set of data from 62 dairy farm managers who were nominated by extension agents, business consultants, or other industry professionals based on their knowledge of the manager. Managers who were known by the professionals to be progressive and profitable were surveyed. The survey gathered information about the managers and the HRM practices they use. Information was gathered through personal visits by project researchers. Job descriptions are a fundamental HRM tool. They improve communication between the employee and employer about specific job qualifications and responsibilities. In this sample, 22% of managers indicated that all of their full-time employees had job descriptions, 25% indicated that some of their full time employees had job descriptions, and 52% indicated that none of their full-time employees had job descriptions. The percent of managers who used job descriptions for all part-time employees was 23%, for some was 20%, and for none of their part-time employees was 57%. Standard operating procedures (SOPs) are used to reduce variation in production processes that is introduced by employees carrying out tasks differently from one person to another and from one time to the next. In this study, 47% of managers indicated that they were using SOPs to manage at least one of their production processes. Providing performance feedback to employees is a basic responsibility for any human resource manager. Thirty-one percent of managers in this sample reported that they provided frequent feedback to their employees, 67% reported that they provided feedback only when an unusual situation (good or bad) arose, and 2% reported that they provided no feedback to employees about their performance. Educational opportunities in HRM should be expanded to increase adoption of important practices.

Key Words: Human resource management, Labor, Standard operating procedures


The National Animal Health Monitoring System’s Dairy 2002 study surveyed dairy operations in 21 states representing 82.8% of U.S. dairy operations and 85.5% of U.S. dairy cows. Dairy 2002 data showed that 7.9% of participating dairies tested positive for Mycoplasma spp. when a single bulk tank sample was cultured. Western region states had a greater percentage of operations with positive cultures than operations in the Midwest, Northeast and Southeast regions. Large herds (500 head or more) were more likely to have positive cultures (21.7% S.E. ± 3.7) than medium herds (100 to 499 head) or small herds (less than 100 head) at 3.9% (S.E. 1.2) and 2.1% (S.E. 0.7), respectively. Variables potentially associated with positive bulk tank results were screened by chi square testing. Significant variables (p <0.2) were entered into a logistic regression model. Types of variables tested in the model included; the number of lactating cows brought on to the operation as a percentage of the total herd, and the outside area that dry cows have access to in the summer. Region was forced into the model as a potential confounding variable. Small and medium sized operations were 25 and 10 times less likely to have a positive bulk tank sample than large herds, respectively. Operations that added a number of lactating cows in 2001 greater than or equal to 10% of the total herd were 2 times as likely to have a positive Mycoplasma bulk tank sample.

Key Words: Mycoplasma, Milk, Survey

226 Sample collection depth and physical separation by screening affect aflatoxin concentration in contaminated corn. A. F. Harper1, J. B. Meldrum2, J. Zhao1, and M. J. Estienne1, 1Virginia Polytechnic Institute and State University, Blacksburg, 2VA-MD Regional College of Veterinary Medicine, Blacksburg.

We conducted a sampling study within a bin of corn grain (73,600 kg) previously determined to be contaminated with aflatoxin (57 ppb). The objective was to determine if depth within the bin and mechanical screening of the sample would have effects on aflatoxin concentration. Samples were collected with a probe at depths of 1, 3 and 5 m within the bin (n = 4/depth). The samples were mechanically shaken over a 0.75 mm screen to separate fine material (fines) from intact kernels. Fines made up 7.9 to 9.2 % of the weight of each sample. Dry matter, bulk density and aflatoxin concentration as detected by ELISA were determined for the separate fractions. Samples taken at 1 m depth had slightly lower dry matter than those taken at 3 and 5 m depths (87.7% vs. 88.7 and 88.6 ± 0.2 %, P <0.01). Whole kernels also had slightly less dry matter than fines (87.8 ± 0.2% vs. 88.8 ± 0.2 %, P <0.001). Samples had greater bulk density with increasing sample depth (688.9, 702.3, and 717.5 ± 3.9 g/L for 1, 3 and 5 m depth, P <0.03); and, whole kernels had greater bulk density than fines (755.8 vs. 649.9 ± 3.2 g/L, P <0.001). The aflatoxin concentration in the whole kernel fractions was 86 to 89 % lower than aflatoxin concentration in the fines (P <0.001). Samples taken at 1 m depth contained greater aflatoxin concentration than those taken at 3 and 5 m (P <0.001). The sampling depth by sample fraction interaction was significant (P <0.001). In the whole kernel sample, aflatoxin concentration was 235, 82 and 96 ± 13 ppb for depths of 1, 3 and 5 m, respectively and not different (P >0.25). In the fines fraction, mean aflatoxin concentrations were 235, 82 and 96 ± 13 ppb for depths of 1, 3 and 5 m, respectively. Aflatoxin concentration in fines from the 1 m sampling depth was greater than in fines from 3 and 5 m depths (P <0.001). These data illustrate the potential difference in aflatoxin concentration of corn at different locations within a bin. Under the conditions of this study, grain screening to remove fines would be effective in reducing aflatoxin to levels that pose little risk for swine and poultry feeding (aflatoxin <20 ppb).

Key Words: Aflatoxin, Sampling, Screening

227 Investigating effects of ambient temperature and day length on milk production of first lactation Iranian Holstein heifers. A. Nasrani2, B. Sarem1, and A. Alizadeh2, 1Ferdowsi University of Mashhad, Khorasan, Iran, 2Tarbiat Modares University, Tehran, Iran.

Heat stress is well known to depress milk yield (MY) and appetite in dairy cows. Cows in early lactation are sensitive to heat stress, and respond to heat stress by reducing milk production. The aim of this study was to investigate effects of day length (DL) and ambient temperature (AT) on milk production of first lactation Holstein heifers. This experiment was conducted during 1997-2002 at the Ferdowsi University of Mashhad dairy farm. Nutrient requirements of different groups of animals were supplied according to NRC (1989). The size of herd is one hundred cows milked daily and produced around 2.5-ton milk. Milk production data were recorded monthly and Khorasan State Climatologic Station prepared temperature and day length data. Data were analyzed using General Linear Models procedures of SAS v6.12 to evaluate differences among experimental groups. The design was completely randomized (unequal replicates). Means were compared with Duncan test. Data in this experiment showed that DL and AT had significant effects on milk production in the second and ninth months (P<0.03 and 0.01 respectively). To optimize MY, data indicate that the second month of milk production should be April, whereas November is the worst month for peak milk production. Based on these data we suggest that September is the best month for the ninth month of lactation and the worst

Key Words: Transients, Harmonics, Power quality

Key Words: Mycoplasma, Milk, Survey

Key Words: Aflatoxin, Sampling, Screening

Key Words: Transients, Harmonics, Power quality

Key Words: Transients, Harmonics, Power quality
Ruminant Nutrition: Grazing - rumen metabolism - protein


An experiment was completed to evaluate effects of corn silage allocation and within day grazing strategy on milk production (MP), milk composition, and body condition score (BCS) of early lactation grazing dairy cows (35±15 d in milk). A daily strip of pasture (1536±289 kg DM/ha), with an allowance of 15 kg DM/cow, was available to each treatment group between 9:00 and 15:00 h. Additionally, cows received 2.7 kg of concentrate at each milking (4:30 h and 15:30 h). Corn silage (16 kg/d/cow; fresh basis) was offered at 17:00 h (T1), at 8:00 h (T2) or in two equal meals at 17:00 and 8:00 h (T3). Thirty six cows were grouped by parity, MP and live weight, and randomly assigned to treatments. MP was recorded daily and milk composition was determined on four consecutive milkings each week (W). BCS was recorded at the beginning, middle and end of the study. Data was analyzed with repeated measures using the Proc Mixed procedure of SAS 8.1. Treatment, W and T*W effects were tested using a covariance structure. MP (25.4±0.94, 24.9±0.91 and 25.8±0.89 L/d for T1, T2 and T3, respectively), did not differ among treatments, but increased with time (P<0.01). There was no T*W interaction. Milk protein percent did not differ among treatments (2.98±0.05, 2.94±0.05 and 2.92±0.04 for T1, T2 and T3, respectively), although a T*W interaction (P<0.01) occurred. T2 cows lost BC at a higher rate than T1 (-0.389 vs. -0.167 units/wk) in the first half of the study but recovered BCS faster in the second half (0.057 vs. 0.135 units/W, for T2 and T1 respectively). Corn silage allocation and grazing session strategy during the day did not effect MP and composition, although it modified BCS changes which could affect reproductive performance and energy partition during the lactation.

Key Words: Grazing, Feeding strategy

229  Effect of corn silage and grazing strategy on rumen fermentation patterns of dairy cows. P. Chilibroste*, C. Baccetta1, S. Etchegaray1, I. Ferreira1, C. Lockhart1, L. Posse1, F. Elizondo1, and D. A. Mattiauda1, Facultad de Agronomía. Est. Exp. M. A. Cassinoni.

An experiment was completed to evaluate effects of within day corn silage feeding times and grazing strategy on rumen pH and ammonia concentrations of early lactation grazing dairy cows (3515 d). A daily strip of pasture (1536289 kg DM/ha; with an allowance of 15 kg DM/cow was provided to each treatment group between 9:00 and 15:00 h. Cows also received 2.7 kg of concentrate at each milking (4:30 h and 15:30 h). Corn silage (16 kg/d/cow, fresh basis) was offered at 17:00 h (T1), at 8:00 h (T2) or equally distributed at 17:00 h and 8:00 h (T3). The 36 cows were grouped by parity, milk production and live weight, and randomly assigned to treatments. Two rumen fistulated dairy cows, within each treatment, were used for rumen fluid collection. Data was analyzed as repeated measures using the Proc Mixed procedure of SAS 8.1. Treatment, week, hour of the day and the interactions were tested using a covariance structure. Rumen samples were collected at the start, middle and end of the experiment at 0, 1.5, 3.5, 5, 8.5, 10, 14 and 22 h from the beginning of the grazing session. pH was determined immediately and ammonia N was determined in samples preserved with sulfuric acid and frozen at -15C. pH declined (P<0.05) as the grazing session progressed, and T1 cows had the lowest (P<0.05) value 8 h from t=0. Ammonia concentrations increased (P<0.05) as the grazing session progressed with T1 cows having higher concentrations than T2 and T3 cows in earlier samplings. After termination of the grazing session (i.e., at t=6) ammonia N concentrations declined linearly in cows on all treatments. Differences among treatments are in the Table. Within day corn silage feeding times and grazing strategy both effect the aspect of rumen pH and ammonia N values, which could suppress pasture dry matter intake and rumen fiber digestion.

Key Words: Grazing, Feeding strategy


A computer model of a whole farm system (known as the Whole Farm Model or WFM) was used to simulate a trial where Holstein-Friesian dairy cows were fed either grass or a Total Mixed Ration (TMR). The genetics were either New Zealand (NZ) or Overseas (OS) and the groups had comparable Breeding Worths. The aim was to determine the accuracy of the WFM in predicting cow production on a high protein versus high energy feed, i.e., pasture (the main feed used in New Zealand) or TMR. The TMR did not include grass and represented the diet upon which the OS genetics had been selected to produce overseas. The WFM is a dynamic model which consists of a framework to which are attached mechanistic submodels for cow metabolism (the Molly model) and pasture growth. Characteristics (initial and dry-off liveweight and milk potential) of a representative cow from each year of the trial were entered into the WFM together with the observed climate data and management so that the cows were fed ad lib pasture or TMR as in the trial. Predicted values for milk yield (kg/cow/year), milk solids production (kg/cow/year), milk fat %, milk protein %, liveweight change during lactation (kg) and dry-off liveweight (kg) were compared for the grass versus the TMR diet. The differences were significant (P<0.001) for milk protein % (mean for grass = 3.66 %, standard error (SE) 0.02; mean for TMR = 3.39 %, SE 0.01), liveweight change during lactation (mean for grass = -12 kg, SE 28; mean for TMR = 139 kg, SE 12), and dry-off liveweight (mean for grass = 491 kg, SE 11; mean for TMR = 668 kg, SE 21). These model results agree with those from the trial. Although the trends were expected, given the higher energy content of TMR and the higher protein content of pasture, the values indicate the potential production of both NZ and OS genetics when fed well. It was concluded that the WFM model correctly predicts milk production, milk composition and body weight change in cows fed diets of different composition.

Key Words: Dairy cow, Model, Diet

231  Effect of grazing systems on chewing activity, ruminal pH fluctuations and pH of milk, blood and urine of dairy cows. C. Graf1, M. Kreuzer2, and F. Dohme*1,1 Swiss Federal Research Station for Animal Production, Posieux, Switzerland, 2 Swiss Federal Institute of Technology, Zurich, Switzerland.

Grass in its young vegetative stage is rich in rapidly-fermentable carbohydrates and poor in physical structure and therefore could cause low ruminal pH and reduced chewing activity in dairy cows on pasture. The effects of full-time grazing (G) versus part-time grazing with nightly supply of 5.5 kg DM either as hay (H) or corn silage (C) on chewing activity and pH in various body fluids and excretion products were studied in six rumen fistulated strain Swiss cows. A replicated 3 x 3 Latin square design was applied. Each experimental period lasted 28 d with sampling taking place from d 21 to 28. Grass intake was quantified by the double
alkane technique using controlled-release capsules. The pH of morning samples of milk, venous blood and urine was measured 2, 4 and 7 times per cow and period, respectively. Rumen pH was recorded continuously over 24 h except during milking with a pH electrode placed in the rumen through the fistula. These data were summarized separately for daytime and night for each cow as mean, maximum and minimum pH and time period when pH was below 5.8. The chewing activity, separated into eating and ruminating, was recorded continuously for 22 h using a behavior recorder. Grazing systems had no effect on the time spent ruminating and rumination time per kg DM intake. Cows in treatment G spent more time for eating per kg DMI (+15 min) compared to C and more time for eating per day (+121 min) compared to H and C (P < 0.05 for each). In rumin fluid, the maximum and minimum pH, the average night pH and the time period with pH < 5.8 did not differ among treatments. By contrast, throughout the day cows in treatment H had a lower mean ruminal pH (-0.24) compared to G, and the time period when pH was below 5.8 was longer with H (+66 min) compared to C (P < 0.05 for each). Milk and blood pH were not affected by treatments while urine pH tended to be lower (+0.07) in group G (P = 0.06). In conclusion, full-time grazing had no adverse effect on ruminal pH and rumination time whereas part-time grazing with nightly supply of hay caused less favourable ruminal pH conditions during the day.

Key Words: Grazing, Ruminal pH, Chewing activity


In pasture-based systems, the dietary cation-anion difference (DCAD) offered can vary from 0 to +100 meq/100g DM, but the effect of such a range on milk production is not known. Thirty-two multiparous Holstein-Friesian cows offered generous quantities of pasture (51±6 kg dry matter/100 kg body weight) 1 day were randomly assigned to one of four treatments. Treatment groups were grazed together and cows were supplemented twice daily with a mixture of NaHCO₃, MgCl₂ and CaCl₂. Final DCAD treatments were +48, +72, +99 and +116 meq/100g DM. Blood and urine pH increased (P < 0.001) linearly with increasing DCAD, as did milk base excess and blood HCO₃⁻ concentration. The ratio of calcium to creatinine in urine (CUCa) increased (P < 0.05) with decreasing DCAD, suggesting an increased intestinal absorption of Ca in cows at lower DCADs. The DCAD range tested did not affect the yield of milk or the concentration of protein or lactose. Milk fat yield and concentration increased (P < 0.05) linearly with increasing DCAD, but pasture intake, BW change and BCS change were not significantly affected. It is apparent from this study that pasture diets with a large range in DCAD do not greatly affect milk production.

<table>
<thead>
<tr>
<th>DCAD, meq/100g DM</th>
<th>+48</th>
<th>+72</th>
<th>+99</th>
<th>+116</th>
<th>SEM</th>
<th>Lin</th>
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<td>Blood pH</td>
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<td>7.45</td>
<td>7.48</td>
<td>7.49</td>
<td>0.007</td>
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**Key Words:** Grazing, Ruminal pH, Chewing activity
0.05) on milk yield, FCM, fat, protein, or SCC. However, concentration of milk solids and MUN were reduced (P < 0.05). Feeding PA had no effect (P > 0.05) on pH, or VFA and ammonia concentrations. Results of this short feeding of a polyclonal antibody preparation against rumen proteolytic bacteria indicate that this preparation may enhance milk yield in early lactation cows without affecting rumen fermentation.

**Key Words:** Rumen fermentation, Milk production, Passive immunization

235 Urea synthesis by ruminal epithelial and duodenal mucosal cells isolated from growing sheep. M. Oba*, L. R. Baldwin, IV*, S. L. Owens*, and B. J. Bequette*, 1Department of Animal and Avian Sciences, University of Maryland, College Park, MD, 2Bovine Functional Genomics Laboratory, ANRI, USDA-ARS, Beltsville, MD.

To determine the capability of ruminant gut tissues to synthesize urea, ruminal epithelial (REC) and duodenal mucosal cells (DMC) were isolated from growing Polypay ram lambs (n=4) fed a mixed forage-concentrate diet. Isolated cells were incubated for 90 min with either 5mM or 50mM urea plus four combinations of substrate to support urea synthesis (arginine, Arg; aspartate + citrulline, AspC; aspartate + ornithine + ammonia, AspON; aspartate + ornithine + ammonia + carbamoylphosphate, AspONG) in a 2 x 4 factorial arrangement of treatments. Background urea present in 0 time (Control) and total urea release was determined by stable-isotope dilution with gas chromatography-mass spectrometry. For both cell types, effects of VFA and interactions between VFA and substrate combinations were not observed. For REC, total urea release was 56.6, 6.7, 3.7, 5.8, and 2.2 nmol per 10^6 cells respectively for Arg, AspC, AspON, AspONG, and Control. Arg addition resulted in 10-fold greater (P < 0.001) urea release than other treatments that did not differ from control. For DMC, total urea release was 4.2, 2.4, 1.5, 4.0, and 2.1 nmol per 10^6 cells respectively for Arg, AspC, AspON, AspONG, and Control. Arg and AspONG treatments resulted in greater (P < 0.001) urea release than other treatments and control, indicating that ammonia N can be utilized for urea synthesis by DMC. Ammonia N can be utilized for urea synthesis by DMC. Ammonia N can be utilized for urea synthesis by DMC.

**Key Words:** Ruminal epithelial cells, Duodenal mucosal cells, Urea synthesis


Metabolizable protein (MP) recommendations by NRC (2001) were derived almost exclusively from Holstein data. The objective of this study was to assess whether the calculated recommendations are accurate for Jersey cows considering the greater protein concentration of Jersey milk. Ten multiparous and ten primiparous Jersey cows were used in a three period, five treatment crossover experimental design. Experimental periods were 4 wk in length, with d 1 to 7 used for standardization, d 8 to 14 as time for adjustment, and d 15 to 28 for data collection. Levels of supplied MP were changed solely by varying the level of RUP (RDP was constant at 10.4% of DM). The treatment diets were 80, 90, 100, 110, and 120% of the RUP recommendations according to NRC (2001) for each individual cow based on DMI, milk production and composition during wk 1 of each period when a control (RUP=100%) diet was fed. All diets contained 30% corn silage, 20% hay, 26.5% ground shell corn, and 10% whole linted cottonseed on a DM basis. A high post-ruminal digestibility bloodmeal and nonenzymatically browned soybean meal supplemented with rumen protected methionine were the sources used to modify RUP of diets by substitution with soybean hulls and urea. The level of RUP had a significant (P<0.01) positive linear effect on milk production (27.2, 26.8, 27.8, 27.8, and 29.3 kg/d), milk true protein concentration (3.69, 3.75, 3.76, 3.81, and 3.80 %), milk true protein production (1.000, 1.001, 1.046, 1.056, and 1.109 kg/d) and milk urea N (11.2, 12.0, 15.5, 13.3, and 18.7 mg/dL) for 80 to 120 % of NRC RUP respectively. Quadratic, cubic and quartic effects of RUP were not significant (P>0.10) for all variables except for a significant quadratic effect of RUP on MUN. Milk fat concentration (5.09 %), fat production (1.402 kg/d), log SCC (5.41), body weight (417.5 kg), body condition score (2.85), and DMI (17.9 kg/d) were not affected (P>0.10) by RUP levels. These results suggest that NRC (2001) either overestimate MP supply from microbial or feed origin, or underestimate MP requirements of Jersey cows.

**Key Words:** Metabolizable protein, Rumen undegradable protein, Jersey cows


The objective of this study was to evaluate the effect of dietary CP level and degradability on N utilization in lactating dairy cows. Four ruminally and duodenally cannulated Holstein cows were allocated to two dietary treatments in a crossover design. The diets were based on alfalfa hay, triticate silage, cottonseed, corn, soybean meal, and molasses and were formulated to provide similar metabolizable protein but different levels of ruminally degradable protein; CP content of the diets was 18.5 (HP) and 17.2% (LP). Ruminal ammonia was labeled with ^15N and excretion of tracer in milk protein was determined for a period of 120 h. Ammonia concentration in the rumen tended to be higher (P < 0.1) on HP than LP. Microbial N flow to the duodenum, ruminal digestibility of dietary nutrients, DMI, milk yield, fat content, and protein content and yield were not different (P > 0.05) between the diets. Total tract apparent digestibility of N was higher (P < 0.05) on the HP diet than on the LP diet (73.0 vs 69.0 %, respectively). Urinary N excretion tended to be higher (P < 0.1) on HP than on LP (0.348 vs 0.274 kg/d, respectively). The cumulative excretion of ammonia ^15N into milk protein, as proportion of ^14N dosed intraruminally, was not different between the two diets (11.8 vs 14.3%, respectively). The area under the milk protein ^14N excretion curve was greater (P < 0.05) for LP compared to HP (1.049 vs 0.957 at % exc. × h, respectively). The proportions of bacterial protein originating from ammonia N and milk protein originating from bacterial N were not different (P > 0.05) between the two diets. Milk urea N concentration was higher (P < 0.05) for HP than for LP (15.8 vs 13.1 mg/dl, respectively). In conclusion, excess RDP in the diet resulted in higher ruminal ammonia and milk urea N concentrations but had no significant effect on the efficiency of utilization of ruminal ammonia for milk protein, urinary N losses, or milk yield and fat protein content.

**Key Words:** Dietary protein, Rumen ammonia, Milk protein

238 Use of milk urea nitrogen to evaluate dietary protein on commercial dairy farms. A. B. Peterson* and R. A. Kohn, University of Maryland, College Park, Maryland.

The first objective was to evaluate the potential for using milk urea N (MUN) to identify overfeeding or underfeeding of protein on commercial dairy farms. The second objective was to use MUN and ration analysis to determine if dairy producers were feeding protein as recommended by the National Research Council (NRC). A previously developed model was used to predict MUN concentrations using milk yield and ration CP% and NE^L. A target MUN was calculated using NRC’s dietary recommendations. If cows were receiving more protein than recommended by NRC then their observed MUN values would be higher than expected and visa versa. Bulk tank and TMR samples, as well as milk production and cow information, were collected from twelve Holstein dairy farms across Maryland repeatedly in March, June, September and December (n=73). Predicted MUN explained 40% of the variation in observed MUN and 8% was explained by collection month (P < 0.05). This model predicted MUN to be 2.2 mg/dl greater than was observed (residual error = 2.8 mg/dl). Observed MUN was influenced by collection month, farm, average days in milk, and dietary CP% (P < 0.05). There is a correlation between MUN and dietary CP% where high MUN indicates high dietary CP% (P < 0.0001). Both TMR and MUN analyses suggested that cows were overfed protein 69% of the time. Additionally, 9.9% of the time, both analyses suggested that cows were underfed protein which resulted in an overall agreement of both methods at 78.9%. However, nearly 20% of the time, the TMR analysis (used in calculating predicted MUN value) indicated that cows were being overfed protein while observed MUN values suggested that cows were not receiving adequate protein. Using observed MUN values
resulted in an under-prediction of protein feeding status compared to using TMR analyses, but most dairy producers were feeding over NRC recommendations for protein.

Key Words: Milk urea ditrogen, Dietary protein

239 Effect of increased rumen-undegradable protein fed prepartum on milk production and milk protein yield in early lactation for high producing Holstein cows. K. M. Kouri*, S. M. Andrew, and T. A. Hoagland, University of Connecticut, Storrs, CT, USA.

Thirty-six, twenty-four multiparous and twelve primiparous, Holstein cows were assigned to one of three treatments to evaluate the impact of feeding higher rumen-undegradable protein (RUP) for four weeks prepartum on milk production, milk protein content and yield of milk protein during early lactation in corn silage-based rations. The prepartum basal diet consisted of 37% corn silage, 11.3% alfalfa silage, 35.8% mixed hay and 10.3% concentrate mix (DM basis) fed as a TMR. The control treatment (CT) was formulated to provide RUP at 31% of CP using soybean meal (SBM). Diet RUP was increased for the other two treatments to 36% of CP, by substituting either heat-treated soybean meal (HTSBM) or animal-marine byproduct (AMP) for SBM. Cows were blocked by parity, expected calving date, body condition score (BCS) and randomly assigned to one of the three treatments. Prepartum treatment rations were fed to maintain BCS for at least 28 d prepartum. Following parturition cows were fed a common lactating cow ration for 56 d postpartum. Daily dry matter intake (DMI), weekly body weight (BW), and bimonthly BCS were measured throughout the entire experiment. Upon parturition, daily milk weights were recorded and weekly milk samples were collected for determination of milk true protein, milk fat, milk urea nitrogen (MUN), somatic cell count (SCC), and total solids (TS). There were no treatment differences for DMI, BW, BCS, milk protein, SCC or TS. There was a trend for increased milk production (P=0.07) and milk protein yield (P=0.17) for multiparous cows fed HTSBM compared with multiparous cows fed CT. No treatment difference in these variables was observed for primiparous cows. MUN tended to be higher for multiparous cows fed HTSBM, compared to multiparous cows fed the CT. Increasing the RUP in the prepartum ration by feeding HTSBM tended to increase milk production and milk protein yield in the subsequent lactation for multiparous cows fed higher levels of RUP.

Key Words: Rumen undegradable protein, Prepartum, Milk protein

240 Strategic ration balancing by supplementing lysine, methionine, and Prolak® on efficiency of milk protein production and potential environmental impact. J. H. Harrison1, R. L. Kincade2, W. Schager1, L. Johnson1, D. Davidson1, L. D. Bunting2, and W. Chalupa1, 1Washington State University, 2Archer Daniels Midland Co., 3University of Pennsylvania.

The primary objective of this study was to reduce dietary CP of lactating cows without reducing milk yield. A second objective was to reduce farm N import. Three diets were formulated using the CPM Dairy model to vary in content of CP, metabolism protein balance, and predicted balance of Met and Lys. According to estimated % Lys and Met sufficiency, treatments were defined as Lys/Met = 89/91 (control), Lys/Met = 99/116, and Lys/Met = 116/119. Ration CP was effectively reduced by 14% (18.6 % CP vs 16.0 % CP) with inclusion of a commercial source of free lysine (Archer Daniels Midland, Decatur, IL), Met (Alimet®, Novus International, St Louis, MO), and a commercially available RUP source (Prolak®). H J Baker, Atlanta, GA). Respective diets were fed in a 14-week continuous trial design. Cows (n = 36) were paired for parity and PTA prior to initiation of the study, then fed individually via Calan® gates. Cows were milked 2x/day and were provided two sorghum brown midrib genes on lactational performance, ruminal metabolism, and digestion. Sixteen multiparous Holstein dairy cows (including four ruminally fistulated) averaging 124 ± 68 DIM were assigned to one of four diets in a replicated Latin square design with 3-week periods. Diets comprised of 40 % test silage, 10 % alfalfa silage, 3.7 % whole cottonseed, and 23.6 % concentrate mix. Cows were housed in a tie-stall barn and fed in individual feed boxes. Lignin was decreased

241 Effect of HMB and HMBi on milk production, composition, and N efficiency of Holstein cows in early and mid-lactation. J. T. Sylvester1, N. R. St-Pierre1, B. K. Sloan2, J. L. Beckman3, and S. M. Nootsger1, 1The Ohio State University, Columbus, OH, USA, 2Adisseo, Alpharetta, GA, USA.

Dietary supplementation of 2-hydroxy-4-(methylthio)-butanoic acid (HMB) results in inconsistent increases in milk yield, fat content and fat production. Chemical modification of HMB to an isopropyl ester (HMBi) increases its methionine (Met) bioavailability to approximately 50%. The objectives of this study were (1) to determine the lactation response (volume and components) to ruminally available Met (HMB), (2) to determine the lactation response to partially protected Met provided as HMBi, and (3) to evaluate whether HMBi supplied at 0.15% of the diet provides enough ruminally available HMB to achieve maximal production response. Sixty-one Holstein cows (24 primiparous, 37 multiparous) were assigned to one of four dietary treatments 21 to 28 days after calving. A base diet consisting of (DM basis) 32.5 % corn silage, 17.5 % alfalfa hay, 10 % whole cottonseed and 40 % of a pelleted concentrate made primarily of ground corn, soybean hulls, Megalac, dehulled-solvent extracted soybean meal, blood meal, urea, vitamins and minerals was fed for 16 weeks as a control diet (treatment 1), or was supplemented with 0.1% of diet DM with HMB (treatment 2), or with 0.15% with HMBi (treatment 3), or with 0.045% HMB and 0.15% HMBi (treatment 4). The control diet contained an estimated 31.3 % NDF, 10.6 % RDP, 6.2 % RUP, 10.9% metabolizable protein (MP), 6.78% lysine (% of MP), and 1.79 % methionine (% of MP). Results were analysed as a randomized block design with repeated measurements using a mixed model with a first order autoregressive covariance of errors. Results showed a significant (P<0.05) increase in milk yield (2.9 kg/d), true protein composition (0.15%), true protein production (115 g/d), fat production (165 g/d), and lactose production (182 g/d) from the feeding of HMBi. Supplementation of HMB had non-significant effects on milk yield and composition with only lactose production showing a significant improvement. Dietary supplementation of HMBi reduced the amount of N excreted in the urine by increasing the amount of N secreted in milk.

Key Words: Methionine hydroxy analog, Dairy cattle, Milk yield and composition

Ruminant Nutrition: Dairy feedstuffs

242 Effect of bmr-6 and bmr-18 brown midrib genes on forage sorghum silage in lactating rations. A. L. Oliver1, R. J. Grant1, and J. F. Pedersen2, 1University of Nebraska, Lincoln, NE, 2USDA/ARS, Lincoln, NE.

Diets of normal sorghum, brown midrib bmr-6 sorghum, bmr-18 sorghum, and corn silage were fed to determine the effect of these,

Key Words: Protein, Environment, Nutrient management

Posilac®. Diet reformulation was successful in reducing (P < .05) N imported by 8.6 %, increasing PCM, reducing MUN, and improving efficiency of milk protein yield. A proper balance of Lys/Met was necessary to maintain milk production when CP% was reduced in the diet. The apparent imbalance of Lys/Met in the second treatment decreased milk fat% and production of PCM. This study illustrates the benefits of reducing dietary CP and improving efficiency of milk protein production. Detailed data are summarized below.
in the bmr-6 and bmr-18 sorghum silage when compared to the normal sorghum silage. In addition, the normal sorghum silage had greater NDF and ADF than bmr-6, bmr-18, and corn silage. There was greater DMI for bmr-6 (25.2 kg/d) sorghum silage than bmr-18 (23.4 kg/d) sorghum silage while no difference was seen between sorghum silages and corn silage. Milk production (kg/d) and 4 % FCM were significantly greater (P < 0.10) for those consuming the bmr-6 sorghum and corn silage than normal sorghum silage. Silage source had no effect on overall chewing time. Eating time was increased (P < 0.10) with the normal and bmr-18 sorghum silages. Ruminating time was greatest with bmr-6 sorghum silage. Corn, bmr-6, and bmr-18 sorghum silage had greater (P < 0.10) DM digestibility when compared to normal sorghum silage. Corn silage and bmr-6 sorghum had higher NDF digestibility (P < 0.10) when compared to bmr-18 and normal sorghum silage.

Key Words: Brown midrib, Sorghum, Milk production

243 Comparison of a corn silage hybrid with high cell wall content and digestibility with a lower cell wall hybrid on lactational performance of Holstein cows. S. K. Iwan*1, R. J. Grant1, D. Weakley2, and J. Beck3, 1University of Nebraska, Lincoln, NE, 2Purina Mills, St. Louis, MO, 3Syngenta Seeds, Golden Valley, MN.

We hypothesized that substituting a corn silage hybrid with high cell wall content and digestibility for a lower cell wall hybrid with lower digestibility would improve feed intake and milk production in lactating Holstein cows. In trial 1, 40 cows (12 primiparous) ranging in milk production from 24.1 to 44.0 kg/d, after a 2-wk preliminary period, were used in a crossover design with 2-wk periods. Diets consisted of either high cell wall and digestibility corn silage (HCW) or 45% lower cell wall corn silage (LCW) plus 10% alfalfa hay, and 45% concentrate. There was a 5.1 percentage-unit range in NDF content and a 5.3 percentage-unit range in 30-h in vitro NDF digestion between the two corn hybrids. The DMI (25.4 vs 24.2 kg/d) and 4% FCM yield (34.3 vs 31.7 kg/d) were higher (P <0.05) for cows fed the HCW diet compared with the LCW diet. Milk composition was unaffected by diet (P >0.20). When LCW was substituted for HCW on a DM basis, there was a linear and quadratic (P <0.01) relationship between preruminal milk yield and response to HCW silage. When HFW-6 was substituted for LCW on a DM basis, there was a linear and quadratic (P <0.02) relationship between preruminal milk yield and response to HCW: cows with greater milk production, DMI, and increased 3.5% FCM (P = 0.10). Flavor endosperm decreased 3.5% FCM 1.2 kg/d compared to viscous endosperm when fed with control corn silage (39.7 vs. 40.3 kg/d, P < 0.05). The interaction of treatment was detected for 3.5% FCM (P = 0.05). Intermeal interval was not affected by treatment. It is unlikely that ruminal distension limited DMI because effects of treatment on meal size and DMI were likely from differences in temporal patterns of feed production and absorption.

Key Words: Corn grain, Starch degradation, Endosperm type

245 Effects of corn grain endosperm type and brown midrib corn silage on milk production and feeding behavior of lactating dairy cows. C. C. Taylor* and M. S. Allen, Michigan State University, East Lansing.

Effects of endosperm type of corn grain and the brown midrib 3 mutation in corn silage on milk yield, DMI, and feeding behavior of cows were evaluated. Eight ruminally and duodenally cannulated Holstein cows (72 ± 8 DM; mean ± SD) were used in a duplicated 4 x 4 Latin square design with a 2 x 2 factorial arrangement of treatments. Grain treatments were dry corn grain from hybrids with floury or viscous endosperm, and silage treatments were corn silage from a hybrid with the bm3 mutation or an isogenic control hybrid without the bm3 mutation. Diets were formulated to 27% neutral detergent fiber and 18% crude protein. Corn grain and silage supplied ~23% and ~38% of the diet DM, respectively. An interaction of treatments was detected for 3.5% FCM (P = 0.10). Flavor endosperm decreased 3.5% FCM 1.2 kg/d compared to viscous endosperm when fed with control corn silage (39.7 vs. 40.3 kg/d, P < 0.05) and ruminal fermentation was lower when fed with the control corn silage (39.7 vs. 40.3 kg/d, P < 0.05). The interaction of grain and silage treatments for DMI can be attributed to a decrease in meal size for floury vs. viscous corn with control corn silage (21.8 vs. 2.47 kg DM) but an increase in meal size for floury vs. viscous corn with the bm3 corn silage (25.2 vs. 24.7 kg/d, P < 0.03). Diets containing bm3 corn silage tended to increase number of meals compared to control corn silage (11.7 vs. 10.6; P < 0.10). Intermeal interval was not affected by treatment. It is unlikely that ruminal fermentation or ruminal pH affected treatment on meal size and ruminal pool sizes of DM and NDF (interactions P > 0.05) reflected effects of treatment on DMI. Treatment effects on meal size and DMI were likely from differences in temporal patterns of feed production and absorption.

Key Words: Endosperm, Brown midrib, Feeding behavior

246 Dairy cattle performance, health, and milk composition when fed silage and grain from Bt (Cry1F) and near-isogenic control hybrids. M. A. Faust*1, B. Smith2, M. Hinds2, and G. Dana3, 1Iowa State University, Ames, 2Pioneer Hi-bred International, Inc., Johnston, IA.

Objectives for this study were to evaluate the health and performance of dairy cows fed non-Bt maize and a new generation variety of Bt maize containing the Cry1F gene (HericulexTM 1). Twenty lactating Holstein cows were assigned to treatment groups and fed diets containing whole plant maize silage and maize grain from Bt and near-isogenic control hybrids. The study used a 2-treatment 2-period crossover design. Cows were fed with control maize grain and silage or maize grain and silage from a hybrid with the bm3 mutation or an isogenic control hybrid without the bm3 mutation. Cows were fed with BM3 maize grain and silage decreased DMI 1.8 kg/d compared to viscous maize when fed with the control silage diets (25.4 vs. 25.0 kg/d, P < 0.05). Milk production was decreased with BM3 maize silage (20.4 vs. 19.7 kg/d, P < 0.05) and increased 3.5% FCM (P = 0.05). The interaction of grain and silage treatments for DMI can be attributed to a decrease in meal size for floury vs. viscous corn with control corn silage (21.8 vs. 2.47 kg DM) but an increase in meal size for floury vs. viscous corn with the bm3 corn silage (25.2 vs. 24.7 kg/d, P < 0.03). Diets containing bm3 corn silage tended to increase number of meals compared to control corn silage (11.7 vs. 10.6; P < 0.10). Intermeal interval was not affected by treatment. It is unlikely that ruminal fermentation or ruminal pH affected treatment on meal size and ruminal pool sizes of DM and NDF (interactions P > 0.05) reflected effects of treatment on DMI. Treatment effects on meal size and DMI were likely from differences in temporal patterns of feed production and absorption.

Key Words: Starch degradation, Endosperm type
Eight multiparous (126 DM) Holstein cows (mean live-weight 647 kg) were used in a single reversal study to assess effects of feeding genetically modified alfalfa silage and milk production. Diets contained (DM basis) 45% corn silage, 10% alfalfa hay and 45% concentrate (1.66 Mcal NE/kg DM, 15.8% CP, 35% NDF and 4.1% fat). Treatments were corn silage containing Roundup Ready even GA21 (RRM) and a non-modified control line (CTR). Milk was analyzed for fat, protein, solids-non-fat, lactose and somatic cell counts, and transgenic DNA and CRY1A(b)-protein. Chemical composition (37.6% DM, 1.51 Mcal NE/kg, 8.6% CP, 40% NDF, 19.6 ADF, and pH 3.76) and in vitro DM digestibility (62% of corn silages were within normal ranges and similar between treatments. Silage type did not affect DM intake (22.1 kg/ cow/d). Cows fed the RRM produced milk with slightly higher (P < 0.05) milk protein (3.09 vs 3.00%), lactose (4.83 vs 4.72%) and solids-non-fat (8.60 vs 8.40%) compared with CTR. However, the total yield (kg/d) of milk (54.0 vs 52.4b), fat (24.7 vs 24.0b), lactose (46.9a vs 46.7b), protein (28.2a vs 26.9a) was significantly decreased the proportion of dietary DM passing through the 8 mm bottom screen of the Penn State Particle Separator (PSPS) and dietary DM content, significantly increased the physical effective NDF (pNDF, NDF retained by the PSPS screens), but did not effect dietary CP, NDF and starch contents in both experiments. In the higher concentrate range, this replacement significantly increased rumen pH, VFA concentrations, DM, milk yield and milk composition. This replacement did not significantly affect rumen pH, VFA concentrations, DM, milk yield and milk composition in the lower concentrate range.

Key Words: Key Words: Genetically modified corn, Dairy cattle, Milk yield

247 Effects of feeding corn silage produced from corn containing MON810 and GA21 genes on feed intake, milk production and composition in lactating dairy cows. S. Callum1, A. Hernandez1, G. F. Hartnell2, and R. H. Pinches3, 1 Universidad Autonoma de Barcelona, Spain, 2 Monsanto Company, St. Louis, MO, 3 University of Reading, UK.

Eight multiparous (126 DM) Holstein cows (mean live-weight 647 kg) were used in a single reversal study to assess effects of feeding genetically modified alfalfa silage and milk production. The potential for transgenic DNA and proteins to occur in milk was also evaluated. The trial consisted of two periods of 28 d (23 d adaptation and 5 d sampling). Cows were housed in a tie-stall barn, fed a TMR ration ad libitum and milked twice daily. Diets contained (DM basis) 45% corn silage, 10% alfalfa hay and 45% concentrate (1.66 Mcal NE/kg DM, 15.8% CP, 35% NDF and 4.1% fat). Treatments were corn silage containing Roundup Ready even GA21 (RRM) and a non-modified control line (CTR). Milk was analyzed for fat, protein, solids-non-fat, lactose and somatic cell counts, and transgenic DNA and CRY1A(b)-protein. Chemical composition (37.6% DM, 1.51 Mcal NE/kg, 8.6% CP, 40% NDF, 19.6 ADF, and pH 3.76) and in vitro DM digestibility (62% of corn silages were within normal ranges and similar between treatments. Silage type did not affect DM intake (22.1 kg/ cow/d). Cows fed the RRM produced milk with slightly higher (P < 0.05) milk protein (3.09 vs 3.00%), lactose (4.83 vs 4.72%) and solids-non-fat (8.60 vs 8.40%) compared with CTR. However, the total yield of milk (54.0 vs 52.4b), fat (24.7 vs 24.0b), lactose (46.9a vs 46.7b), protein (28.2a vs 26.9a) was significantly decreased the proportion of dietary DM passing through the 8 mm bottom screen of the Penn State Particle Separator (PSPS) and dietary DM content, significantly increased the physical effective NDF (pNDF, NDF retained by the PSPS screens), but did not effect dietary CP, NDF and starch contents in both experiments. In the higher concentrate range, this replacement significantly increased rumen pH, VFA concentrations, DM, milk yield and milk composition. This replacement did not significantly affect rumen pH, VFA concentrations, DM, milk yield and milk composition in the lower concentrate range.

Key Words: Key Words: Genetically modified corn, Dairy cattle, Milk yield

248 Effects of replacing chopped alfalfa hay with alfalfa silage in total mixed rations fed to lactating dairy cows at two levels of concentrate inclusion. M. S. Einason1, J. M. Callbery2, B. W. McSride2, K. M. Wittenberg2, and J. C. Plaizier3, 1 Department of Animal Science, University of Manitoba, 2 Department of Animal and Poultry Science, University of Guelph.

Twenty four lactating dairy cows received one of three total mixed rations (TMR) in a higher concentrate range (Exp. I) or a lower concentrate range (Exp. II). Diets in the higher concentrate range (A, B and C) contained (DM basis) 38.5% barley grain based energy supplement, 30.5% corn silage, 17% protein supplement and 4.2% sunflower sunflower seeds. Diets in the lower concentrate range (D, E, and F) contained (DM basis) 31.7% barley grain based energy supplement, 40.5% corn silage, 13.9% protein supplement and 4.2% sunflower sunflower seeds. Diets also contained (DM basis) 40% corn silage in total mixed rations fed to lactating dairy cows were not different (P > 0.05). Physical measures of cow health were collected weekly and included body weight, body condition score, temperature, and pulse and respiration rate; treatment group means for these parameters were not different. Blood chemistry and hematological analyses were conducted using blood samples collected from cows at two-week intervals. Overall, the Bt and non-Bt fed groups did not differ for these 21 indices of health. Further, hematological profiles for cows in the treatment groups were not different (P > 0.05). In summary, there were no differences in milk production, milk composition, or cow health as indicated by physical parameters, blood chemistry, and hematological analyses when dairy cows were fed diets containing maize grain and whole plant maize silage from Bt (Cry1F) or its near-isogenic counterpart hybrid. Eight multiparous (126 DM) Holstein cows (mean live-weight 647 kg) were used in a single reversal study to assess effects of feeding genetically modified alfalfa silage and milk production. The potential for transgenic DNA and proteins to occur in milk was also evaluated. The trial consisted of two periods of 28 d (23 d adaptation and 5 d sampling). Cows were housed in a tie-stall barn, fed a TMR ration ad libitum and milked twice daily. Diets contained (DM basis) 45% corn silage, 10% alfalfa hay and 45% concentrate (1.66 Mcal NE/kg DM, 15.8% CP, 35% NDF and 4.1% fat). Treatments were corn silage containing Roundup Ready even GA21 (RRM) and a non-modified control line (CTR). Milk was analyzed for fat, protein, solids-non-fat, lactose and somatic cell counts, and transgenic DNA and CRY1A(b)-protein. Chemical composition (37.6% DM, 1.51 Mcal NE/kg, 8.6% CP, 40% NDF, 19.6 ADF, and pH 3.76) and in vitro DM digestibility (62% of corn silages were within normal ranges and similar between treatments. Silage type did not affect DM intake (22.1 kg/ cow/d). Cows fed the RRM produced milk with slightly higher (P < 0.05) milk protein (3.09 vs 3.00%), lactose (4.83 vs 4.72%) and solids-non-fat (8.60 vs 8.40%) compared with CTR. However, the total yield of milk (54.0 vs 52.4b), fat (24.7 vs 24.0b), lactose (46.9a vs 46.7b), protein (28.2a vs 26.9a) was significantly decreased the proportion of dietary DM passing through the 8 mm bottom screen of the Penn State Particle Separator (PSPS) and dietary DM content, significantly increased the physical effective NDF (pNDF, NDF retained by the PSPS screens), but did not effect dietary CP, NDF and starch contents in both experiments. In the higher concentrate range, this replacement significantly increased rumen pH, VFA concentrations, DM, milk yield and milk composition. This replacement did not significantly affect rumen pH, VFA concentrations, DM, milk yield and milk composition in the lower concentrate range.

Key Words: Physical effective NDF, Dairy cows, Rumen


Diluting alfalfa silage with corn silage may be useful for improving N efficiency in dairy cattle. Twenty-eight lactating Holstein cows (8 runiminally fistulated) were randomly assigned to 7, X4 X replicated Latin squares with 28-d periods to assess the effects of different ratios of alfalfa to corn silage on milk production, rumen metabolism, and N utilization. Diets contained (DM basis) 45% corn silage, 10% alfalfa hay and 45% concentrate (1.66 Mcal NE/kg DM, 15.8% CP, 35% NDF and 4.1% fat). Treatments were corn silage containing Roundup Ready even GA21 (RRM) and a non-modified control line (CTR). Milk was analyzed for fat, protein, solids-non-fat, lactose and somatic cell counts, and transgenic DNA and CRY1A(b)-protein. Chemical composition (37.6% DM, 1.51 Mcal NE/kg, 8.6% CP, 40% NDF, 19.6 ADF, and pH 3.76) and in vitro DM digestibility (62% of corn silages were within normal ranges and similar between treatments. Silage type did not affect DM intake (22.1 kg/ cow/d). Cows fed the RRM produced milk with slightly higher (P < 0.05) milk protein (3.09 vs 3.00%), lactose (4.83 vs 4.72%) and solids-non-fat (8.60 vs 8.40%) compared with CTR. However, the total yield of milk (54.0 vs 52.4b), fat (24.7 vs 24.0b), lactose (46.9a vs 46.7b), protein (28.2a vs 26.9a) was significantly decreased the proportion of dietary DM passing through the 8 mm bottom screen of the Penn State Particle Separator (PSPS) and dietary DM content, significantly increased the physical effective NDF (pNDF, NDF retained by the PSPS screens), but did not effect dietary CP, NDF and starch contents in both experiments. In the higher concentrate range, this replacement significantly increased rumen pH, VFA concentrations, DM, milk yield and milk composition. This replacement did not significantly affect rumen pH, VFA concentrations, DM, milk yield and milk composition in the lower concentrate range.

Key Words: Physical effective NDF, Dairy cows, Rumen

Whole plant corn (Pioneer hybrid 38K06; RM 93 d) planted on May 4, 2001 on four plots, was harvested at 35% DM content and processed using one of three methods prior to ensiling: (1) chopped at 0.95-cm theoretical length of cut (TLC) and unprocessed; (2) chopped at 1.91-cm TLC and processed with 3 mm roll clearance; and (3) chopped at 1.91 cm TLC and processed with 1-mm roll clearance. Forage samples were ensiled in laboratory minisilos that were sealed for 130 days and analyzed for theoretical length of cut (TLC) and processed with 3 mm roll clearance; and (3) chopped at 1.91 cm TLC and processed with 1-mm roll clearance. Forage samples (approx. 6 g DM basis) were weighed into Dacron bags (10 x 20 cm) in triplicate and incubated into the rumen of a lactating dairy cow for 24 h to determine apparent DM (DMDa), NDF (NDFd), and apparent starch (Starch-d) disappearances. Repeatability of each method used to prepare the samples prior to in situ digestion was determined by measuring the coefficient of variation among the replicates. In summary, pseudo-mastication and grinding increased NDFd of corn silage from forage processed with 3-mm roll clearance at harvest.

Main Effects

<table>
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<tr>
<th>Item</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>SE</th>
<th>P-value</th>
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<td>23.27</td>
<td>40.0</td>
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<tr>
<td>DMI, kg/d</td>
<td>26.5a</td>
<td>25.9a</td>
<td>25.0b</td>
<td>23.2c</td>
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<td>BW gain, kg/d</td>
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<td>0.90</td>
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<td>1.03</td>
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<tr>
<td>Milk yield, kg/d</td>
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<td>42.0a</td>
<td>41.5a</td>
<td>39.5b</td>
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<tr>
<td>Milk fat, kg/d</td>
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<td>1.52b</td>
<td>1.41a</td>
<td>1.35c</td>
<td>0.07</td>
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<td>Milk protein, kg/d</td>
<td>1.26</td>
<td>1.32</td>
<td>1.30</td>
<td>1.26</td>
<td>0.03</td>
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<td>Urinary N excretion, g/d</td>
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<td>429a</td>
<td>401a</td>
<td>367b</td>
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<td>7.14a</td>
<td>6.23a</td>
<td>4.42a</td>
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<td>Ruminal total AA, mM</td>
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<td>4.07a</td>
<td>2.57a</td>
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<tr>
<td>Ruminal Acetate, mM</td>
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<td>84.8a</td>
<td>79.6b</td>
<td>74.0a</td>
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<td>Ruminal Propionate, mM</td>
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<td>30.3</td>
<td>31.5</td>
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<tr>
<td>Ruminal Ac/Pr</td>
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<td>2.95b</td>
<td>2.84b</td>
<td>2.53b</td>
<td>0.14</td>
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1 Standard error of least square mean difference; a,b,c,dMeans in rows without

Key Words: Milk production, Alfalfacorn silages, N utilization


The objective of this study was to investigate the effect of sugar, starch, NDF, and a carbohydrate (CHO) mix on utilization of ruminal ammonia in dairy cows. Four ruminally and duodenally cannulated Holstein cows were allocated to four dietary treatments in a 4 x 4 Latin square design trial. Cows were fed, at 12-h intervals, an all alfalfa hay diet. CHO (corn dextrose, GLU: corn starch, STA: fiber, NDF (white oat fiber); and a CHO mix (25% each): apple pectin, GLU, STA, and NDF, PEC) were introduced intraruminally during feeding at 20% of dietary DMI. Ruminal ammonia was labeled with 15N. GLU resulted in reduced (P < 0.05) DMI compared to NDF (21.7 vs 22.6 kg/d, respectively). NDF had the highest (6.41, P < 0.05) average ruminal pH (13 samples in 30 h) followed by STA, PEC, and GLU (6.19, 6.05, and 5.96). Ruminal ammonia concentration was higher (P < 0.05) in NDF and PEC than in GLU and STA (16.4, 12.4, 8.5, and 9.6 mmol/L). Compared to the other CHO, GLU reduced (P < 0.05) acetate and total VFA concentrations in the rumen. Milk yield and milk fat content were not different (P > 0.05) between treatments but NDF had lower (P < 0.05) milk protein concentration compared to the other CHO. STA resulted in lower (P < 0.05) MUN concentration than NDF (16.9 vs 22.4 mg/dL). The area under the milk protein 15N excretion curve (22 samples in 120 h) tended to be larger (P = 0.052) for STA than for NDF and PEC. As percent of the dose given, cumulative excretion of 15N in milk protein was greater for STA (6.64%) than for GLU (5.87%, trend at P < 0.1) or NDF (5.58%, P < 0.05). Estimated time to reach 50% of maximum 15N excretion tended to be shorter (P = 0.101) for STA than for GLU (36 vs 48 h, respectively). Overall, excretion of 15N in milk protein was greater (P < 0.05) for STA than for GLU and NDF. Compared to glucose and fiber, starch enhanced utilization of ruminal ammonia for milk protein synthesis in dairy cows.

Key Words: Dietary carbohydrates, Rumen ammonia, Milk protein

Lent and delinted cottonseed as feeds for lactating dairy cows. V. R. Moreira*, 1, L. D. Satter1,2, and B. Harding3, 1U.S. Dairy Forage Research Center, Madison, USDA - Agricultural Research Service, 2Department of Dairy Science, University of Wisconsin - Madison, 3Buckeye Technologies, Memphis, TN.

Performance of lactating dairy cows fed diets containing either mechanically delinted whole cottonseed (DWCS: 3.7% lint) or linted whole cottonseed (LWCS: 11.7% lint) was measured. Forty one primiparous (86±3.0 DIM) and 39 multiparous (884±30 DIM) cows were fed TMR containing 13% (DM basis) DWCS or LWCS in two blocks of 112d (n=53, and n=27). Other TMR ingredients were corn silage (28.1%DM), alfalfa silage (23%), high moisture shelled corn (27.8%), soybean meal (1.8%), Soy-plus® (1.8%), blood meal (2%), and mineral-vitamin supplements (2.5%). Dry matter intake and milk yield were measured daily, and milk composition bi-weekly. Fecal grab samples were taken on weeks 3 and 13 of each block to estimate excretion of intact whole seeds. Body condition score tended (P<0.11) to increase with DWCS (22 vs .11) for primiparous cows, although this was not reflected in body weight change. Assuming a DM digestibility of 67% for all TMR, only 3.37 and 1.91% of ingested seeds (lint excluded) were excreted undigest ed with DWCS and LWCS, respectively. Although significant, treatment differences in excreted seeds would have little nutritional consequence. DWCS performed as well as LWCS for all of the key cow performance and milk composition variables measured.
The objectives of this study were to evaluate fermentation and physical effectiveness of whole cottonseed as influenced by particle size and availability of linters. Six ruminally cannulated Holstein cows averaging 990 kg BW and 42 DIM were blocked for milk production and milk composition of dairy cows. M.L.M. Lima*, J. L. Firkins, J. T. Sylvester, S.K.R. Karnati, and W. Mattos, 1 Escola de Veterinaria - UFG, Goiania, GO - Brazil, 2 The Ohio State University, Columbus - OH, 3 Universidade de Sao Paulo, ESALQ, Piracicaba - SP - Brazil.

The study evaluated the effects of changes in rations physically effective NDF (peNDF) and starch source on intake, milk production and milk composition of dairy cows. P. Berzaghi*1,2 and D. R. Mertens2, 1 University of Padova, Italy, 2 US Dairy Forage Research Center, Madison, WI.

<table>
<thead>
<tr>
<th>MULTIPAROUS</th>
<th>P&lt;</th>
<th>DWCS1</th>
<th>LWCS1</th>
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<tr>
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<td>37.5</td>
<td>0.83</td>
<td>0.91</td>
<td>0.68</td>
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<td>23.1</td>
<td>1.60</td>
<td>0.14</td>
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<td>Fat, %</td>
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<td>3.16</td>
<td>0.23</td>
<td>0.95</td>
<td>0.51</td>
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<td>True protein, %</td>
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<td>2.88</td>
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<td>3.5%FCM, kg/d</td>
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<td>34.8</td>
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<td>BW change, kg/d</td>
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<td>BCS change</td>
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<td>Intact WCS, % fecal DM</td>
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<td>Milk Yield, kg/d</td>
<td>32.7</td>
<td>32.8</td>
<td>0.78</td>
<td>0.88</td>
<td>0.96</td>
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<tr>
<td>DMI, kg/d</td>
<td>20.5</td>
<td>20.4</td>
<td>0.59</td>
<td>0.83</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.23</td>
<td>3.19</td>
<td>0.11</td>
<td>0.77</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>True protein, %</td>
<td>2.99</td>
<td>2.95</td>
<td>0.03</td>
<td>0.35</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>3.5%FCM, kg/d</td>
<td>31.3</td>
<td>30.9</td>
<td>1.12</td>
<td>0.70</td>
<td>0.11</td>
<td></td>
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<tr>
<td>BW change, kg/d</td>
<td>2.0</td>
<td>0.96</td>
<td>133.0</td>
<td>0.60</td>
<td>-</td>
<td></td>
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<tr>
<td>BCS change</td>
<td>0.22</td>
<td>0.11</td>
<td>0.45</td>
<td>0.11</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Intact WCS, % fecal DM</td>
<td>1.02</td>
<td>0.61</td>
<td>0.10</td>
<td>0.01</td>
<td>0.65</td>
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253 Physical effectiveness of whole cottonseed as affected by lint and particle size. M.L.M. Lima*, J. L. Firkins, J. T. Sylvester, S.K.R. Karnati, and W. Mattos, 1 Escola de Veterinaria - UFG, Goiania, GO - Brazil, 2 The Ohio State University, Columbus - OH, 3 Universidade de Sao Paulo, ESALQ, Piracicaba - SP - Brazil.

Key Words: Physical effectiveness of whole cottonseed, Particle size


Excess dietary P is excreted in the feces, largely in water-soluble form, thus increasing the risk of P loss to the environment. The effect of dietary Ca concentration on the solubility of feed P in feces of lactating cows was determined by feeding diets containing either 0.6 (LCa) or 1.0 (%HCA) of Ca and 0.5 % of P. Diets contained (% DM) 35 % corn silage, 20 % alfalfa silage, 25.35 % high moisture shelled corn (HMSC), 8 % soybean meal, 10 % roasted soybeans, 0.6 % monosodium phosphate, 0.55 % CaCO3 and 0.5 % of a salt and vitamin mix. To achieve the higher dietary Ca concentration a small amount of HMSC was replaced by limestone (%CaCO3). The diets were fed to 11 mid-lactation cows in a crossover design using 2-wk periods. Fecal grab samples were collected from the rectum at four different times during the last two days of each period (two samples per day) and refrigerated for later analysis. Feed intake and lactation performance were also measured during the trial. The increase in Ca concentration in the diet from 0.6 to 1.1 % had a significant effect (P<0.01) on the amount of soluble P in feces (LCA= 0.36 and HCA=0.31 %), but had no effect (P=0.26) when it was expressed as a percentage of total P in feces (LCA= 0.87 vs. 0.81 %) and fecal Ca (2.4 vs. 2.6 %) for the LCAs and HCAs trts were not affected by treatment (P>0.10). Animal performance measurements were consistent with those from other studies, although a lower fecal Ca excretion was expected with cows on the LCAs diet. High levels of Ca in the diet do not appear to affect the proportion of soluble P: total P in the feces.

Key Words: Physically effective fiber, Starch, Milk fat

Impressive progress has been made during the past 20 years in our understanding of the biology of somatotropin (ST) in domestic animals. Collectively, studies have established that administration of porcine ST (pST) to growing pigs markedly stimulates muscle growth and decreases fat deposition. In addition to these “efficacy” studies, a substantial number of investigations examined the mechanisms by which ST regulates growth of domestic animals. A central concept proposed initially to explain the effects of ST was the “somatomedin hypothesis”, i.e., that the effects of ST, secreted by the pituitary, are mediated by circulating IGF-I (initially characterized as sulfation factor and then somatomedin) produced exclusively in the liver. Much subsequent research has established that the somatomedin theory needs to be revised (and has been). Work conducted in our lab has shown that the effects of ST on lipid metabolism and insulin sensitivity in adipose tissue are not mediated by IGF-I and are direct effects of ST. While circulating IGF-I is important for postnatal growth, studies have demonstrated that mice lacking the liver IGF-I gene have an 80% reduction in total IGF-I (and IGF binding proteins), however, postnatal growth is normal. In these mice, free IGF-I levels (not bound to IGF binding proteins) are normal. Thus, the original somatomedin hypothesis has undergone considerable remodeling to a contemporary version that better explains the complexities of GH effects on adipose tissue metabolism and growth. The latter appears to reflect a situation where liver-derived IGF-I, at least in mice, is not essential for growth. Further studies will be necessary to unravel the importance of endocrine versus autocrine/paracrine IGF-I.

257 A new plasmid-mediated approach to enhance somatotropin function in pigs. R. Draghi*, ADV/SYS Inc.

Tremendous progress is being made in identifying and understanding the stimulatory molecules that regulate growth and the potential application of these molecules in animals. A parallel and significant effort is focused on the discovery and development of economically feasible gene delivery technologies. Plasmid-mediated growth hormone releasing hormone (GHRH) therapy has emerged as an excellent candidate. GHRH, a hypothalamic hormone, stimulates normal growth hormone (GH) production and release. We have shown that pigs directly injected with 0.1mg myoglycan plasmid expressing porcine GHRH had significantly greater weight gain than controls. With plasmid treatment, body composition studies have shown a 22% decrease in fat deposition and a 10% increase in bone mineral density. In a different study, pigs were injected intramuscularly at day 85 of gestation with 0, 0.1, 0.5, 1, or 5 mg of a synthetic GHRH-expressing plasmid (HV-GHRH). Piglets from gilts treated with 1 or 5 mg of HV-GHRH were larger at birth and weaning compared to controls. These two groups reached 100 kg 9 days earlier than the other groups. GHRH levels were higher at birth, and IGF-I levels were significantly increased in the 5 mg group beginning at 21 days of age when compared with controls. Pituitaries from the 5 mg group contained a significantly increased number of somatotrophs and lactotrophs from birth to 100 kg. Because of the central role of the GHRH-GH-IGF-I axis in the regulation and coordination of the anabolic processes of growth and reproduction, the benefits of plasmid-mediated GHRH supplementation to pregnant animals are far-reaching. During pregnancy, maternal changes impact intrauterine and postnatal development. Direct GHRH action induces changes in pituitary cell lineage of the offspring which can then directly enhance growth and welfare once the postnatal growth comes under the control of GH and IGF-I. Administration of GHRH to the gilt has an additional advantage over the direct administration of growth-promoting agents to the adult individual animal. By improving fetal growth, GHRH treatment of the gilts diminishes the incidence of neonatal deaths, which has always represented a major economic loss for the swine industry.

Key Words: GHRH, GH, Plasmid


A primary goal of exogenous somatotropin (ST) treatment is to increase lean body mass. This is accomplished, in part, by increasing the efficiency with which dietary amino acids are used for protein deposition. ST administration also improves protein balance by minimizing the loss of protein during fasting and maximizing the protein gained during meal absorption. Amino acid catabolism is reduced by ST treatment as indicated by reductions in blood urea nitrogen concentrations, urea synthesis, liver urea cycle enzyme activity, and amino acid oxidation. Stable isotope tracer/mass transorgan balance studies have recently demonstrated that ST treatment increases protein anabolism in young, growing swine by increasing protein synthesis in the hindlimb and portal-drained viscera in the fully-fed state, with no effect of ST on protein degradation. More detailed study to examine the tissue-specific response to ST treatment indicates that GH treatment increases protein synthesis in skeletal muscle by increasing the efficiency of the translational process, but only in the fed state. The ST-induced stimulation of skeletal muscle protein synthesis in the postprandial state involves mechanisms that enhance the binding of both mRNA and initiator methionyl-tRNA to the 40S ribosomal subunit. ST increases protein synthesis in the intestine and liver in both the fasted and fed state by increasing ribosome number, with no change in translation initiation. Thus, the protein synthetic response to ST treatment is tissue specific and dependent upon nutritional state.

259 Alteration of somatotropic function by proinflammatory cytokines. R. A. Frost* and C. H. Lang, Penn State University College of Medicine.

Unsanitary living and rearing conditions contribute to infection and weight loss in animals and humans. Infectious insults direct amino acids away from growth and skeletal muscle accretion towards the synthesis of acute phase proteins. The loss of skeletal muscle protein stores results in both a decrease in muscle function and increased mortality. In general, muscle protein synthesis is decreased in rat models of sepsis including after the injection of components of the bacterial cell wall such as lipopolysaccharide (LPS). Although the over-expression of proinflammatory cytokines is known to hasten the loss of skeletal muscle protein it is not known whether this is a direct effect of cytokines or if it is secondary to changes in the IGF system. The drop in muscle protein synthesis is preceded by changes in the expression of IGF-system components. Plasma levels of IGF-I are dramatically lowered by infection in rats, mice, pigs and steers. The drop in IGF-I occurs despite an increase in the plasma concentration of somatropin (GH). Animals are therefore GH resistant. IGF bioactivity is determined not only by its plasma concentration but also by IGF binding proteins (IGFBPs). IGFBP-3 is the most abundant IGFBP is degraded during some catabolic states. Administration of IGF-1 as a complex with IGFBP-3 restores both plasma IGF-I levels and muscle protein synthesis in septic rats. In contrast to IGFBP-3, the plasma concentration of inhibitory IGFBP’s such as IGFBP-1 are increased during infection. IGFBP-1 accumulates in skeletal muscle where it can inhibit IGF dependent protein synthesis. IGF-I and IGFBP-1 are regulated at the level of gene transcription by proinflammatory cytokines. Prophylactic administration of an IL-1 receptor antagonist or a TNF binding protein can prevent the changes in IGF-I, IGFBP-1, and muscle protein synthesis. Recent studies demonstrate that bacterial components that activate immune cells also activate the innate immune response in skeletal muscle. LPS increases proinflammatory cytokine mRNA expression in muscle from control mice but not mice with a mutation in the LPS receptor (TLR4). LPS also increases cytokine expression in human and mouse myoblasts. Local expression of cytokines in skeletal muscle may negatively regulate the autocrine synthesis of IGF-I. Current work is focused on deciphering the mechanisms by which muscle becomes GH resistant and the development of therapies to maintain muscle protein stores during infection.

260 Relationship between conception rate and in vitro sperm viability. J. J. Parrish*, University of Wisconsin, Madison, WI.

It has been the goal of many scientists to develop in vitro methods of predicting a bull’s fertility. One approach has been to evaluate the viability of sperm. While it is obvious that a sperm must be viable to fertilize an oocyte, it is not clear what are the criteria that define a viable sperm. For example, viability stains that use histological stains such as eosin or fluorescent DNA binding molecules such as propidium iodide rely on a permeable plasma membrane to define a non-viable sperm. Evaluation of the percentage of non-viable sperm might be done using microscopy or flow cytometry for better accuracy but in either case only a single aspect of viability is addressed. Only modest correlations have been reported between this type of a viability measurement and bull fertility. Additional aspects of sperm viability or functionality need to be measured in order to improve the correlations. In the development of computer-aided methodology that evaluates sperm morphology and its relationship to bull fertility we found that only viable sperm morphology was related to bull fertility. The method used to assess the relationship of bull fertility to measures of semen quality is important as well. It is likely that identifying bulls with fertility below a desired threshold, diagnostic test approach, will be more productive than evaluating the relationship of a semen quality traits to fertility of all bulls. Approaches using multiple comparisons on viable sperm and diagnostic statistics need to be developed if bull fertility is to be predicted better. Supported by the College of Agriculture and Life Sciences and USDA-NRI.

Key Words: Sperm viability, Flow cytometry, Bull fertility


Six-day-old non-surgically recovered bovine ova/embryos from single ovulating cows have been used as biomonitors to evaluate seminal deficiencies that are compensable (where fertility responds positively to elevated sperm dosage) and uncompensable (where fertility is depressed and does not respond to elevated sperm dosage). They have also been used to evaluate reproductive strategies and in some cases, the interaction of individual males with different strategies. The fertilization status and embryo quality of the six-day-old presumptive morula permits the independent evaluation of two major components contributing to pregnancy or its failure, i.e., fertilization status and embryonic development. In addition, quantitative and qualitative evaluation of accessory sperm provides some insight to the sperm available for fertilization either as a function of the male/inseminate or a specific reproductive strategy. Factors influencing sperm access to the ovum in vivo (based upon accessory sperm number per ovum/embryo) were differences due to: the male, the female, time of insemination relative to ovulation, the interaction of males with time of insemination, site of insemination, dosage of sperm per inseminate, interaction of male and dosage and superfertilization. Major identifiable male factors depressing quality of embryos were associated with perturbations in spermatogenesis as reflected by altered sperm head morphology and/or incidence of sperm nuclear vacuoles in semen. Impacts of these factors on fertility appear to be exacerbated by superovulation. In agreement with field data, male/semen factors influencing sperm access to the ovum (compensable) appear to be quite independent from those influencing embryo quality (uncompensable). Futuristically, meaningful laboratory testing of semen for fertility should ultimately consider compensable and uncompensable seminal deficiencies, sperm dosage, and the reproductive strategy to which the semen will be applied.

Key Words: Bull, Semen quality, AI fertility

262 Genetic selection for improved reproduction. K. Weigel*, University of Wisconsin.

Achieving pregnancy in high-producing dairy cows in a timely and cost-effective manner may be today’s greatest management challenge. Fertility is highly influenced by management and environmental factors, but significant genetic differences exist in both male (service sire) and female (daughter) fertility. The first challenge in improving fertility through genetic selection is data collection, because an inverse relationship exists between quantity and quality. Rough measures, such as calving interval, are available for all multiparous milk-recorded cows. Insemination data (and non-return rates) are available for about half of the cows, while pregnancy exam outcomes are available for perhaps a quarter of the animals. Detailed data, such as technician ID and type of estrus (standing or synchronized) are available in selected herds, and milk progesterone data are typically limited to experimental herds. The second challenge is statistical modeling. Linear models are inappropriate for binary conception rates, and data of continuous traits, such as days open, are badly skewed. Threshold models are technically appealing, but extreme category problems can occur when contemporary groups are small (especially in animal models). Survival analysis can be used to evaluate days open or time from first insemination until pregnancy, and this allows inclusion of censored data (e.g., cows with no pregnancy exam). Models for longitudinal binary analysis may have the greatest potential, because direct genetic evaluation of 21-day pregnancy rate for individual animals is possible (e.g., did pregnancy occur in each successive 21-day interval after the voluntary waiting period). The third challenge is education of users. Results can be published in various ways, but each has limitations. The concept of a trailing 21-day pregnancy rate is understood by many producers, but some confuse it with non-return rate or conception rate. Differentiation between male and female fertility is an ongoing problem, so published information must be labeled concisely. Lastly, the negative relationship between milk production and female fertility creates challenges, because many sires with high genetic merit for production will have undesirable daughter fertility values.

Key Words: Fertility, Dairy cattle, Genetic selection


As the dairy industry strives to thwart an apparent decline in reproductive efficiency, the fertility of the male must not be overlooked. The fertility potential of an artificial insemination (AI) dose is a function of the quantity, quality and health status of the semen contained therein. Management of sire health and associated disease testing protocols are paramount. Post-thaw semen quality evaluations combined with adjustments to cell numbers per dose and culling of ejaculates and (or) bulls, minimizes the variation in fertility potential of individual samples and (or) sires released for sale. Identification of additional semen quality attributes associated with fertility could provide more accurate methods to predict, manage and select for AI sire fertility. However, because the values of most “known” semen quality traits (motility, acrosome integrity, normal morphology) are highly correlated with each other, any “new” technology must not be evaluated in a vacuum but in light of existing methodology to consider the additive benefit in fertility prediction and (or) economic utility of implementation. Unfortunately, the association between semen quality and fertility is often limited by the accuracy of the fertility estimate. Cryopreservation techniques that extend post-thaw sperm survival and (or) reduce rates of capacitation may reduce sensitivity to insemination timing and are promising opportunities to improve fertility from the male perspective. The AI industry must increase research efforts to enhance, predict and measure fertility in both male and female bovines. The role of the AI industry representative has and will continue to evolve from that of salesperson and genetic advisor to that of reproductive and herd-management consultant. More emphasis must be placed on these characteristics in hiring practices and in advanced training in reproductive-management skills. The magnitude of the decline in reproductive efficiency that can be attributed to genetics is the subject of considerable debate. Through semen purchasing decisions, dairymen dictate the relative importance of various genetic selection criteria to the dairy industry and thereby the emphasis to be placed on these traits in AI sire-sampling programs.

Key Words: Artificial insemination, Fertility, Dairy cow
264 Relative importance among sow productivity traits in the selection criterion for purebred dam lines, based on a modified profit function with causal relationships between traits. V. M. Quinton*1, J. W. Wilton 1, J. A. B. Robinson1, and P. K. Mathur2, 1University of Guelph, Guelph, Canada, 2Canadian Centre for Swine Improvement, Ottawa, Canada.

Economic weights for sow productivity traits in pure-line pig populations were derived from a single profit equation in order to provide flexibility to alternative market requirements or production systems. The profit function method was modified to account for differences in piglet perinatal survival environment imposed by litter size at birth. Both the 100kg finished pig and the feeder pig market were considered. As an example, the economic weights were calculated from average trait values in Ontario purebred Yorkshire herds and provincial average prices and costs. Based on the unmodified profit function, when the mean litter size was increased from 6 to 16 pigs, and all other traits remained constant, the economic weight for total litter size was constant, and those for survival traits increased from $0.16/\% to $0.43/\% for the finished pig market. When the profit function was modified, the weight for litter size decreased as mean litter size increased, from $2.51/pig for 6 pigs/litter to $1.76/pig for 16 pigs/litter. Economic weights for all other traits were the same as before the modification. The effect was similar for the feeder pig market. Short-term profit in the finished pig market from index selection with economic weights for a mean litter size of 8 pigs was 97% of that using the correct weights when the mean litter size was 12 pigs, and 87% when the mean litter size was 16 pigs. Profit from selection for litter size alone was 85% of the maximum attainable from selection on the correct index in the finished pig market, and 51% of the maximum in the feeder pig market for an average litter size of 12 pigs. Relative predicted gains from selection on either reduced or incorrect indices decreased with the length of the selection program, and in some cases the decrease became substantial in the long-term.

Key Words: Sow productivity, Profit function, Economic weight

265 Comparison of two models to estimate breeding values for intramuscular fat percentage in Duroc pigs. D. W. Newcom* and T. J. Baas, Iowa State University, Ames, IA.

Data from a selection experiment designed to increase intramuscular fat percentage in Duroc swine were used to compare how animals rank based on breeding values estimated from either a one- or two-trait animal model. Predicted intramuscular fat percentage (PIMF) was estimated using linear regression analysis of 8 image parameters averaged across four longitudinal ultrasonic images and 10th rib off-midline backfat from a cross-sectional image. Carcass intramuscular fat percentage (CIMF) was determined by chemical analysis of a slice from the 10th rib of the loin. All pigs in the selection experiment (boars, barrows, and gilts) were scanned, and one to three barrows and selected gilts from each litter were harvested. Breeding values were estimated using MATVEC and fitting a one- or two-trait animal model. The one-trait model estimated breeding values for PIMF (P1) from only PIMF for all pigs (n=1630) with gender and scan group as fixed effects, animal (genetic) and litter as random effects, and scan weight as a covariate. The two-trait model estimated breeding values for PIMF (P2) and CIMF (C2) from PIMF for all pigs and CIMF from those pigs (n=392) harvested. In addition to the effects in the one-trait model, harvest group and harvest weight were added as a fixed effect and covariate, respectively, in the two-trait model. Spearman rank correlation coefficients were calculated between P2 and C2, P2 and P1, and C2 and P1. Correlations were calculated for all pigs with scan data, within year for all pigs scanned (n=379, 637, and 614, for Gen 0, 1, and 2, respectively), and by gender within year. The rank correlations between P2 and C2, P2 and P1, and C2 and P1 for all pigs with scan data were 0.95, 0.95, and 0.84, respectively. Rank correlations by year for all three EBV combinations were calculated between P2 and C2, P2 and P1, and C2 and P1. Correlations by year for all three EBV combinations were calculated between P2 and C2, P2 and P1, and C2 and P1. Rank correlations by year for all three EBV combinations were calculated between P2 and C2, P2 and P1, and C2 and P1. Rank correlations by year for all three EBV combinations were calculated between P2 and C2, P2 and P1, and C2 and P1. Rank correlations by year for all three EBV combinations were calculated between P2 and C2, P2 and P1, and C2 and P1.

Key Words: Swine, Breeding values, Intramuscular fat


Objectives were to estimate effects of sire breed (Dorset, Finnsheep, Romanov, Texel, and Montadale), dam breed (Composite III and northwestern whiteface), mating season (August, October, December), ewe age (1, 2, and 3 yr), and their interactions on productivity of F1 ewes. A total of 1,799 F1 ewes produced 3,849 litters from 4,804 exposures to Suffolk rams during 35-d mating seasons. Conception rate and ewe longevity were determined. Litter size and weight at birth were recorded and litter size and weight at weaning and 20 wk of age were analyzed separately for dam- and nursery-reared litter mates. Total productivity through 3 yr of age for each ewe entering the breeding flock was calculated as the sum of 20-wk weights for dam- or nursery-reared lambs. Interactions of sire breed x mating season, sire breed x ewe age, and mating season x ewe age were generally significant. Interactions of sire breed x mating season were often due to changes in rank as well as magnitude, indicating the importance of matching sire breeds to specific mating seasons. Litter size at birth of Dorset-, Texel-, and Montadale-sired ewes was not affected by dam breed; however, Finnsheep-sired ewes out of northwestern whiteface dams were more prolific than Finnsheep-sired ewes out of Composite III dams and the opposite situation existed for Romanov-sired ewes. Least-squares means of sire breeds (P < 0.001) for total productivity of dam-reared lambs were 98.5, 103.5, 106.9, 124.6, and 154.9 kg for Texel, Dorset, Montadale, Finnsheep, and Romanov, respectively. Superior productivity of Romanov-sired ewes was due to greater conception rates and litter sizes for each mating season and ewe age, as well as greater ewe longevity. Total productivity of F1 ewes by Composite III dams (125.6 kg) was greater (P < 0.001) than ewes born to northwestern whiteface dams (109.7 kg). Experimental results provide comprehensive information about the appropriate use of these breeds in crossbreeding systems.

Key Words: Reproductive traits, Sheep, Breeds


Inbreeding and genetic diversity were compared in selected and control lines of 50% Dorset, 25% Rambouillet and 25% Finnsheep breeding established in 1983 and maintained as closed populations for 13 yr. Falling lambing selection (S) and spring-lambing genetic control (C) lines were created in spring, 1987. Selection for fall lambing began in spring, 1988. Fall lambing S consisted of 125 ewes x 10 rams; G was composed of 45 ewes and 5 rams. Fourteen sire lines were identified in G in 1987; a ram from each line was retained whenever possible. Founder numbers were 126 in S and 96 in G. Inbreeding was evaluated for three sets of animals from each line: all lambs (L), all rams and ewes present (P) and an offspring from each mating (M, including hypothetical offspring for open ewes). Inbreeding rates were similar for L, P and M in S (1.41 ± 0.04, 1.46 ± 0.06 and 1.56 ± 0.04/%/yr), but variable in G due to small population size and sampling of rams. Numbers of founder genome equivalents (the number of equally represented founders needed to produce the observed heterozygosity) reveal impacts of small population size, bottlenecking, inbreeding and overlapping generations, which were more evident for L, P and M in G (5.2, 10.0 and 3.7) than in S (6.6, 6.7 and 5.3). Effects of inbreeding on lamb BW, fall fertility of ewes and ewe litter size were calculated using REML and found to be -0.027 ± 0.023 kg/%, -0.70 ± 0.25 %/ and -0.0018 ± 0.0053 %/yr. Results suggest that genetic variation in a flock is best determined by analysis of animals available to be bred. G animals were similar in heterozygosity to S, as is desired in a genetic control line.

Key Words: Pedigree, Inbreeding depression, Sheep
268 Competing risks analysis of lamb mortality. B. R. Southey1, S. L. Rodriguez-Zas2, and K. A. Leymaster3, 1University of Illinois Champaign-Urbana, Urbana, IL, 2USDA, ARS, USMARC, Clay Center, NE.

Survival is often represented as the time elapsed between two events (e.g. birth to mortality) or until the end of period considered. The typical survival models assume one type of terminal event thereby ignoring that there could be multiple causes of mortality. A competing risks model that accounts for different causes of mortality was evaluated. Discrete survival methods using a complementary log-log link function were applied to lamb mortality records from a composite population at the US Meat Animal Research Center. Causes of mortality were grouped into disease, maternal (e.g. dystocia), pneumonia and other causes. A total 8301 lamb survival records from birth to weaning were analyzed using sire, animal and maternal effect mixed models including sex, contemporary group, type of birth and age of dam as fixed effects. The results showed substantial differences on the effect of lamb sex among mortality categories. The influence of birth type and age of dam on survival showed little variation with mortality category. Estimates of variance components from the sire and animal models compared to the maternal model indicated maternal components were present. Estimates of heritability from a maternal effects model ranged between 10 and 20% and varied with the mortality category. Results from the maternal category were consistent with literature studies on parturition, lamb behavior and selection for rearing ability. These results indicate that failure to account for the cause of the terminal event on mortality and longevity studies may hide important genetic differences. Therefore, breeding programs are likely to be ineffective when the multiple causes involved in time to event traits such as mortality and longevity are ignored.

Key Words: Analysis, Sheep, Survival

269 Genetic correlations for litter weight weaned with reproduction and wool characteristics in Rambouillet, Columbia, Targhee and Polypay sheep. K. J. Hanford1, L. D. Van Vleck1, and G. D. Snowden1, 1USDA, ARS, U.S. Meat Animal Research Center, 1Lincoln, NE, 2Clay Center, NE.

Genetic correlations between litter weight weaned (LW) and litter size born (NB), litter size weaned (NW), fleece weight (FW), fleece grade (FG), and staple length (SL) were estimated from Rambouillet (RAM), Columbia (COL), Targhee (TAR), and Polypay (POL) data collected from 1950 to 1998 at the U.S. Sheep Experiment Station, Dubois, ID. Numbers of breed records ranged from 8,313 to 39,816 for LW; 9,081 to 44,211 for NB and NW; 8,872 to 39,820 for FW and FG; and 1805 to 3574 for SL. Estimates of direct heritability with single-trait animal models using REML ranged from 0.07 to 0.09 for LW, 0.08 to 0.10 for NB, 0.03 to 0.07 for NW, 0.50 to 0.66 for FW, 0.16 to 0.41 for FG, and 0.56 to 0.76 for SL. Estimates of the genetic correlation between LW and NB were similar for RAM, COL and TAR breeds (0.59, 0.68, and 0.62, respectively), but was close to zero for POL (0.05). The low correlation for POL may be due to generally restricting ewes to rearing only 2-3 lambs, which would impact a highly prolific breed such as POL more than less prolific breeds. The estimate of genetic correlation between LW and NW was close to one for all breeds, as expected, because NW is a component of LW. Estimates of the genetic correlations between LW and both FW and FG were near zero for all breeds, except RAM (0.12 for FW and -0.19 for FG). Estimates of the genetic correlations between LW and SL varied among the breeds (0.07, -0.19, 0.10, and -0.17 for RAM, COL, TAR, and POL, respectively). Litter weight weaned is often used as an overall measure of range ewe productivity. These results suggest that selection for LW would result in neutral or favorable correlated responses except for a decrease in FG for RAM and decreases in SL for COL and POL. Decreases in FG and SL would have a minimal economic impact because of the small genetic correlations and because increased LW should offset decreases in FG and SL under today’s market prices.

Key Words: Fiber, Genetic Correlation, Prolificacy

270 Influence of birth weight and birth rank on lamb survivability. C. S. Welsh1, B. L. Golden1, R. M. Enns1, D. J. Garrick1, and G. B. N gigg1, 1Colorado State University, Fort Collins, CO, USA, 2Landcorp Farming Ltd, Rotorua, New Zealand.

The objective of the sheep breeder is to increase the number of lambs weaned, either by increasing prolificacy or increasing lamb survival. Increasing prolificacy reduces lamb survival because, relative to singles, multiple lambs have competition for milk and reduced birth weight (BW). Breeding values (BV) for prolificacy are readily available. The heritability of number born is 0.10 to 0.15, implying birth rank (BR; single, twin, triplet, or quadruplet) has a genetic component. Lamb survivability BV have yet to be implemented. The objective of this study was to determine if BR should be fit as a fixed effect in the evaluation of lamb survivability (LS). If birth rank (BR) is fit, the BV predicts LS including the effect BR has on LS. Possible genetic influences on LS include BW and BR. Data were from two Romney flocks (n=31,127) with lambs born 1997-2000 at Landcorp, New Zealand. LS was scored 0 for death prior to weaning and 1 for survival. Pearson (partial) correlation matrices were derived. The phenotypic correlation between LS and BR was -0.17, indicating lamb survival decreases as number of lambs born increases. Adjusted for BW, this correlation decreased to -0.14, suggesting birth weight does not fully account for the decline in lamb survival observed as BR increases. The phenotypic correlation between BW and LS was 0.2, suggesting higher birth weight is associated with higher survival. Once this correlation was adjusted for BR, it decreased to 0.13, indicating some of the effect birth weight has on lamb survival is independent of number of lambs born. These results show phenotypic variation in lamb survival cannot be explained entirely by birth weight differences nor by birth rank differences. Further research to compare the relative accuracy of lamb survivability BV for alternative models is planned.

Key Words: Sheep, Survival, Genetic analysis

271 Caprine genetic resource conservation program. J. M. Dzakuma1, S. A. Ericsson2, B. L. Sayre3, T. A. Gibson4, and H. D. Blackburn5, 1Prairie View A&M University, Prairie View, TX, 2Sul Ross State University, Alpine, TX, 3Virginia State University, Petersburg, VA, 4Langston University, Langston, OK, 5USDA-ARS-National Animal Germplasm Program, Fort Collins, CO.

A genetic resource conservation center for goats has been established at Prairie View A&M University (PVAMU). The objectives of the project are based upon: 1) Genetic resources are the building blocks for all production systems. 2) Conservation, maintenance, enhancement and access to these genetic resources will enable small goat producers to increase their profitability. 3) Angora doe numbers have declined two-thirds from about 750,000 in 1995 to 260,000 in 2000. Spanish and Tennessee stiff-legged doe numbers have also declined because they have been crossed to the dominant meat type breeds. Sixty four F and 8 M per breed of Tennessee Stiff-legged, Spanish and Boer goats, were bred in fall 2002 in order to establish live populations (in situ conservation program at PVAMU. The in situ population was divided into 2 lines/breed: Line 1, would be selected for growth and Line 2, selected for resistance to common gastro-intestinal parasites. Inter se matings will be made in subsequent years within each line, within breed. Simultaneously, collection of semen that would be preserved cryogenically (ex situ) as part of the National Animal Germplasm Program (NAGP), has commenced in West TX with Sul Ross State University and in East TX with PVAMU. Genotyping efforts at Virginia State University have linked the myotonic phenotype to a single nucleotide polymorphism (SNP) in the chloride channel-1 (C1C-1) gene expressed in skeletal muscle. Continued efforts are underway to characterize the genotype in relationship to carcass traits in the Tennessee Stiff-legged breed. Phenotypic and genetic characterization of goat breeds will be carried out at all the institutions. Although this project has been initiated in TX the preservation effort commenced in West TX with Sul Ross State University and in East TX with PVAMU. The in situ population was divided into 2 lines/breed: Line 1, would be selected for growth and Line 2, selected for resistance to common gastro-intestinal parasites. Inter se matings will be made in subsequent years within each line, within breed. Simultaneously, collection of semen that would be preserved cryogenically as part of the National Animal Germplasm Program (NAGP), has commenced in West TX with Sul Ross State University and in East TX with PVAMU. Genotyping efforts at Virginia State University have linked the myotonic phenotype to a single nucleotide polymorphism (SNP) in the chloride channel-1 (C1C-1) gene expressed in skeletal muscle. Continued efforts are underway to characterize the genotype in relationship to carcass traits in the Tennessee Stiff-legged breed. Phenotypic and genetic characterization of goat breeds will be carried out at all the institutions. Although this project has been initiated in TX the preservation effort will be extended nationally. This in situ project will enable the breeders to properly characterized and evaluated in East TX environment and allow us to perform comparative trials, undertake crossing experiments and conduct research into other areas. Presently, 12.9 and 22.9 % of the germplasm needs for Spanish and Angora breed regeneration and security have been acquired.

Key Words: Goats, ex situ, Genetic resources

Pedigree analysis was used to describe changes in genetic diversity in a colony of dog guides. German Shepherds (GS) and Labrador Retrievers (LR) were evaluated. Parameters estimated included average coefficients of relationships to the breed, average coefficients of inbreeding, effective numbers of founders, effective ancestor number, founder equivalents, and effective population size. There were rapid increases in average pairwise relationship in both breeds, although the average was approximately one-third higher in the GS population than in the LR population. A similar trend was observed for average inbreeding. Both measures showed a steady increase for several generations and levelled off thereafter. Inbreeding generation next to the founder generation and generation 1 had the highest inbreeding coefficients. Inbreeding for all animals averaged 25.3% and 26.2% in GS and 15.5% and 22.0% in LR, respectively. Effective founder number initially decreased in GS until generation 3, and then increased steadily. There was a constant increase in effective founder number in LR after founding. Final values were 35.5 and 20.2 in GS and LR, respectively. A similar pattern, with current values of 23.6 and 16.9, was seen for effective ancestor number as well. This is probably due to the fact that this is a small population which received new genetic material by migration distinctly different populations. Founder genome equivalents were initially higher in the GS but decreased over time in both breeds to 5.6 and 5.3 in GS and LR, respectively. Changes have been in the genetic management of the breeding colony to slow, and eventually reverse, the trends towards increased relationships and inbreeding. Effective population sizes are not expected to change significantly in the near- to medium-term. Use of a more diverse portfolio of sires and dams, as well as the introduction of germplasm from outside of the current breeding colony, will help insure the continued health of this population.

Key Words: Population structure, Dog guides, Genetic diversity

273 Human-animal-relationship as a risk factor for overweight pets. E. Kienzle1 and R. Bergler2. 1Chair of Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany, 2Psychological Institute, University of Bonn, Bonn, Germany.

Hundred and twenty cat owners and 120 dog owners (60 with overweight and 60 with normal pets, respectively) were interviewed by standardized questionnaires. Questions to dog and cat owners were made similar where applicable. Overweight dogs more often slept in their owner’s bed. Their owners talked more and on a greater variety of subjects to their dogs and they were less afraid of taking diseases from their dogs. Exercise, work or protection by the dog were rated as less important. These characteristics of the human-animal-relationship were interpreted as signs of over-humanisation of overweight dogs. In overweight cats the human-animal-relationship also showed indicators of over-humanization, such as talking to the cat on topics which are not related to the cat. Owners of overweight cats and dogs watched their pets more often when they were eating. Several items indicate that feeding the pet was an important stimulant for communication with the overweight pet. The human-animal-relationship of owners of overweight cats was characterized by a higher intensity of the bond between owner and cat. By contrast there were hardly any indications that the bond between overweight dogs and their owners was stronger than the bond between normal dogs and their owners. Owners of overweight dogs appeared to be more aware of the overweight problem than owners of overweight cats. In overweight dogs the number of meals and snacks was significantly increased compared to normal dogs. In normal and overweight cats there was no difference in the frequency of meals and snacks, however, overweight cats often had free choice of food intake. Overweight dogs and cats were given kitchen scraps more often on top of their usual diet. Preventive health care for the pet (such as health checks, observation of feces quality, vaccinations) was more important to the owners of normal pets than to those of overweight pets. Owners of overweight dogs had less interest in preventive health care for themselves than owners of normal dogs, whereas in owners of overweight cats there was a tendency to the contrary.

Key Words: Human-animal-relationship, Overweight, Pets

274 Effect of temperament on stress response of stray adult dogs in a shelter environment. C. L. Coppola*, T. Grandin, and R. M. Enns, Colorado State University, Fort Collins, CO USA.

Due to a dog’s inherent social nature and a keen sense of its surroundings they are vulnerable to changes in the environment. The main stressors a domestic dog encounters in a shelter are isolation, exposure to constant noise and novel, irritating stimuli. The objective of this study was to examine the relationship between seven temperament traits of stray adult dogs and their stress response to the shelter environment as measured by salivary cortisol after 9 days in the shelter. Dogs (n = 26) included in the study were healthy, non-pregnant, potential adoption candidates not claimed by their owner. Animals computer programmed experience is necessary. Potential efficacy may be demonstrated by the fact that all students (8 years, more than 180 students) have been able to design a working system, with

Key Words: Population structure, Dog guides, Genetic diversity

Companion Animals

275 Use of expert system software in teaching problem solving in a companion animal nutrition class. J. P. McNamara*, Washington State University.

The objective was to demonstrate effectiveness of teaching nutrition and problem solving skills using expert solving techniques and expert system software in an advanced class. The course is AS 406, Nonruminant Nutrition. The only prerequisite is one basic Animal Feeds and Feeding class, for which students have had one year of college chemistry, biology, one semester of organic chemistry. The objective is to teach advanced nutritional principles and practical feeding of nonruminants, primarily companion animals. Students first demonstrate that they can balance a ration using the algebraic method, then move on to problem scenarios. Students do not answer questions, rather they design a list of questions they need to have answered to solve the problem. After that, students begin designing an expert system to help someone else (a client, for example) to solve a different problem or to learn some aspect of nutrition. They develop an objective, a flowchart of questions and potential answers, and then write an expert system using commercially available software containing an inference engine for backward or forward chaining. This process forces students to define a problem or a learning objective and devise the question set which will provide answers leading to a specific recommendation or finding. They must also provide the potential answers to the questions they ask, and then make their findings. The process helps the students to learn nutritional facts and concepts, and to use specific logic, as the system will not run otherwise. Students (with teacher guidance and input at each step) decide which pieces of information are critical to the situation then explain the reasoning for the solution to the user. The software is easy to learn, based on normal English, and logical IF, AND, OR, THEN, and ELSE, statements. No previous computer programming experience is necessary. Potential effectiveness may be demonstrated by the fact that all students (8 years, more than 180 students) have been able to design a working system, with
the majority including sufficient depth of knowledge expected at senior level. Student evaluations provide high rankings (9 of 10 or better) on fostering independent thinking ability, problem-solving skills, ability to apply knowledge.

Key Words: Critical thinking, Nutrition, Companion animals

276 Investigations on the energy requirements of adult cats. G. Edztadtler-Pietsch1, R. Rudnick2, and E. Kienzle3, 1Chair for Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany, 2Nestle Purina PetCare Research.

Energy requirements of 138 adult colony cats were determined by recording the energy intake during periods of weight constancy (> 4 weeks). Females had a mean body weight of 3.88 kg, while the body weight of male cats averaged 5.09 kg. Neutered females were significantly heavier than intact queens (mean body weight of 4.09 kg and 3.64 kg, respectively, p<0.05). Middle-aged cats had higher body weights than young (<5 yrs) and very old cats (>10 yrs.). The mean energy requirement of adult cats was 251 kJ ME/kg BW. Maintenance energy requirements per body mass unit decreased with increasing body weight. Mean energy requirements of cats with a body weight of up to 3 kg were 319 kJ ME/kg BW, while heavy cats with a body weight of over 5 kg needed only 209 kJ ME/kg BW for weight maintenance. This suggests that most of the heavier cats were not larger cats, but rather more overweight cats with a reduced percentage of fat-free body mass. Energy requirements of a cat population with a considerable percentage of overweight individuals can therefore be best described using a function with an exponent for metabolic body mass, which is considerably lower than 0.75 (maintenance energy requirements = 544 kJ ME/kg BW). Neutered cats had significantly lower energy requirements than intact cats (286 kJ ME/kg BW vs. 231 kJ ME/kg BW, p<0.05). When the cats were grouped according to body weight there were no significant differences between intact and neutered cats of the same weight group. The young adult cats had higher energy requirements per body mass unit than middle-aged animals. While cats of 1 to 5 years of age needed an average of 313 kJ ME/kg BW, mean maintenance energy requirements of cats between 6 and 10 years of age only came up to 231 kJ ME/kg BW. Very old cats had slightly higher energy requirements than middle aged cats. Age effect interacted with the effect of overweight. When only data of lean cats were evaluated there was a gradual decrease of energy requirements with age.

Key Words: Maintenance energy requirements, Cats

277 Prediction of energy digestibility based on total dietary fiber (AOAC-method) in complete dry food for dogs and cats. E. Kienzle1, V. Bourge2, and A. Schömmeier1, 1Chair of Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany, 2Royal Canin, Research Center, Aimargues, France.

It has repeatedly been demonstrated that there is a negative relationship between fiber in dry matter and energy digestibility in pet foods. This is true for any method of fiber determination that measures the major percentage of cellulose. So far, however, there are only few observations on total dietary fiber (TDF; by AOAC-method) and energy digestibility. In the present study therefore 610 digestion trials with dog foods and 261 digestion trials with cat foods were evaluated. Digestion trials were carried out according to AAFCO-protocols, and energy in food and feces was determined by bomb calorimetry. In addition to TDF the crude fiber (CF) content was determined in 495 dog foods. The following regression equation between energy digestibility (%) and TDF in % dry matter (DM) was obtained for dog food: energy digestibility = 96.6% × TDF (% DM); r=0.94**. A similar equation was obtained for cat food: energy digestibility = 95.6% × TDF (% DM); r=0.88**. For crude fiber in dog foods the regression equation was: energy digestibility = 92.9% × CF (% DM); r=0.87**. This confirms earlier results. The correlation was even closer for TDF than for CF, and for TDF there were no outliers. Prediction of energy digestibility in dry food by TDF as a basis for prediction of ME may be even more accurate then prediction of energy digestibility by CF.

Key Words: Total dietary fiber, Energy digestibility, Cats and dogs


A model for estimating in vitro nutrient digestibility previously has been developed and validated using ileal-cannulated pigs. Our objective was to determine the accuracy of this model at predicting dry matter (DM), organic matter (OM), and crude protein (CP) digestibility in ileal-cannulated dogs. Two diets were used: a moderate diet (25% protein, 11% fat) and a super-premium diet (28% protein, 23% fat). Diets were fed to 8 ileal-cannulated dogs in a crossover design with chronic oxide used as a digestibility marker. The same diets were used as substrates in an in vitro system. Briefly, samples were ground and incubated with pepsin-HCl followed by pancreatin enzyme to simulate hydrolytic digestion before incubating with anaerobic media and canine fecal inoculum to simulate colonic fermentation. The in vitro model accurately ranked DM, OM, and CP hydrolytic digestibility of these diets, but predicted differences (P<0.05) due to diet in digestibility of all three nutrients, while the in vivo model resulted in differences (P<0.05) for CP alone. For digestive values including fermentation, the in vitro model correctly ranked and predicted differences (P<0.01) in disappearance of DM and CP as compared to the in vivo model. However, the in vitro model predicted no difference between the OM total tract digestibility of the two diets, while the in vivo model resulted in greater (P<0.01) OM digestibility of the super-premium diet. Generally, the in vitro model predicted digestibility coefficients that were lower than in vivo results, with the most variability occurring in CP digestibility values and the least variability occurring in DM digestibility values. These results indicate that although this in vitro model may aid in predicting relative diet digestibility, it is not a substitute for in vivo research on canine nutrient digestibility.

Key Words: Dog, In vitro, Nutrient digestibility

279 Influence of diet on fecal Lactobacillus population. C. J. Fu1, J. N. Carter2, J. H. Porter1, and M. S. Kerley1, 1University of Missouri-Columbia, 2Nestle Purina PetCare Company.

Forty Labrador Retriever puppies were used in a completely randomized block design to compare the effect of two meat-based (treatments 1 and 2) and two grain-based (treatments 3 and 4) extruded dry commercial diets on the Lactobacillus population in the feces. The crude protein content of treatments 1 - 4 were 28.0, 28.0, 25.5, and 27.0 % on DM basis, respectively. The fecal samples were collected individually from each dog on day 0, 3, and 14. Total anaerobe (TOTA) and Lactobacillus (LACT) bacteria were enumerated by an agar plating method. The media for TOTA enumeration was anaerobic basal agar (Oxoid, CM972, Basingstoke, Hampshire, England) with 10 % sterile defibrinated horse blood. The media for LACT was MRS broth (Difco, #288130, Sparks, MD, USA) and agar (20 g/L) with 20 mg/L vancomycin supplement. Incubation time was 48 h in an anaerobic chamber at 37 °C. Lactobacillus as a percentage of TOTA was greater (P<0.05) for treatment compared to the others (24 vs 16, 7, and 14 %). There was no main effect (P>0.05) due to day of sampling (11, 15, and 20 % LACT for day 0, 3, and 14, respectively). However, the ratio increased (P<0.05) from day 0 to day 14(11 and 38 % LACT, respectively) for the puppies fed the diet that resulted in the greater percentage LACT population. Diet can influence gut bacterial population in the puppy. Differences appear to exist in the ability of commercial diets to elicit bacterial population responses. There were no obvious correlations between type of diet and fecal LACT.

Key Words: Diet, Lactobacillus, Puppy

Dairy Foods: Goat cheeses and international milk sources

280 Effects of refrigeration and extended frozen-storage on organic acid profiles of commercial soft goat milk cheeses. Y. W. Park*, J. H. Lee, and S. J. Lee, Fort Valley State University, Fort Valley, GA.

Acceptability of a cheese depends largely on flavors formed during its aging process. Organic acids are important flavor compounds in cheeses, and form the basis of the evolution of flavor. In cheeses, the production of organic acids is due to the metabolism of bacteria, bifidobacteria, or due to the addition of acidulants during cheesemaking. Although organic acid compositions of goat cheeses are important flavor parameters for consumer acceptability, little information is available on this premise. Three lots of commercial soft goat milk cheeses were purchased from a licensed goat dairy to study organic acid profiles and their changes in goat cheeses during extended refrigeration and frozen storage. The cheeses were subdivided into three equal portions. One subsample was stored as unfrozen control (UFC) at 4°C for 4 weeks (0, 14, 28 days), and the other two portions were frozen at -20°C and stored for 0 and 3 months (FZC and 3FZ), then immediately thawed at 4°C, followed by aging at 4°C for 4 wks.

Concentrations of various organic acids were quantified using a HPLC (Hewlett Packard; LC-1100 Series) equipped with auto sampler, quaternary pump, vacuum degasser, diode array detector, and fluorescence detector. The column was reverse phase Hewlett Packard ODS Hypersil 5mm (125 X 4 mm), and solvent was 0.5% (wt/vol) (NH4)2HPO4. The soft goat cheese contained all tested standard organic acids except pyruvic acid in various amounts including formic, malic, lactic, acetic, orotic, citric, uric, tartaric, and propionic acids. Many unidentified isomeric peaks appeared between the known standard peaks. Lactate was highest organic acid, followed by acetate in the soft cheeses. Storage treatments (UFC, FZC and 3FZ) significantly (P<0.05) affected most of the identified organic acid contents such as acetate, butyrate, citrate, formate, lactate, malate, orotate isomers, propionate, propionate isomers, a tartarate isomer and uric acid, while aging periods did not influence them. Acetic, orotic and propionic acids were most significantly (P<0.05) affected by frozen-storage, which could be important predictors for the soft goat cheese.

Key Words: Goat cheese, Organic acids, Frozen-storage

282 tocopherol concentrations and their changes in caprine milk cheeses during extended refrigeration and frozen storage. J. H. Lee*, S. J. Lee, B. L Gadiyaram, and Y. W. Park, Fort Valley State University, Fort Valley, GA.

Vitamin E has antioxidant activity capable of protecting polyunsaturated lipids in biological systems from oxidative degradation. Vitamin E activity in milk is derived from a series of compounds of plant origin, the tocopherols and tocotrienols. The study was conducted to determine tocopherol contents of caprine milk cheeses and evaluate effects of refrigerated and frozen storage on tocopherol levels in the products. Three lots of commercial plain soft caprine cheeses were purchased and 3 lots of Monterey Jack goat cheeses were manufactured at the university dairy pilot plant. Each lot of both cheese varieties was divided into three equal portions. One portion was immediately stored at 4°C for 0, 14 and 28 days, and the 2nd and 3rd portions were immediately frozen (-20°C) for 0 and 3 months, then thawed, and stored as the same way as the unfrozen samples. Concentrations of tocopherol were quantified using a HPLC (Hewlett Packard; LC-1100 Series) equipped with auto sampler, quaternary pump, vacuum degasser, diode array detector, and fluorescence detector. The column used was reverse phase column Bio-Sil ODS-55 (250 X 4 mm, i.d.), and solvent was mobile phase (Hexane:isopropanol; v/v=98:5:1.5). Flow rate was 1.5 mL/min, and detector was Hewlett Packard 1046A programmable fluorescence detector, fluorescence set at excitation wavelength of 295 nm and emission wavelength of 330 nm. The pooled data of the mean -tocopherol (g/g cheese) for the unfrozen, 0 and 3 months frozen soft goat cheeses at 4°C for 4 wks were: 7.47, 7.98 and 7.28, indicating no difference between storage treatments. The corresponding mean -tocopherol contents of Monterey Jack hard cheese were: 18.2, 12.2, and 6.66, showing that significant (P<0.05) differences in vitamin E between storage treatments. There was a significant (F<0.01) and negative correlation between -tocopherol level and storage period, while no relations were found between vitamin E levels and acid degree value or pH of the experimental cheeses.

Key Words: Caprine cheese, Tocopherol, Refrigerated storage
Subsidy for private storing butter and cream in Hungary. I. Feher1, G. Vira2, S. J. Szanoczi3, H. F. Salem1, and L. Villanyi4, 1Szent Istvan University, Godollo, Hungary, 2Agricultural Intervention Centre, Budapest, Hungary.

The aim of the subsidy for private storing at ensuring the adequate butter supply in European Union. After joining to EU also this kind of subsidies will be used in Hungary. The subsidy for private storing could be provided based on the following conditions: 1. for pasteurized cream, whereby the content of fat in pasteurized cream or milk in factory permitted by EU and its fat content is 82% at minimum level and its water content is 16% at maximum level, 3. for salted butter made of pasteurized cream or milk in factory permitted by EU and its fat content is 82% at minimum level and its water content is 16% at maximum level. The subsidy is determined by storing cost and possible changing prices of fresh butter and butter-stock. The condition of subsidy for private storing is to make an contract for storing based on decided demands with Agency of Payment belonging to state member, in areas of which butter and cream are stored. The subsidy can be claimed in writing form from Agency of Payment for butter and cream having been stored between 15th of March and 15th of August in given year. The application for subsidy should be sent to Agency of Payment, when products have arrived to store within 28 days. The contract for storing is signed, when the application has received at Agency within 30 days. The contracting party or person responsible for storing should keep a record of products stored relevant to contract. In case of contract for private storing the storing period extents between 90 and 210 days. If the contracting party does not keep the deadline, the subsidy will be decreased by 15% and be payed only for that period, when butter and cream were really stored.

Key Words: Subsidy for private storing, Pasteurized cream, Contract for private storing

Horse: Equine production & management

Development of a Model for Treating Insulin Resistance in Mares. M. M. Vick*, R. D. Sessions, S. E. Reedy, B. A. Murphy, E. L. Kennedy, and B. P. Fitzgerald, University of Kentucky, Lexington, KY.

Obesity in mares is associated with insulin resistance (IR), which in turn may predispose them to laminitis and other inflammatory disease states. In obese horses, biguanides are a family of drugs that have been successfully used to treat IR. The goal of this study was to test the hypothesis that in the horse, dietary-induced insulin resistance can be alleviated by treatment with the biguanide, metformin. Fourteen mares (body condition score 5-7) were maintained at pasture and supplemented with .75 kg mixed grain and corn oil per day (2.64Mcal/kg) for a period of two months to increase obesity and induce insulin resistance. Mares were then challenged by hyperinsulinemic euglycemic clamp procedure at the end of each 30-day interval. Additionally, blood samples were collected x3 per week and body weight and percent body fat were determined at 3-week intervals. Treatment with metformin (1.5g x2/day) was associated with increased insulin sensitivity compared to untreated mares (P < 0.05). The highest dose (4.5g) was unaccompanied by increased insulin sensitivity. At a dose of 3.0g, insulin sensitivity was greater than pretreatment (P < 0.05) and accompanied by reduced fasting insulin concentrations; however, the degree of sensitivity was not different from that observed in untreated mares. In conclusion, observations from this preliminary study suggest that treatment of obese, insulin resistant mares with metformin may lead to increased insulin sensitivity. This effect may be dose dependent since only lower doses appeared to be effective.

Key Words: Metformin, Insulin resistance

Factors associated with mare reproductive loss syndrome in central Kentucky and surrounding areas. S. L. Gray*, D. L. Cross, K. E. Pantzer, W. C. Bridges, and T. Gimenez, 1Clemson University, Clemson, SC, 2USDA Poisonous Plants Research Lab, Logan, UT.

On 10 May 2001, a study of the Mare Reproductive Loss Syndrome (MRLS) reported in Central Kentucky and surrounding areas was initiated. This syndrome caused several thousand mares in this area to abort many early-term and a few late-term foals. The mares showed few signs of toxicity. Thirty-eight pastures on 11 farms were studied. Pastures were divided into two groups; those with early fetal losses (Treatment), and those without losses (Control). Overall botanical composition of pastures was evaluated. Chi square analysis of the botanical data showed a relationship between the evidence of consumption (p<0.0001) of Poison Hemlock (Conium maculatum) in problem pastures and MRLS. Subsequent chemical analysis determined that the Poison Hemlock plants contained 0.8-1.0% piperidinic alkaloids that are known to be toxic to animals. To study the clinical response to Conium maculatum in gravid mares, 14 mares were bred for experimental study. At gestational age 45 days, mares were randomly assigned to one of three groups: (1) Control-received no Conium; (2) Low (L)-received Conium at an alkaloid titration of 2.8mg/kg body weight; (3) High (H)-received Conium at an alkaloid titration of 4.3mg/kg body weight. Conium maculatum slurry was administered once per day for 4 days. Foals were observed by transrectal ultrasound. Mares were physically examined and blood samples were collected at times 0h, 1h, 2h, 3h, 4h, 5h, 6h, 24h, 25h, 48h, 49h, 72h, and 73h. Blood samples were analyzed for piperidinic alkaloid concentrations, blood chemistry components, and progesterone levels. Compared to the control mares, the H and L groups both showed increased frequencies of incoordination and tremors.

Key Words: Poison Hemlock, Conium maculatum, MRLS, Metformin, Insulin resistance
A high incidence of early embryonic death and spontaneous late-term abortions occurred in Kentucky and neighboring states in spring 2001 and 2002. The objective of this study was to evaluate the embryotoxic potential of feeding endophyte-infected tall fescue seed and hay to mares during early gestation. Mares (n = 12) were matched by stage of gestation (d 60-100) and assigned to diets (6/diet) that were fed for 10 days. Diets consisted of endophyte-free (E-) or endophyte-infected (E+; 271 µg ergot alkaloid content equivalent to 1.36 µg/kg BW/day) tall fescue seed (0.5% BW) mixed with sweet feed (10% CP) as well as ad libitum access to E+ tall fescue or ryegrass hay, for E- and E+ treatments, respectively. Rectal temperatures (RT), blood samples and urine were collected daily. Blood and serum was analyzed for clinical chemistry, progesterone (P4), prolactin (PRL), and 3,4-dihydroxynaphthaleneacetic acid (DOPAC, a catecholamine metabolite) analyses, whereas urine was analyzed for ergot alkaloids. Also, fetal heartbeat and presence of echogenic material in fetal fluids was monitored daily by ultrasonography (US). RT (E+ 37.76 ± 0.03; E- 37.84 ± 0.03 C) and PRL (E+ 14.06 ± 0.76; E- 12.11 ± 0.76 ng/ml) serum concentrations were not different between groups. Measuring the change in concentration from d 0 over time, P4 concentrations were not different (E+ 0.64 ± 1.49; E- 0.55 ± 1.47 ng/ml). There was no negative pregnancy outcome and US showed no increase in echogenic material in fetal fluids. There was a rapid and persistent (p < 0.05) decline in DOPAC concentrations in E+ compared with E- mares (2.1 0.14 and 4.4 0.43 ng/ml, respectively). Urinary ergot alkaloid concentration was greater (p < 0.01) in E+ compared with E- mares (532.12 ± 52.51 and 13.36 ± 2.67 ng/mg creatinine, respectively).

Although no embryo loss was observed during the current study, the elevated concentrations of urinary ergot alkaloids and the depressed endogenous catecholamine activity indicate that prolonged exposure to E+ tall fescue could be detrimental to embryonic development and survival in horses.

**Key Words:** Equine, Ergot alkaloids, Catecholamine

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**Meat Science & Muscle Biology: Muscle proteinases and meat quality**


Even before purification of calpain was first described (Dayton et al., 1976), calpain activity had been linked to postmortem tenderization (Goll et al., 1974). Studies have since established that nearly all (up to 90 % or more) of the tenderization that occurs during postmortem storage at 2-4°C is the result of calpain activity. Most convincing are the studies showing that there is nearly no degradation of actin and myosin during storage at 2-4°C even for periods as long as 2–3 weeks postmortem. The major cathepsins in skeletal muscle, cathepsins B, D, and L, all rapidly degrade myosin and actin, whereas the calpains are unique among the known proteolytic enzymes in that they do not degrade either actin or myosin.

There presently are three well-characterized members of the calpain family: μ-calpain, a protease that requires 3-50 mM Ca2+ for half-maximal activity; μ-calpain, a protease that requires 400–800 mM Ca2+ for half-maximal activity; and calpastatin, a protein that inhibits proteolytic activity of the calpains but of no other protease with which it has been tested.

In addition to its role in postmortem tenderization, evidence indicates that the calpain system is responsible for initiating turnover of the myofibrillar proteins in skeletal muscle. Hence, the calpain system has an important role in muscle protein turnover and the rate and efficiency of skeletal muscle growth. Existing evidence indicates that changes in calpastatin activity are more closely related to postmortem tenderization than changes in calpain activity. Because skeletal muscle contains sufficient calpain activity to destroy all myofibrillar proteins in the muscle in less than 5 min, future studies should focus on how activity of the calpains is regulated (e.g., via calpastatin, phosphorylation, other?) in postmortem and growing muscle.


Calpain and calpastatin activity are thought to be the determining factors for meat tenderness, and Ca plays a role in calpain activity. The present theory is to manipulate beef cattle diets to change muscle Ca levels and consequently calpain activity and shear force. To test whether dietary Ca manipulations affect tenderness, Angus steers (n=20) from a single source, were assigned to pairs based on an allotment weight. One steer from each pair was assigned to the control treatment (CO) and the other to the low dietary Ca (LC) treatment. All cattle were fed a typical high grain finishing (0.65% Ca) diet starting at 343 kg BW; dietary restrictions were imposed 113 d later at 561 kg BW. The LC received a 0.24 % Ca diet for 14, 21 or 28 d prior to harvest and was returned to the CO diet for one feeding 16 h prior to harvest. Individual performance and carcass data were collected. Postmortem muscle temperature and pH were determined for the Longissimus dorsi, Triceps brachii, and Semimembranosus muscles from each carcass at 1, 3, 6, 24, and 48 h post mortem. Warner-Bratzler shear force was determined on three steaks from each muscle from each carcass, on d 5, 10, and 15 post mortem. There appeared to be no adverse affect on DMI or ADG when fed a LC diet. Serum Ca levels at exsanguination were higher (P<0.01) for LC cattle than CO (11.9 v. 9.3 mg/dL). Muscle pH was higher (P<0.05) for LC at 1 h (6.47 v. 6.25), 3 h (6.16 v. 5.97), 48 h (5.61 v. 5.57) post mortem. Warner-Bratzler shear force values did not differ (P>0.2) between treatments on d 5, 10, and 15 for the Longissimus dorsi (3.0 kg ± 0.18) and Triceps brachii (3.1 kg ± 0.15). Shear force was lower (P<0.05) for LC on d 5 for the Semimembranosus (3.6 v. 4.2 kg). Muscle Ca concentration was numerically higher in the LC than CO (38.6 v. 37.3 µg/g). The depletion of Ca from finishing diets did not appear to have adverse effects on performance, but did increase serum Ca levels and altered muscle pH and shear force values of the Semimembranosus.

**Key Words:** Beef, Muscle, Calcium

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The objective of this study was to examine the impact of early postmortem protein oxidation on the color and tenderness of beef steaks. To obtain a range of oxidation levels, both longissimus dorsi et lumbarum (LDL) muscles from each of ten beef steers fed a finishing diet with vitamin E (1000 IU per head per day, minimum of 126 d [VITE], n = 20 muscles) and from another ten beef steers fed the same finishing diet without vitamin E (CON diet, n = 20 muscles) were used. Within 24 h after harvest, LDL muscles from each animal were cut into 2.54 cm thick steaks and individually vacuum packaged. Steaks from each animal were assigned to a control group (not irradiated) and an irradiated group (average dose = 6.4 kGy). Steaks were irradiated within 26 h postmortem and were aged at 4°C for 0, 1, 3, 7, and 14 d after irradiation. Steaks from each diet/irradiation/aging time treatment were used to determine color, shear force, and degree of protein oxidation (carbonyl content and sulphydryl content). Steaks from animals fed VITE diet had significantly higher α-tocopherol contents than steaks from animals fed the CON diet. At 0 d post-irradiation, within diet,
steaks that had been irradiated had lower L* values (P < 0.05). At all aging times irradiated steaks, regardless of diet, had significantly lower a* and b* values than non-irradiated steaks. Carboxyl concentrations were significantly higher in irradiated steaks compared to non-irradiated steaks at 0, 1, 3, and 7 d post-irradiation (P < 0.05). Protein carboxyl content was significantly and positively correlated to Warner-Bratzler shear force values. Immunoblot analysis for carboxyls showed that Vitamin E supplementation decreased the number and extent of oxidized sarcoplasmic proteins. At 0 d post-irradiation, sulfhydril content of purified myofibrils from irradiated steaks was significantly lower compared to myofibrils from non-irradiated steaks (P < 0.05). These results indicate that increased oxidation of muscle proteins early postmortem could have negative impacts on fresh meat quality.

Key Words: Protein oxidation, Irradiation, Beef quality


The objective of this study was to examine the role of early postmortem tissue oxidation in regulating postmortem mu-calpain activity and subsequent meat tenderness. It was hypothesized that oxidative conditions in postmortem (PM) tissue would decrease mu-calpain activity and minimize shear force degradation of myofibrillar proteins. At 1, 3, 7, and 14 d post-irradiation, steaks from each diet/irradiation/aging group were used to determine Warner-Bratzler shear force (WBS), calpain activity, autoxidation, and degradation of myofibrillar proteins. At 1, 3, 7, and 14 d post-irradiation, WBS values of irradiated steaks were significantly greater than non-irradiated steaks. Western blots were used to determine the percent of intact RYR in the LD bands were quantified using densitometry. WBS at 1 d was significantly correlated to the amount of intact RYR in the LD (r=0.358), indicating that samples with less intact RYR may have negative impacts on fresh meat quality. For the observation that within each ionic strength, percent inhibition of m-calpain was greater at 295 mM than 165 mM NaCl at 30 min and 7 d and desmin degradation in the LD at 96 h and 7 d (r=0.527 and 0.528), indicating that samples with less intact RYR may have negative impacts on fresh meat quality.

Key Words: Calpain, Protein oxidation, Mu-calpain


The objective of the study was to determine the extent to which pH and ionic strength influence the inhibition of μ- and m-calpain. Calpastatin, μ-calpain, and m-calpain were purified from porcine semimembranosus. μ- or m-Calpain (0.45 units) were incubated with fluorescent peptide Sue-Leu-Leu-Val-Tyr-AMC (170 M) in the presence of calpastatin (0, 0.15, or 0.30 units) under the following pH and NaCl concentration conditions: pH 7.5, 165 mM NaCl; pH 6.5, 165 mM NaCl; pH 6.0, 165 mM NaCl; pH 7.5, 295 mM NaCl; pH 6.5, 295 mM NaCl; pH 6.0, 295 mM NaCl in a total volume of 1 ml. The reactions were initiated with addition of 100 μM CaCl2 for μ-calpain and 1 mM CaCl2 for m-calpain. Calpain activity was measured at 30 and 60 min in a fluorometer using an excitation wavelength of 340 nm and emission wavelength of 460 nm. Percent inhibition with 0.15 or 0.3 units calpastatin was standardized against activity of calpain alone at each pH and ionic strength combination. Activity of μ-calpain was affected by pH (P < 0.01). Immunoblotting of μ-calpain demonstrated more autoxidation of the 80 kDa subunit in pH 7.5 incubations compared to pH 6.5. This may explain the observation that within each ionic strength, percent inhibition of m-calpain was greater at pH 6.5 than 7.5 (P < 0.01). Percent inhibition of μ-calpain by calpastatin was not affected by pH, but was affected by ionic strength. Percent inhibition of μ-calpain was significantly higher in 295 mM than 165 mM NaCl at 30 min and 60 min when 0.3 units of calpastatin was included in the assay. Activity of m-calpain was greater at pH 7.5 than 6.5 (P < 0.01). m-Calpain activity was not detected at pH 6.0. Percent inhibition of m-calpain by calpastatin was greater at pH 6.5 than 7.5 at 165 mM NaCl (P < 0.01). Percent inhibition of m-calpain was greater at 295 mM than 165 mM NaCl (P<0.01). These observations indicate that activity of calpain and inhibition of μ- and m-calpain by calpastatin can be affected by pH and ionic strength and merits further investigation.

Key Words: Calpain, Calpastatin, Protein oxidation


Proteins that regulate calcium in muscle may influence pork tenderness and water-holding capacity. These proteins include the sarcoplasmic reticulum Ca2+-ATPase pump-1 (SERCA-1) and ryanodine receptor (RYR). Proteolysis of the intermediate filament protein desmin has also been related to increased tenderness in meat. We hypothesized that degradation of these proteins (SERCA-1, RYR, and desmin) may be related to tenderness. Commercial hybrid pigs (n=54) were harvested and pH measurements were taken in the longissimus dorsi (LD) and the semimembranosus (SM) at 1 h and 24 h postmortem. Warner-Bratzler (WBS) shear force measurements were made on LD samples at 1 d and 21 d postmortem. LD and SM samples were analyzed by immunoblotting with antibodies for SERCA-1, RYR, and desmin. Immunoreactive bands were quantified using densitometry. WBS at 1 d was significantly correlated to intact SERCA-1 at 7 d in the LD (r=0.358), indicating products with lower WBS may have less intact SERCA-1. WBS at 1 d was significantly correlated to the amount of intact RYR in the LD at 24 h (r=0.422), indicating that samples with less intact RYR may have lower WBS. Significant correlations were observed between WBS at 21 d and desmin degradation in the LD at 96 h and 7 d (r=0.527 and 0.528).
Nonruminant Nutrition: Feed ingredients


In previous research, we showed that roller mill (RM) ground corn flows better than corn ground with a hammer mill (HM), and decreases particle size and increasing fat decreases flow ability. Therefore the objective of these experiments was to determine if the flow differences between HM and RM ground corn were due to the particle size standard deviation (PSSD). In both Exp., RM and HM corn samples were sifted through 13 screens and material from each screen was collected. Samples were dried to equalize moisture content. Analysis of variance (P < 0.05) of the maximum angle measured in degrees at which a pile of grain retains its slope. A large angle of repose represents a steeper slope and poorer flow ability. In Exp. 1, we created 5 RM samples with mean particle size ranging from 1415 to 333 microns and 5 HM samples from 1382 to 333 microns. All samples were created to have similar PSSD, ranging from 1.1 to 1.3. There was an interaction (P < 0.05) between particle size, added fat, and mill type. Increasing fat increased angle of repose; however, the difference was less in fine ground HM samples than in the RM samples. In RM samples, decreasing particle size had less of an impact on flow ability than in HM ground corn. In Exp. 2, we used 4 RM and 4 HM samples that were constructed from the previously collected grain. All samples were similar in mean particle size (641 to 679 microns) with varying PSSD (1.62 to 2.27). There was no (P > 0.10) fat x PSSD x mill type interaction observed. Increasing fat (P < 0.04) and PSSD (P < 0.001) decreased flow ability. These data suggest that the greater flow ability of RM ground corn appears to be a result of less particle size variation. However, with fine particle sizes (<700 microns) other factors, such as particle shape, may also contribute to flow ability.

Key Words: Particle size, Hammer mill, Roller mill


Three experiments were conducted to compare the effects of increasing solvent extracted soybean meal (SBM) and extruded-expelled soybean meal (EESOY) in diets for early-weaned pigs. All pigs (PIC; 5 pigs/pen) were fed a control diet containing no SBM or diets containing 20% or 40% of either SBM or EESOY. In Exp. 1 (n=175, 6.0 kg BW; 7 pens/treatment), diets were formulated using NRC (1998) nutrient values for SBM and previously determined values for EESOY. From d 0 to 14, no differences were observed in ADG or ADFE (P > 0.05), but G:F became poorer (linear, P < 0.06) with increasing soybean meal source. Soybean meal sources were analyzed for CP after the trial was completed. We speculated numeric differences in performance between sources could have been a result of lower than expected CP in the EESOY. In Exp. 2 (n=350, 5.9 kg BW; 14 pens/treatment), soybean meal sources were analyzed and actual nutrient values were used in diet formulation. From d 0 to 14, increasing SBM decreased ADFI (linear, P < 0.02). Increasing EESOY decreased ADG, ADFI, and G:F (linear, P < 0.01). Soybean meal sources used in Exp. 1 and 2 were then analyzed for trypsin inhibitor (TI). The EESOY from Exp. 1 and 2 had TI values greater than 6 mg TI/g, suggesting it was underprocessed, while SBM had values less than 2 mg TI/g. In Exp. 3 (n=350, 7.1 kg BW; 14 pens/treatment), different lots of EESOY and SBM were analyzed for TI (EESOY=1.8 mg TI/g; SBM=0.7 mg TI/g) to ensure quality and actual nutrient values were used in diet formulation. From d 0 to 14, increasing EESOY decreased ADG and ADFI, but increasing SBM decreased ADFI, but improved G:F (linear, P < 0.02). No differences (P > 0.05) were found between soybean meal sources. Feeding 40% EESOY or SBM in diets immediately after weaning resulted in poorer growth performance of weanling pigs compared to those fed lower levels (20%). Feeding properly processed EESOY resulted in similar growth performance compared to feeding SBM.

Key Words: Pigs, Soybean meal, Performance


Searching and assessing proteinaceous ingredients to be used in single stomach animals is a constant task. On the other hand, there is a continuous renewal of poultry population which generates a protein source of amino acids that can be used in pig feeding. The objective of the trial was to assess increasing levels of a poultry by-product meal in practical pig feeding, from weaning to market weight. Forty newly weaned hybrid pigs were separated into 5 animal groups to assess the addition of 0, 2.5, 5 and 7.5% (dry matter basis) of a poultry by-product meal (HSA) to a soybean-soybean meal diet in pigs. The intake was measured daily and the weight gain was calculated using initial and final measurements. The initial weight was used as co-variable for the gain. Most of the production parameters were negatively affected with the addition of HSA (P < 0.05). Carcass yield and fat content were reduced (P < 0.05), however the yield of mexican style cuts varied differently. In conclusion, increasing the addition of HSA affects negatively some of the production parameters and carcass yield in pigs.

Key Words: Poultry by-product, Pig, Feeding

299 Effect of inulin and sugar beet pulp on the growth performance and carcass characteristics of wean to finish pigs. G. F. He*, S. K. Baidoo, Q. Yang, and R. D. Walker, Southern Research and Outreach Center, University of Minnesota, Waseca, MN 56093.

The objective of the present study was to determine the performance and carcass characteristics of wean-to-finish pigs fed diets with different carbohydrate sources (inulin and sugar beet pulp). Six hundred and forty early weaned (17-d old, 5.7 ± 0.11 kg body weight) barrows and gilts were housed in an environmentally controlled facility from wean to finish. The duration of the study was divided into five phases: 5.7-10: 10-20; 20-50; 50-90; 90-115 kg BW. Pigs were blocked by initial body weight and allotted to four dietary treatments: (1) corn soybean meal basal diet as control; (2) basal diet supplemented with inulin in water, 132 g/L in phase 1-2, 66 g/L in phase 3-5; (3) Ground sugar beet pulp (5% and 7% in phase 1 and 2, 9% in phase 3-5) replacing partial corn in control diet; (4) basal diet supplemented with 0.25% antibiotics (ASP250, Roche Vitamins Inc., Basel, Switzerland) only in phase 1-3. Pigs in treatment 4 grew faster (P < 0.01, 601, 613, 594 and 666 g/day for treatment 1-4, respectively, s.e. = 8.10) and had higher feed intake (P < 0.01, 1244, 1276, 1273, 1368 g/day for treatment 1-4, respectively, s.e. = 18.30) than others in phase 1-3. Gain to Feed was negatively influenced (P < 0.01) by sugar beet pulp supplementation in treatment 3 compared to treatments 1, 2 and 4 (0.48, 0.48, 0.46, 0.49 for treatment 1-4, respectively, s.e. = 0.11) and had higher feed intake (P < 0.01, 1244, 1276, 1273, 1368 g/day for treatment 1-4, respectively, s.e. = 9.79). In phase 5, there was no difference in growth performance among treatment groups. Post-slaughter carcass characteristics, including average fat depth, average loin depth, lean percentage and carcass grade premium, were not influenced by the treatments except dressing percent, which was lower for treatment 3 group (P = 0.02, 74.4%, 74.4%, 73.4% and 74.6% for treatment 1, 2, 3 and 4, respectively, s.e. = 0.29). In conclusion, continuous supplementation of inulin
in water improved pig performance in late but not early growth stage. Dressing percentage was reduced by sugar beet pulp supplementation in wean-to-finish diets.

**Key Words:** Wean - 40 - finish pigs, Inulin, Sugar beet pulp

### 300 Effect of ractopamine on the performance and carcass characteristics in finishing pigs. G. He*, S. K. Baidoo, Q. M. Yang, and R. D. Walker, Southern Research and Outreach Center, University of Minnesota, Waseca.

This study was designed to evaluate the effect of ractopamine on finishing pigs fed two levels of total lysine (0.81% vs. 1.11%) with and without ractopamine (0 vs. 10 ppm) in a two-way factorial arrangement. Three hundred and twenty crossbred barrows and gilts with body weight of 971.12 kg housed in an environmentally controlled facility were blocked and randomly allotted to the four dietary treatments. Pigs' weight and feed intake were recorded weekly until the average of the pen reached 115-kg body weight. Ractopamine significantly promoted growth rate (965 vs. 1110 g/day, S.E. =23.3, P<0.01) and improved Feed ratio (0.28 vs. 0.33, S.E. =0.00867, P<0.01). The improvement in growth rate by ractopamine was 133% higher at high lysine level than low lysine level. In addition, the improvement by ractopamine on growth rate decreased with time (1158 vs. 1441 g/day in week 1, 946 vs 1050 g/day in week 2 and 791 vs 839 g/day in week 3, S.E. =40.3, P=0.014). Average backfat depth was reduced by ractopamine supplementation only when high lysine diet was fed (0.76 vs 0.79 cm at 0.81% lysine and 0.80 vs 0.70 at 1.11% lysine, S.E. =0.025, P<0.01). Average loin depth was significantly increased by the addition of ractopamine (2.79 vs 2.90 cm, S.E. =0.021, P<0.01). Increased lean muscle percentage by ractopamine was only observed in high lysine group (55.2% vs 55.4% at 0.81% lysine and 55.1% vs 56.3% at 1.11% lysine, s.e. =0.22, P=0.026), whereas dressing percentage was significantly increased by ractopamine only in low lysine group (73.7% vs 74.2% at 0.81% lysine and 74.2% vs 74.6% at 1.11% lysine, s.e. =0.31, P=0.021). In conclusion, ractopamine improved growth performance and carcass characteristics in pigs fed the high lysine diet and increased dressing percentage in finishing pigs fed low lysine diet.

**Key Words:** Pigs, Ractopamine, Carcass characteristics

### 301 Comparison of grain sources (barley, white corn, and yellow corn) for swine diets and their effect on fatty acid composition and fat quality. J. F. Lampe*, T. J. Baas, and J. W. Mabry, Iowa State University.

An experiment was conducted to evaluate the effect of energy source on fatty acid characteristics and fat quality of the longissimus muscle of pigs. Diet treatments (primary energy sources) were: 1) yellow corn, 2) white corn, 3) 1/3 yellow corn, 2/3 white corn, 4) 2/3 yellow corn, 1/3 white corn, and 5) barley. Pigs were from two genetic sire lines, Duroc and Hamp x Duroc sires (HD) on PIC 1055 females. A total of 999 pigs were included in the trial in a 2 x 2 x 5 factorial arrangement with two genetic types, two sexes (barrows and gilts) and five dietary treatments. Eight pigs were randomly selected from each pen of 26 (n=319) for meat, eating quality, and fatty acid evaluation. Pigs were placed on test at 27.6 kg and fed to 130.2 kg. In a four-phase diet regimen, the final two phases of the finishing diets (67.2 to 130.2 kg) included 1% supplemented choice white grease. All animals were held overnight at a commercial abattoir before harvest. One whole skin-on, boneless loin was collected from each carcass and held at -1 degree Cebiun in a vacuum-sealed bag at the Iowa State University Meat Lab. At 25 to 27 days post-harvest, loins were analyzed for meat and eating quality and samples were collected from the 10th rib for fatty acid analysis. Fatty acid composition was determined by standard gas chromatographic procedures. Pigs were given an individual subjective fat color score. Pigs fed diet 5 had a lower (P<0.05) iodine value than pigs fed all other diets. Dietary treatments had no effect on subjective fat color scores. Pigs fed diet 5 had higher (P<0.05) saturated and monounsaturated fatty acids than pigs fed all other diets. Results suggest that different energy sources evaluated in this study do not have an effect on subjective fat color but do have an effect on fat firmness.

**Key Words:** Pigs, Fatty acid composition, Energy sources

### Production, Management, and the Environment

#### 302 Effect of scraping frequency in a free stall barn on volatile N loss from dairy manure during summer. V. R. Moreira* and L. D. Satter1,2, 1U.S. Dairy Forage Research Center, Madison, USDA - Agricultural Research Service, 2Department of Dairy Science, University of Wisconsin - Madison.

The difference between estimated nitrogen:phosphorus ratio (N:P) of fresh excreta and measured N:P in scraped manure was used to estimate N loss when manure was scraped 2x (0800 and 1900h) or 6x (0900, 1200, 1500, 1800, 2300, and 0400h) daily, during each of two 24h-periods in late August. Mid-lactation cows (n=137), milking 31.6 kg/cow/d, were distributed among 4 pens for an ongoing feeding trial 24h-periods in late August. Mid-lactation cows (15/ per group) to examine the effect on water intake by reducing the time of manure exposure. This was not observed. Frequent scraping could have an offsetting effect by enhancing volatile N loss through spreading urine over a larger floor area. Volatile N loss was estimated to range between 37.5 and 43.1% of excreted N.

**Key Words:** Dairy manure, Ammonia, Nitrogen

#### 303 The effect of dietary calcium and phosphorus on water extractable phosphorus in feces of dairy cows. J. D. Ferguson1, S. R. Michelson*, C. F. Ramberg, Jr.1, and Z. Dou, 1University of Pennsylvania, School of Veterinary Medicine.

Four TMR rations varying in Ca and P content were fed to two groups of mid-late lactation cows (15/ per group) to examine the effect on water extractable phosphorus in feces. The study used a Square design with three, four week periods with diet switches between groups every two weeks. The rations had the following Ca, P content (%DM basis): Con: Ca .69, P .38; HighCa: Ca 1.2, P .38; HighP: Ca 1.2, P .60; HighP: Ca .69, P .60. On three consecutive days of the second week of each dietary block, daily samples of feed and feces were collected for analysis of DM, Ca and P. Fecal samples were collected from each cow, mixed thoroughly, and composited daily by group. Wet samples of feces (2 g, approximately .3 g of DM) and dried, ground samples of TMR
(3.3 g DM) were analyzed in replicate for total P and water extractable P. Samples were mixed with ninety eight ml of water, shaken for one hour at room temperature and then filtered. The filtrate was analyzed for inorganic P (Pi) and total P (Pt) using the phosphomolybdate blue method of Murphy and Riley (1962) and ICP methodology, respectively. All variables were analyzed as a repeated measures with dietary treatment nested within group using PROC GLM in SAS statistical software.

**Key Words:** Phosphorus, Calcium, Feces

### 304 Slow-release thyme oil granules for control of odor and pathogens in feedlot cattle waste.


Confined animal feeding operations can be a source of odor emissions, global warming gases, water pollution, and food contamination. Laboratory studies have indicated plant oils with antimicrobial activity can be used to control pathogens and odor emissions from cattle and swine wastes. However, these oils are volatile and were ineffective when topically applied to a feedlot surface. Our objective was to evaluate the effectiveness of topically applying thyme oil incorporated into corncob and treated pens. However, production of VFA in treated pens, 7.5 ± 1.91 gDM−1wk−1, was less than control pens, 0.55 ± 0.04 gDM−1wk−1 (P < 0.01). Similarly, concentrations of coliforms in treated pens, 35.3 ± 1.73 P < 0.04). These results indicate odor emissions and fecal coliforms can be reduced in feedlot manure with a once per week application of thyme oil in a granular form.

**Key Words:** Plant oils, Feedlot waste, Odor

### 305 Changes in concentrations of selected malodorous compounds from dairy manures associated with storage and composting.

L. B. Willett*, D. C. Borger, and D. L. Elwell, The Ohio State University/OARDC, Wooster, OH. USA.

Emissions of malodorous compounds from livestock manures are offensive and can cause health hazards to humans and cattle. Changes of manure storage and handling methods may prevent the formation and/or enhance the degradation of odors. Volatile fatty acids (VFAs), phenol, cresols, indoles and NH3 were quantified with fresh (n=12) and 12-day-aged (n=12) manures during pilot-scale composting in 205 L vessels either aerated continuously (AC) with high (2.3 kg/hr)/low (0.8 kg/hr) air flow controlled by thermostats or intermittently (AI) on a 5 min high air flow 55 min off cycle. Manures were mixed with sawdust (3:1, w/w) to yield C:N ratios between 21 and 29. GLC/FID was used to analyze VFAs in emissions and pH water extracts of composting masses. Ether extracts of phenolics and indoles were quantified by GLC/MS. Aeration

**Key Words:** Clinoptilolite zeolite, Nitrogen loss, Manure

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**Table:**

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<th>SE</th>
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**Key Words:** Manure, Odors, Ammonia

### 306 Adding potassium, clinoptilolite zeolite and yucca extract to feedlot diets to reduce nitrogen losses from manure.


Rapid loss of nitrogen (N) from manure and resulting nitrogen emissions is a major environmental concern. It is possible that a potassium clinoptilolite zeolite (CZ) because of its cation exchange capacity may bind ammonia, thus reducing manure N loss. Furthermore, yucca extract (YP) is believed to have anti-urease activity, which could reduce urea breakdown to ammonia in manure. In this study, the CZ was added to feedlot diets at 1.2 and 2.5% (DMB) in place of steam flaked corn. YP was added in addition to the 1.2% CZ level in Treatment 3. Experimental cattle were heavy yearling Angus-Continental cross steers. The experimental control diet consisted of 86% steam flaked corn, 6.5% corn silage and 7.5% premix (DMB). There were 8 reps/treatment and 8 steers/rep. They were fed on concrete floor pens and at approximately 100 days, on feed, the pens were cleaned and no bedding added. After one week of manure accumulation, the manure was collected from each treatment, mixed and stacked and analyzed for N and DM initially and at 3, 7 and 14 days. Previous studies had indicated that the majority of the N loss occurs within the first 28-days. Manure N losses for the four treatments are shown in Table 1. CZ 1.2%, CZ 1.2% + YP and the CZ 2.4% treatments each reduced N loss compared to the control. The CZ 2.4% treatment was not better than the CZ 1.2% treatment. The combination of CZ 1.2% + YP was extremely effective in reducing N loss at the 3, 7 and 14 day sampling periods, but not better than CZ alone at 21 and 29 days. It was concluded that the CZ or CZ + YP resulted in a substantial reduction in manure N losses compared to the control.

**Percent N/d loss/d**

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<th>Treatments</th>
<th>Control</th>
<th>CZ2.1%</th>
<th>CZ2.1% + YP</th>
<th>CZ2.4%</th>
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<tr>
<td>3</td>
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<td>25.3</td>
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**Key Words:** Clinoptilolite zeolite, Nitrogen loss, Manure
Demonstrations to show the economic value of dairy manure as fertilizer. J. A. Pennington1,2, K. W. VanDevender1, J. A. Hawkins3, and R. L. Duncan1, 1University of Arkansas Cooperative Extension Service, Little Rock, 2University of Arkansas Cooperative Extension Service, Conway, 3University of Arkansas Cooperative Extension Service, Berryville.

Demonstrations were conducted on a dairy farm (DF) with a dry manure management system and on a dairy farm (WF) with a wet or liquid manure system to determine the economic value as fertilizer of manure collected around the milking center. Nitrogen (N), phosphorus (P), and potassium (K) were valued at $0.64, $0.53, and $0.31/kg. DF had 80 cows which were in a holding pen and scraped feeding floor for 5.5 h/d; it produced 197,000 L/yr of manure with 6.1, 4.8, and 5.6 g/L of N, P, and K in manure from the stacking shed. Total value of manure as fertilizer was $1610.23/yr for N, P, and K. WF had 120 cows in a holding pen for 3 h/d; it produced 1,700,000 L/yr of manure with 0.57, 0.22, and 0.52 g/L of N, P, and K. Total value of manure as fertilizer from WF was $1091.70/yr for N, P, and K. Assuming that P is not needed with no value and 20% of nitrogen is lost in application, net values of the manure near the milking center as fertilizer were $959.11/yr for 5.5 h/d on DF and $772.02/yr for 3 h/d on WF. Assuming uniform distribution of manure throughout the 24 h, net values of manure were $3541.33/yr for 80 cows on DF and $6176.16/yr for 120 cows on WF or $44.27/cow/yr assuming uniform distribution of manure per kg of ethanol DM.

Key Words: Dairy, Manure, Fertilizer

Production of eight byproducts over a ten-year period for California and seven countries with estimates of phosphorus and potential ethanol production. J. N. Asmus and J. G. Fadel1, University of California, Davis, CA.

Byproduct production from ten countries: Argentina, China, Egypt, Kenya, Republic of Korea, Mexico and the USA, plus world totals and California were determined from 1990-1999 for almond hulls, bagasse, brans, beet pulp, molasses, brewers grain, grain straws and cake. Total DM tonnages, phosphorous and theoretical ethanol yields were examined over time. Simple linear regressions were used to test if slopes were significantly different from zero. Crop production data were from FAO and California state databases. Byproduct conversions were from published articles. Compositions were from NRC. Ethanol yields were determined from published conversions from cellulose and hemi-cellulose fractions. Ethanol DM yields were converted to liters assuming 1.14 liters of ethanol per kg of ethanol DM. Total world DM and phosphorous production showed an increase over time for bagasse, brewers grains, and brans with increases of 22%, 12% and 17% respectively. Slopes were different from zero (P<0.05) for bagasse, brans, and brewers grains. China’s production of brewers grain contributed 66% of the world’s increase. Byproduct trends showed little change over time for all countries studied. However, production of brewers grains, wheat straw, and bagasse in China increased by 180%, 100% and 100% with slopes different from zero (P<0.05). California’s production showed changes in cottonseed of ≥35% with a slope different from zero (P=0.01). Theoretical ethanol yields follow the same trends as metric tonnes of DM for each byproduct. Byproducts used as a feed in California had a higher economic value when compared to byproducts used for ethanol production. This is in contrast to straw byproducts that showed a higher value when used for ethanol production compared to their feed value. Byproducts production over a ten-year period showed stable trends except for China. Total worldwide byproduct use for feed is not reflected in this study. Under current California market conditions only straw byproducts should be considered as potential substrates for ethanol production.

Key Words: Byproduct

Gravity belt thickener with polymer assisted

Relationship between dystocia and calf morbidity and mortality. S. M. Tomlinson1, J. E. Lombard1, F. B. Garry1, V. Khunkhun1, and L. P. Garber2, 1Integrated Livestock Management, Colorado State University, Fort Collins, CO, 2USDA:APHIS:VS, CEAH, Center for Animal Health Monitoring, Fort Collins, CO.

The objectives of this year-long observational study were to obtain dystocia occurrence rates on three Colorado dairy farms and to identify the relationship between dystocia and subsequent calf morbidity and mortality. Each delivery received a dystocia score (standard scale 1 to 5) based on calving ease. Calf viability and health data were collected for 6,690 calves from 6,528 dams. Odds ratios (OR) were calculated for calves born with any assistance (scores 2-5) compared to calves born without assistance (score 1). The odds of being stillborn were calculated for each call sex. Subsequent OR’s for calf morbidity, death greater than 1 day of age and overall calf death prior to weaning were calculated only for heifer calves since bull calves were sold soon after birth. Primi-parous animals required significantly more assistance at calving (52.6%) compared to 28.7% of multiparous animals (P<0.0001). Overall, 7.2% of calves were stillborn. Calves that required birthing assistance were significantly more likely to be stillborn than those calves that did not require assistance (OR=5.3). The odds ratios for still births were 4.7 for bull calves and 6.8 for heifer calves that experienced dystocia, although this sex difference was not statistically significant. Calf morbidity was significantly increased for heifer calves that required assistance during birth (OR=1.3). Heifer calves that required assistance were more likely to experience a respiratory or digestive event compared to heifers that did not require assistance (OR=1.4). Overall, 13.4% of heifer calves were born dead or died prior to weaning. No significant increase in death rate was observed from 1 day of age until weaning. When heifer births plus mortality to weaning was evaluated, dystocia heifers were more likely to die (OR=2.3). Dystocia had a significant impact on calf morbidity and mortality.

Key Words: Dystocia, Calf morbidity, Calf mortality
678 Biological considerations pertaining to use of the retinal vascular pattern for permanent identification of livestock. J.C. Whittier\textsuperscript{1*}, J. Doubet\textsuperscript{2}, D. Henrickson\textsuperscript{3}, J. Cobb\textsuperscript{4}, J. Shaddick\textsuperscript{1,2} and B. L. Golden\textsuperscript{1,2}. \textsuperscript{1}Colorado State University, \textsuperscript{2}Optibrand, Ltd LLC.

Our objective was to characterize the retinal vascular pattern (RVP) as a stable biomarker for use in identification of livestock. The central retinal artery and vein enter the eye along the optic nerve and divide to supply the retina. The geometric configuration of this vascular bed develops and is completed during fetal growth as vasculogenesis and angiogenesis occur. Other authors have reported that retinal angiogenesis is a Laplacian process which is ubiquitous in nature and follows branching patterns seen in rivers, trees, roots, and erosion channels. RVP images from livestock can be converted into a quantifiable format using a digital camera. These algorithms can generate a binary image resulting from a hashing function to allow rapid one-to-many searching. The number and position of branches, along with the diameter of each vessel combine to offer an information rich biomarker for use in animal identification. To evaluate each RVP the dominate trunk vessel of bovine RVP images was positioned vertically and branches on the right and left of the trunk and other branching points were counted. RVP images from 52 different cattle were evaluated. Branches from the left (LB=6.4; mean, variance) and right (RB=6.1) of the vascular trunk; total branches from the vascular trunk (TBVT=12.8, 4.3), and total branching points (TBP=20.0, 13.2) showed differences across animals. A paired comparison of RVP from both eyes of 30 other animals confirmed that eyes from the same animal differ. RVP images of 4 cloned sheep from the same parent line were evaluated to confirm the unique RVP is genetically identical animals. The uniqueness of the RVP allows for the unalterable association of animal with owner and premises improving the reliability of processes such as contaminated product recall, disease epidemic containment, and subsidy payment schemes.

Key Words: Retinal vascular pattern, Animal identification, Biomarker

311 Role of trace minerals and vitamins in optimizing immune function of cattle. E. B. Kegley\textsuperscript{*}, University of Arkansas, Fayetteville.

The immune system is a complex, multi-faceted response to challenge. Dysfunctions of this system result in significant annual losses to livestock producers; problems may, in part, be addressed by nutritional intervention. Enhancing the immune response through optimizing nutrition is a goal receiving increasing emphasis. Specifically, trace mineral and vitamin status alter various components of the immune system and will be the subject of this review. Research results indicate that trace minerals; including: Zn, Cu, Se, Cr, and Co; and vitamins E and A; impact immunocompetence. Many of these micronutrients have antioxidant activities that benefit animal health. Zinc plays a major role in disease resistance and immune responsiveness of many species. In lab animals, Zn deficiency impairs thymus activity, natural killer cell and neutrophil function, and cytokine production. Yet, research in ruminants has been more variable. Severe Zn deficiency impacts lymphocyte function and wound healing. In dairy cattle, high levels of supplemental Zn are generally associated with reduced somatic cell counts, possibly reflecting the importance of Zn in maintaining effective epithelial barriers. Copper and Se status affect several aspects of the immune system. In vitro, neutrophils isolated from ruminants deficient in Cu or Se have reduced ability to kill ingested bacteria, part of nonspecific immunity. Studies with ruminants indicate little effect of Cu deficiency on specific immune function. In contrast, supplemental Se has enhanced ruminant antibody response. Selenium deficiency is correlated with increased incidence of metritis and clinical mastitis in dairy cows. Suplemental vitamin E decreases morbidity in stressed calves. Research continues to impact immunocompetence. Many of these micronutrients have antioxidant activities that benefit animal health. These data suggest that initial plasma glucose and lactate concentrations may be indicative of health status of newly arrived receiving cattle and that increased incidence of BRD in cattle decreases ADG and carcass quality.

Key Words: Health, Daily gain, Carcass quality

312 Incidence of bovine respiratory disease in receiving heifers: effects on weight gain and carcass characteristics. J.C. Whittier\textsuperscript{1*}, J. Doubet\textsuperscript{2}, D. Henrickson\textsuperscript{3}, J. Cobb\textsuperscript{4}, J. Shaddick\textsuperscript{1,2} and B. L. Golden\textsuperscript{1,2}. Crossbred beef heifers (n=665, BW=225 < 24 kg) were used in a completely randomized design to determine the effects of bovine respiratory disease (BRD) on ADG and carcass characteristics. Heifers were pro- duced within 24 h of arrival and processing included vaccination against common viral and clostridial diseases, recording of rectal temperature, and measurement of plasma glucose and lactate concentrations. Heifers were subsequently monitored for clinical signs of BRD including depression, lethargy, anorexia, coughing, rapid breathing, and nasal or ocular discharge. Heifers exhibiting signs of BRD received antibiotic therapy and the number of times a heifer was treated for BRD was recorded.

Key Words: Trace minerals, Vitamins, Cattle

Ruminant Nutrition: Minerals and vitamins

to a commercial feedyard where they were fed a common series of diets throughout a 124-d finishing period. Plasma glucose and lactate concentrations measured at time of initial processing were greater (P < 0.1) for heifers not treated for BRD than the mean of heifers subsequently treated for BRD, and decreased (linear, P < 0.01) as treatment for BRD increased. Rectal temperature measured at time of initial processing increased (linear, P < 0.03) with increased treatment for BRD. In Exp. 1, ADG, and final BW during the receiving period decreased (linear, P < 0.01) as treatment for BRD increased, while grazing period ADG was increased (linear, P < 0.01). Finishing period ADG, final BW, hot carcass weight, fat thickness, and marbling score were decreased (linear, P < 0.05) with previous incidence of BRD. These data suggest that initial plasma glucose and lactate concentrations may be indicative of health status of newly arrived receiving cattle and that increased incidence of BRD in cattle decreases ADG and carcass quality.

Key Words: Health, Daily gain, Carcass quality

313 Effect of copper source and level on performance and copper status of cattle consuming molasses-based supplements. J. D. Arbington\textsuperscript{1}, F. M. Pate\textsuperscript{1}, and J. W. Spears\textsuperscript{2}. University of Florida - IFAS, Oka. North Carolina State University.

Two studies were conducted to evaluate the availability of Cu offered to cattle consuming molasses-based supplements. In Exp. 1 (84 d), 24 Braford heifers were randomly assigned to 12 pastures (n = 8 per pasture). Heifers were provided 1.5 kg of TDN and 0.3 kg of supplemental CP/heifer daily using a molasses-cotcontised meal slurry. Three treatments were randomly assigned to pastures (4 pastures/treatment), providing 100 mg of supplemental Cu daily in the form of 1) CuSO\textsubscript{4} (inorganic Cu), or 2) organic-Cu (Availa-Cu; Zinpro Corporation, Eden Prairie, MN). A third treatment received no supplemental Cu. Heifer BW was collected at the start and conclusion of the study. Jugular blood and liver samples were collected on d 0, 29, 56, and 84. In Exp. 2 (72 d), 24 Brahman-crossbred steers were fed the same molasses-cotcontised meal supplement at the same rate used in Exp. 1. Steers were housed in individual pens (15 m\textsuperscript{2}) with free-choice access to stargass hay. Four Cu treatments were assigned to 6 pens/treatment providing, 1) 10 ppm Cu from an organic source (Availa-Cu), 2) 10 ppm Cu from Tri-basic Cu chloride (TBCC; Micronutrients Inc., Indianapolis, IN), 3) 30 ppm Cu from TBCC, or 4) 30 ppm Cu, 50:50 ratio of TBCC and organic Cu. Body weights, blood, and liver samples were collected on d 0, 24, 48, and 72. In Exp. 1, liver Cu was similar between heifers supplemented with inorganic and organic Cu. Each source resulted in increased (P < 0.05) liver Cu concentrations compared with the unsupplemented control. Plasma ceruloplasmin concentrations were higher (P < 0.05) for Cu-supplemented heifers, independent of Cu source. Heifer ADG tended (P = 0.11) to increase with Cu supplementation compared with the non-supplemented control. In Exp. 2, liver Cu was greater (P < 0.05) on d 24, 48, and 72 for steers consuming 30 ppm compared with 10 ppm Cu. Steers supplemented with organic Cu had lower DMI compared with steers supplemented with 10 or 30 ppm of TBCC. The inorganic and organic Cu sources evaluated
in this study were of similar availability when offered in molasses supplements. A dietary Cu concentration greater than 10 ppm might be necessary to ensure absorption in beef cattle fed molasses-based supplements.

Key Words: Cattle, Copper, Molasses

314 Evaluation of Na requirements for finishing feedlot heifers. C. B. Wilson*, G. E. Erickson, C. N. Macken, and T. J. Klopfenstein1, University of Nebraska, Lincoln, NE.

A trial was conducted to evaluate the effects of increasing levels of salt (NaCl) inclusion on animal performance and feed intake. The objective of this trial was to establish a NaCl level and Na requirement that maximizes intake and performance while minimizing excretion of Na to the environment. Fifty-nine head of individually fed yearling heifers (365 kg) were assigned randomly to treatment and fed for 113d. Heifers were adapted to concentrate on treatment diets by increasing intake (0.23 kg/d) from 1.5 % of BW until ad libitum consumption was attained, approximately 21 d. The diet included 42.5% high moisture corn, 42.5% dry rolled corn, 7.5% grass hay, 3% tallow and 5% supplement. Five treatments (12 hd/trt) were formulated to include increasing levels of NaCl in the supplement at 0, 0.125, 0.25, 0.375 and 0.5 % of diet DM. Treatments bracketed 1996 National Research Council (NRC) minimum Na requirements (0.08% of DM). Water intake was measured using water meters on a group basis to evaluate additional Na intake. Ingredient and water analysis showed increasing levels of Na intake from 3.0, 7.0, 11.0, 14.7 and 19.3 ± 0.8 g/heifer/d with an average of 1.9 g/d from water. Analyzed Na levels in the diet were 0.03, 0.07, 0.11, 0.16 and 0.20 % of DM. Analysis of performance data showed no significant difference in ADG, DMI or gain/feed (G:F) with different levels of NaCl. Overall, NaCl supplementation was not effective in increasing ADG, G:F or DMI. Heifer performance averaged 1.46 ± 0.06 kg/d ADG with G:F averaging 0.150 ± 0.004. No significant effects were detected for fat, marble or yield grade (P > 0.10) data across all treatments. These results suggest that NaCl inclusion in diets is not necessary, and the Na requirement is less than current NRC recommendations. Feedlot operations may reduce the excretion of Na to the environment and help to make feeding cattle more environmentally sustainable (i.e. minimizing Na buildup in acres receiving manure and runoff water).

Key Words: Salt, Sodium requirement, Feedlot cattle

315 Effect of feeds naturally high in selenium on performance and selenium concentration in various tissues of finishing beef steers. T. L. Lawler*1, J. B. Taylor2, J. W. Finley2, and J. S. Caton1. North Dakota State University, Fargo, ND, USDA-ARS, Dubois, ID, USDA-ARS, Grand Forks, ND.

A majority of the human daily requirement of selenium (Se) can be obtained from beef. Although Se content of edible beef tissue is highly variable, previous research suggests that this content can be influenced by the concentration and form of Se in feedstuffs consumed. Data are limited describing effects of feeds high in Se on performance and tissue Se concentration of finishing beef steers. Therefore, 45 beef steers (BW = 351.1 ± 24.1 kg) were assigned to one of four treatments: Se adequate (CON; n = 12), or high Se provided as high Se wheat (WHT; n = 11), sodium selenate (SEO; n = 11). Selenium content for WHT, HAY, and SEO diets was 65, 9.5 g/kg·−1 BW·−1, and for CON, 9.5 g/kg·−1 BW·−1. Kidney, pelvic, and heart fat was higher (P = 0.06) among CON and WHT compared to SEO and HAY (2.9, 2.9, 2.4, 2.5 0.2%, respectively); other performance measures were not affected (P > 0.01). Concentration of Se in kidney and spleen was different (P < 0.01) in response to treatment with WHT > HAY > SEO > CON (12.98, 10.86, 10.05, 8.40 0.26 ppm for kidney and 5.16, 3.82, 2.60, 2.00 0.09 ppm for spleen, respectively). Liver samples contained 10.79, 9.91, 6.56, 2.33 0.80 ppm Se where WHT = SEO > HAY > CON, respectively (P < 0.01). Selenium content of the muscle was much greater (P < 0.01) in treatments containing feeds naturally high in Se (WHT > HAY > SEO = CON; 4.41, 3.32, 1.55, 1.33 0.18 ppm, respectively). In conclusion, producers can effectively increase selenium concentration in muscle tissues by feeding feedstuffs naturally high in Se without compromising performance or carcass characteristics. These results reveal a potential market for feeds naturally high Se through the provision of a readily available Se source to cattle, and an effective method to create a beef product that is naturally high in Se.

Key Words: Beef, Wheat, Natural

316 Effect of total dissolved solids and sulfates in drinking water for growing steers. H. H. Patterson, P. S. Johnson, and W. B. Epperson, South Dakota State University, Brookings, SD.

Previous data from our laboratory showed that water with elevated total dissolved solids (TDS) and sulfates was detrimental to performance and health of growing steers. The objective of this study was to determine the effects of TDS or sulfates where reductions in performance and health occur. Eighty-four crossbred steers (290 kg) were blocked by weight and randomly assigned to one of 12 pens (7 steers/pen). Pens were randomly assigned to one of four water treatments (3 pens/treatment) based on TDS and sulfate concentrations (mg/L): 1) 1150 TDS (385 sulfates); 2) 2800 TDS (1815 sulfates); 3) 4800 TDS (3000 sulfates); and 4) 7500 TDS (4800 sulfates). All water was obtained from natural sources and constituted the only available water source. Steers were fed a diet (0.97 Mcal/kg NEg) of ground grass hay and wheat middlings from May 23 to September 4 (104 days). Compared to 1150 TDS water, steers on 4800 TDS water had lower (P = 0.08) body weights at study end. Steers receiving 7500 TDS water had lower (P = 0.001) ending weights than all other treatments. Average daily gain and dry matter intake declined quadratically (each P = 0.02) with increasing TDS level (0.81, 0.75, 0.67, and 0.28 kg/d and 9.43, 9.35, 8.59, 5.98 kg/d for ADG and DMI on 1150, 2800, 4800, and 7500 water, respectively). Gain/feed declined quadratically (P = 0.04) with increasing TDS level. Incidence of polioencephalomalacia was 48% in the 7500 treatment with no cases in any other treatment (P = 0.0001), and 33% of steers on the 7500 treatment died of polioencephalomalacia (P = 0.0001). Water with 4800 mg/L TDS and 3000 mg/L sulfates tended to cause performance reductions in growing steers, whereas water with 7500 mg/L/ TDS and 4800 mg/L sulfates caused marked reductions in steer performance and health. These data, combined with field observations, suggest that water quality in a significant portion of South Dakota may be insufficient for optimal production.

Key Words: Water quality, Polioencephalomalacia, Performance

Dairy Foods Symposium: Hispanic-Style Cheeses

317 Overview of Hispanic cheese. N. Y. Farkye*, Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.

The growth of Hispanic population in the U.S.—31.3 million in 2000 (i.e., 11.9% of the U.S. population) and the increased interest in ethnic foods has resulted in an increased demand for Hispanic cheeses. Between 1997 and 2002, Hispanic cheese production in the U.S. grew over 70% from 68.8 million lb to 117.5 million lb. Queso Fresco (pronounced Keh-so Fres-co) is the most popular variety with a finely milled and crumbly texture. Panela (Pah neh-la) has a basket-weave appearance. Average composition of Queso Fresco is 49% moisture, 22.5% fat, 21.5% protein, 2.0% salt and pH of 6.3; and Panela contains 50% moisture, 23% fat, 20% protein, 1.6% salt and pH of 6.3. Cotija (Ko tee-hah) is hard and crumbly, similar to young Parmesan and contains 37% moisture, 27% fat, 26% protein, 4% salt and pH 5.5. Queso Oaxaca (Wa a-ha) is a ‘pasta filata’ variety similar to Mozzarella with an average composition of 45% moisture, 24% fat, 23% protein, 1.7% salt and pH of 6.0. Asadero (Ah-sah-deh-ro) contains 45% moisture, 21% fat, 24.5% protein, 1.7% salt and pH 5.6. Asadero may contain emulsifying salts, hence its high meltability. Other Hispanic cheeses are Queso Blanco (Keh so Bli-an-ro); Queso Para Freir, Queso Ajeo (Keh-so An ye-ho), meaning ‘aged cheese’; Queso Enchilado (Keh-so En chee-lah do) which is essentially Queso Fresco with a coating of paprika or chili powder; Queso Chihuahua (Keh so Chee-wah-wah), also called Mennonita or Queso Quesadilla is a hard to semi-hard variety similar to Cheddar or Jack; Queso Crema which is similar to Panela but has a higher fat content; and Requeson which is similar to ricotta.
The Hispanic consumer is a significant market segment in the USA. Current Hispanic population in the U.S. is 34.8 million and it is expected to grow to 13.3% of the U.S. population by 2005. The demand for Hispanic cheeses is no longer regional but national. Cheese is an integral part of an average Hispanic meal—with queso being used as a staple oriller. Distribution of Hispanic cheeses is primarily in “bulk”. Customers always want to taste the product prior to purchase, and then purchase by weight. Pre-packaged cheese is less than 10% of volume. In the U.S., about 90% of “bulk” Hispanic cheeses are delivered by Direct Store Delivery (DSD) to Carnicerias (mom and pop stores). However, the growth of pre-packaged cheeses is expanding rapidly due to retail chains recognizing the growth of Hispanic cheeses. Hence, the newest trend of distribution is through Retail Chain Distribution Centers and/or Master Distributors. Current distribution and marketing trends will be discussed.

Key Words: Hispanic cheese, Marketing, Distribution


Queso Fresco is characterized by being high in moisture content, having a mild flavor and a short shelf-life. It is also the most popular Hispanic-style cheese consumed in Mexico and the United States. Traditionally, Queso Fresco is made from raw milk; however, its high moisture content, near neutral pH and absence of starter cultures makes this cheese an unsafe product. To solve this problem, an alternative would be to produce Fresco cheese from pasteurized milk using non-specific starters. However, the use of such starters means that the organoleptic quality of the product bear little relation to those of its traditional counterpart. There is thus increasing interest in the development of specific indigenous starters for use in the manufacture of traditional-type cheeses that would allow the making of a uniform safe product of constant quality. The objectives of this work are to present the design of specific starter cultures for the production of Queso Fresco. Additionally, the use of non-specific commercial starter cultures utilized in the manufacture of the most popular Hispanic-style cheeses consumed in Mexico will be discussed. Four cheese batches were prepared following traditional practices. Physiological and biochemical characteristics of native lactic acid bacteria isolated from the cheese were studied for their identification and inclusion in the specific starters. Cheeses were made by using pasteurized milk and six different starters and their flavor and texture were compared with the traditional cheese. Queso Fresco made with specific starter cultures were not significantly different (p > 0.01) from the traditional cheese made from raw milk. Qeso Fresco made from pasteurized milk and specific starters allowed the making of a uniform safe product of organoleptic qualities equivalent to its traditional counterpart.

Key Words: Starter cultures, Hispanic-style cheeses, Fresco cheese

320 Effect of fatty acid modification to lower saturates on quality of Queso Blanco. S. O’Keefe* and A. Aigster, Virginia Tech Department of Food Science.

Nutritional recommendations to lower consumption of saturated fat often lead to reduced consumption of dairy products, including cheese. Dairy products with fatty acid compositions with lower saturates and higher monooenyes would have clear health benefits for consumers. Qeso blanco is a Hispanic, acid-set cheese which is non-melting and has a very short production time. Experiments were conducted to investigate the effects of milk fatty acid modification, to increase monounsaturates and lower saturates. Sensory, instrumental and oxidative stability of qeso blanco prepared using acetic acid. Milk with modified fatty acid composition was obtained by feeding calcium salts of high oleic sunflower oil. Oleic acid was increased from 26% to 40% and the oleic to palmitic acid ratio increased from 1.0 to 2.0 after modification. The was no measurable effect of modification on texture of cheese as determined using an Instron. Sensory panels indicated that acceptability was similar between normal and modified cheese and storage stability testing showed similar levels of oxidation after storage. Qeso blanco prepared using milk modified to have high oleic and low saturated fatty acid compositions has similar texture, sensory and stability to traditional cheese.

Key Words: Qeso blanco, Monoene, Cheese quality

321 Crumbliness of Queso Fresco. S. Gunasekaran*, University of Wisconsin-Madison.

The Qeso Fresco is one of the most common Latin American white cheeses that has a unique crumbly texture. Qeso Fresco is crushed and sprinkled on foods and then consumed. The cheese maintains its integrity until it is broken. Therefore, it is ideal for casseroles, Mexican specialties such as enchiladas, quesadillas, tacos and other dishes that are broiled or baked before serving. Since Latin American cheeses are new for mass manufacture in the U.S., evaluation of major textural characteristics has not been widely performed. The crumbliness of Qeso Fresco-type cheeses may be defined as a “measure of how readily the cheese can be fragmented into small particles suitable for even spreading.” Currently, crumbliness is measured subjectively. We have developed an objective instrumental method to measure crumbliness in comparison to sensory evaluation. The instrumental tests we investigated include texture profile analysis, uniaxial compression, and shear. The samples crushed in the compression tests were subsequently subjected to particle analysis to estimate total number of fragmented particles. Statistical correlations were obtained using ANOVA with Tukey multiple comparison between the sensory parameters (firmness, moistness, crumbliness, particle size, particle size uniformity) and instrumental-test parameters (hardness, toughness, modulus, fracture stress, fracture strain, number of particles, etc.). The sensory perception of crumbliness, described as the ease of fragmenting the cheese, was used as the primary indicator defining the cheese crumbliness. Among the many properties measured, total number of particles determined from particle analysis correlated the best with sensory crumbliness.

Key Words: Qeso fresco, Crumbliness, Particle size

322 Cheeses from different countries of Latino America. V. Alvarez* and R. Jimenez-Flores, 1 The Ohio State University, 2 DPTC-California Polytechnic State University.

Latin American (LA) countries have a rich tradition in the production and consumption of cheese, which is called “Qeso” and “Queijo” in Spanish and Portuguese, respectively. Cheesemaking in LA region started when the Spanish and Portuguese conquerors brought the first herds to the American continent. Therefore, all cheeses made in LA were originally developed following European cheesemaking procedures. There is a wide variety of cheese products found from the north of Mexico to the south of Argentina due to vast differences in climate, agricultural practices and traditions. LA cheeses can be soft, semi-hard and hard. As in other countries of the world, cheeses are named for the town, region or community in which they are made, thus many cheeses with different names might have practically the same textural and flavor characteristics. Some well known cheeses from LA are queso Añejo, Panela, Cotija, Oaxaca, tipo Manchego from Mexico; fresh cheeses made with whole or partially skimmed milk and pressed are called Qeso Prensado, in El Salvador and Venezuela, Queso de Puna in Puerto Rico, Qeso Estrella in Colombia and Qeso Descremado in Costa Rica. Other recognized LA cheeses are Qeso Colonia in Uruguay; Queijo Prato (Prato cheese), Requeijao and Minas Frescal in Brazil; Mar de Plata, Mantequero and Parmesan in Argentina. The important characteristics and processing of these LA cheeses and their relationship with the Hispanic cheeses found in the U.S. market will be reviewed and discussed.

Key Words: Cheese, Qeso, Latino America


The range of functional and rheological properties of the many styles of Hispanic cheeses arise from variations in their composition and methods used to process them. However, limited information is available on these cheeses. The objective of this joint ERRC-CIAD study was to characterize the compositional (moisture, fat, protein, salt), physical (pH, water activity), functional (color change upon heating, meltability), and...
Dairy Foods Symposium: Listeria monocytogenes: a model pathogen for farm-to-table intervention


Listeria monocytogenes not only causes a severe human foodborne disease, but also has been linked to infections in more than 20 different animal species. Animal listeriosis has particularly been reported in cattle, goats, and sheep; symptoms in these animals include meningitis, abortions, and septicaemia as well as, less commonly, non-systemic infections such as uveitis and mastitis. Human listeriosis outbreaks involving a variety of dairy products (including butter, chocolate milk, Hispanic style cheeses) have been reported. According to the USDA/FDA Listeria risk assessment Hispanic style fresh cheeses represent a particular high risk food for acquiring listeriosis (on a per serving basis). L. monocytogenes strains also have a considerable ability to survive outside a mammalian host and under a variety of stress conditions, which represent a particular concern for the food industry. This organism has not only been shown to be present in most dairy processing plant environments, but specific strains of this organism have also been found to persist in processing plant environments for extended periods (up to months and years). While L. monocytogenes has been found in raw milk, current pasteurization time-temperature combinations effectively inactivate L. monocytogenes. Post-processing contamination from plant environments probably represents the most common source of L. monocytogenes contamination of pasteurized dairy products. Nevertheless, any point of the dairy food continuum may contribute to the presence of L. monocytogenes in dairy foods. Even for dairy products produced from pasteurized milk, L. monocytogenes present in raw materials or introduced from farm environments into processing plant on fomites (e.g., personnel) may indirectly contribute to finished product contamination. I will present a farm to table transmission model for L. monocytogenes, which will incorporate our current knowledge on the ecology and transmission of L. monocytogenes. Considerable gaps in this model will need to be filled before we can quantify the contributions of different potential sources in the dairy food continuum to finished product contamination at point of consumption.

Key Words: Listeria, Transmission, Food safety


Listeria monocytogenes is an important human foodborne and animal pathogen. The interaction of agent, host, and environmental factors such as strain virulence, host immunity, and agricultural production practices, makes the epidemiology listeriosis difficult to elucidate. L. monocytogenes has been implicated as the causative agent in several large outbreaks of human foodborne illness. Thus, L. monocytogenes contamination of raw agricultural commodities used to produce foods that undergo minimal bactericidal processing (i.e., unpasteurized dairy and ready-to-eat products) is a serious concern. The definitive source of L. monocytogenes in finished products is not clear. Because L. monocytogenes can infect food animals and survive in the environment for extended periods of time, L. monocytogenes may be carried through the food continuum by animals. Knowledge of L. monocytogenes transmission and ecology in pre-harvest food systems is needed to reduce contamination throughout the food chain. A case-control study was conducted to determine the prevalence and molecular epidemiology of L. monocytogenes in production ruminants, animal feed, and the farm environment (soil and water). Overall, L. monocytogenes was abundantly present in ruminant feces, animal feed, and the farm environment. While the prevalence of L. monocytogenes was not significantly different in bovine case and control farms, L. monocytogenes was significantly more common in small ruminant (caprine and ovine) case farms compared to controls. Therefore, the epidemiology of L. monocytogenes differs in small ruminant and bovine farms. Our data support an on-farm transmission model in which specific pathogenic L. monocytogenes subtypes in animals feeds are amplified in animals with or without clinical disease and dispersed into the farm environment. Cattle farms appear to maintain a large environmental L. monocytogenes load, including subtypes which have been linked to human listeriosis outbreaks. While we have established the presence of disease related L. monocytogenes subtypes on farms, the contamination source of animal-based foods which undergo listeriocidal heating steps is not known and requires further research.

Key Words: L. monocytogenes, Molecular epidemiology, Pre-harvest food safety

326 Human listeriosis outbreaks linked to dairy products: a European perspective. J. Lunden* and H. Korkeala, Helsinki University, Helsinki, Finland.

Dairy products have been implicated in approximately half of the reported listeriosis outbreaks in Europe. The listeriosis outbreaks have mostly been linked to consumption of raw milk or products produced from non-pasteurized milk. The outbreaks in Switzerland in 1983 to 1987 due to non-pasteurized soft cheese, the outbreak in Austria in 1986 related to non-pasteurized milk, and the outbreak in France in 1995 related to a brie-type cheese made of non-pasteurized milk demonstrate the risks involved with consumption of raw milk or soft cheeses made of non-pasteurized milk. The pasteurization process of raw milk, which destroys Listeria monocytogenes, has not eliminated the risk of L. monocytogenes in dairy products. The outbreak in Finland from 1998 to 1999, with butter as the source, points out the fact that dairy products made of pasteurized milk may act as vehicles for L. monocytogenes. The post-pasteurization equipment such as the packaging machine was contaminated with the outbreak strain elucidating the importance of post processing hygiene. Extensive work has been done in several European countries during the last decade to the present day to prevent outbreaks and to decrease the incidence of listeriosis. This work has included preventive measures in the food processing plants, consumer advice, and early detection of outbreaks. The dairy processing plants have focused on improving the post processing hygiene and implementation of hazard analysis critical control programs, and the consumers belonging to the risk group have been informed about dietary risk factors. In fact, there has been a marked reduction in the incidence of listeriosis in some European countries during the last decade suggesting a relationship between the preventive measures and the reduction in listeriosis. Several European countries have a national surveillance system with continuous genotyping of clinical strains which enables early detection of listeriosis outbreaks. The development of a common European surveillance program is in a planning stage. Such a program would give requisites for the recognition of multi-national outbreaks.

Key Words: Listeriosis, Dairy product, Outbreak

Control of Listeria monocytogenes (LM) in processing plant environments is a multi-faceted approach requiring diligence and dedication throughout the entire organization. There are five elements that add up to effective LM control in a processing facility. The so-called Listeria equation consists of Traffic Patterns + GMPs + Dry, Uncracked Clean Floors + Sanitary Design + Sanitation Procedures. A breakdown in any one of these elements can lead to an unacceptable risk of LM contamination in the plant environment and, ultimately, the finished product. Essential to effective LM control is a rigorous, aggressive environmental monitoring program. It is recommended that the genus Listeria be used as an indicator for LM and that a sufficient number of equipment and other surfaces be monitored (dependant on the facility) on a weekly basis to ensure that the processing environment is under control. Incentive must be provided to plant personnel to aggressively find and eliminate LM in the environment. In order to ensure this, plant employees must be provided with the proper tools and training, and the criticality of LM control must continuously be reinforced. This presentation will cover the key elements and specifics required to ensure effective LM control in dairy processing facilities.

Key Words: Listeria monocytogenes, Food safety, Environmental monitoring


The average 455-kg horse produces 26 L of manure per day or 9.5 m³/yr. When bedding material is added, the volume can easily exceed 20 m³/yr per horse. How do horse owners manage all of this manure? The National Animal Health Monitoring System (NAHMS) Equine ’98 Study found that approximately 11% of horse operations in the U.S. had manure removed from their property, 78% utilized or stored manure on-site, and the remaining 11% reported “other” means of disposal. Over half of the operations surveyed by NAHMS reported that the application of manure and stall waste on fields and pastures was the primary means of disposal. Those that allowed waste to accumulate or “left it to nature” made up 29% of the operations, and this practice was more likely to be employed when fewer horses were housed on the property. Hauling waste to a landfill or combining manure with household garbage for pickup was also more likely to be used as a disposal option with small, 1 or 2 horse operations. On-farm composting of horse manure was attempted by approximately 36% of those surveyed by NAHMS and was more prevalent in the northeast and western states. The increasing trend for horses to be housed on small, 1-35 acre “hobby” farms and in boarding stables means a larger number of horses are being housed on smaller parcels of land with less acreage available for spreading manure. Add to this greater restrictions on landfill dumping and the expense of hauling manure off-site and it becomes evident that horse owners are quickly losing waste disposal options. And simply “leaving it to nature” is not acceptable due to the risk of runoff and leachate from manure polluting watercourses and domestic water supplies. Educational programs are needed to inform horse owners about environmentally sound and neighbor-friendly waste management practices. In addition, markets must be found for horse waste or composted horse manure. And methods to reduce the waste stream (e.g., efforts to minimize bedding, feeding highly digestible feeds) should be investigated.

Key Words: Horse, Manure disposal, Waste management practices


In 1992, NC state regulations covering waste discharge required confined animal feeding operations above species based thresholds including equine operations with 75 or more head, to develop a waste management plan. Additional regulations developed by the Environmental Management Commission, govern surface water loading of nutrients in 3 of 17 NC river basins. The Tar-Pamlico River Basin (TPRB) nutrient management strategy requires agricultural operations to collectively achieve a 30% reduction in nitrogen from 1991, loading within a 7 year period. The N.C. Horse Council-Environmental Issues Committee (NCHC-EIC) monitors development of nutrient management regulations, recommends best management practices (BMP’s) to control nutrient loading and serves as the horse industry liaison working with government agencies. Current recommended TPRB regulations require horse operations with 20 or more head to participate in a pasture point system based on pasture BMP’s. The NCHC-EIC assists in development of BMP’s with pre-assigned point values. Producers who implement BMP’s will earn points. When BMP’s are implemented and a required point total is reached, producers will be exempt from additional nutrient management efforts. Potential BMP’s include exclusion from water sources, non-fertilizer zones, alternate water sources and dietary nutrient management. A lack of equine research data to support BMP’s has hindered the approval process. The NCSU Animal Science and Biological Engineering Departments received FY 2003 to 2005 grant funding from the U.S. Environmental Protection Agency to conduct manure and pasture management educational programs. A series of producer educational conferences and field days will demonstrate BMP’s on horse farms that improve water quality. The project will be implemented with the assistance of Regional Equine Information Network System volunteers in multi-county areas. Demonstrations will focus on developing and testing improved animal crop and waste management systems to provide maximum environmental protection. This information will be essential to support the development of future equine BMP’s to enhance water quality.

Key Words: Equine, Pasture management, Water quality


The new regulations from EPA concerning the definition of Animal Feeding Operations (AFO) and regulation of certain AFOs as Concentrated Animal Feeding Operations (CAFO) have been finalized. These new regulations contain provisions that have potentially serious consequences for the horse industry. EPA has adopted a three-tiered plan for regulation of CAFOs that classify them as Large, Medium, or Small and places the number of confined horses necessary to qualify for a particular status at 500 and 150 for the first two categories and authority of regional directors to specify operations for the third. Any AFO that discharges pollutants directly into the waters of the U.S. or has animals in direct contact with waters of the U.S. may be designated as a CAFO regardless of the number of animals confined. Data was provided to EPA from the

Key Words: Risk assessment, Listeria monocytogenes

Horse Symposium: Nutrient management

The HHS/USDA Listeria monocytogenes risk assessment was issued in draft for public comment in January 2001. The purpose of the risk assessment was to systematically examine available scientific data and information to estimate the predicted relative risk of serious illness and death associated with consumption of ready-to-eat foods. The types of foods evaluated in the risk assessment include seafood, produce, dairy foods, meats, and deli salads. The dairy foods include five types of cheeses, milk, ice cream and other miscellaneous dairy products. This risk assessment is a tool that regulatory agencies can use to evaluate the effectiveness of current policies, programs, and regulatory practices. Using newly available data, information, and modeling techniques, the draft risk assessment will be revised in 2003. If the revised risk assessment is released before the meeting, the latest information on the predicted risks will be presented.

Key Words: Risk assessment, Listeria monocytogenes
American Horse Council requesting that horses be counted in the same manner as feedlot cattle, however EPA chose to continue counting each horse as two animal units. Thus, any operation that has 150 or more horses in confinement (including stalls or dry lots) for a total of 45 days or more in any 12-month period or is otherwise designated as a CAFO has a duty to seek coverage under an NPDES permit. Many stables, breeding farms, and exhibition facilities that have not previously been affected may now have to meet the requirements of the new regulations, including a provision to be able to contain all of the runoff from a 25-year, 24-hour storm event. The economic cost could be devastating to the industry.

**Key Words:** Equine industry, CAFO regulation, Environmental regulations

### Southern Branch ADSA Symposium: How can we best work together to serve tomorrow’s dairy industry?

332 How best can we work together to serve tomorrow’s dairy industry: university extension faculty perspective. L. O. Ely*, University of Georgia.

The Cooperative Extension Service was created with the Smith-Lever Act of May 8, 1914. Extension work was to “consist of giving instruction and practical demonstrations in agriculture and home economics to persons not attending or resident in said colleges in the several communities, and imparting to such persons information on said subjects through field demonstrations, publications and otherwise.” At this time the population of the US was rural and education for most was finished at the eighth grade level. Basic information in animal and human nutrition was being discovered. Today extension work has the same objective but the audience is much different. Only a small percent of the US population is rural and engaged in agriculture. The education level is post high school. The need is not for basic information but for fine tuning management decision-making. Producers are looking for ways to handle the overload of information and records that are available to them. Extension can provide resources that will aid in utilization of record keeping systems and decision-making programs that analyze these records. These programs may be web based for independent use by producers instead of one on one or group meetings between producers and extension specialists. Society has demanded impact and accountability statements that have left agriculture with low scores because of small clientele numbers. Evaluation of quality is not part of these scores, as it is not easily quantified. Other countries have privatized their extension services. In the US there has been an increase in private companies developing their sales force into an extension service that competes with the land grant system. The new objective may be that extension service and industry must cooperate to provide programs and resources to the dairy industry. How does the leadership in college administration evaluate this paradigm shift?

**Key Words:** Dairy industry, Extension service, Function

### Animal Health: Diseases and mammary health

333 Changes in the mechanical properties and the lesion score of the sole horn in first lactation dairy heifers. B. Winkler and J. K. Margerison*, University of Plymouth, Seale Hayne.

This experiment compares mechanical tests of the sole horn toughness with the pattern of lesion formation, in the pre- and postpartum heifers. 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 levels (LS) of 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. PR force required fracture sole horn was significantly greater in front claws (FC) when compared to hind claws (HC) (p<0.05) (FC 9.7, HC 8.8N), but there was no significant difference between the inner and outer claws. PR force, ELM and LS significantly increased postpartum compared with prepartum (p<0.01) (p1- 7.8N, 86.9N/mm2 and 73.1; p2- 10.7N, 118.0N/mm2 and 186.5). LS was significantly greater in the HC compared with the FC during the postpartum period (p<0.001) (HC 223.7, FC149.3). In the HC the outer claws presented a significantly (p<0.05) greater LS when compared to the inner claws in both periods. In the FC the LS was significantly higher in the inner claws (P<0.01) postpartum. 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). Differences of ELM and PR between FC and HC may be related to the different pressure distribution in these claws. Mechanical tests reflected increases in sole lesions and LS following

**Key Words:** Lameness, Sole tissue, Mechanical testing

334 Muscle protein tyrosine nitration patterns during chronic subclinical intramuscular parasitism: Co-localization to fiber type and ubiquitin. T. H. Elsasser*1, S. Kahl1, J.L. Sartin2, R. Fayer1, A. Martinez3, F. Cuttitta3, and J. Hinson3, 1 USDA-ARS, Beltsville, MD, 2 Auburn University, Auburn, AL, 3 NIH-NCI, Bethesda, MD, 4 University of Arkansas, Little Rock, AR.

The present study was conducted to determine whether the inflammatory oxidative response to chronic intramuscular parasitism, as modeled with the protozoan parasite _Sarcocystis cruzi_, results in protein nitration damage and whether a pattern to it localization can be characterized. Holstein steer calves (n=10; av wt = 124 kg) were assigned equally to control (C) and infected (I, 25,000 Sarco sporocysts) groups. Calves were slaughtered on d56 postinfection and samples of rectus femoris (RF) and psoas major (PM) harvested. Xanthine oxidase (XO) was measured in muscle homogenates by fluorescence (resorufin, 587 nm). Frozen sections (9 µ) were immunostained (H+; horseradish peroxidase/DAB) for nitrotyrosine (NT) or ubiquitin (UBI) or co-localization of NT with fibertype (staining v nonstaining with mouse anti-myosin fast twitch), or NT with UBI via confocal immunofluorescence. Extracted muscle proteins were extracted, separated on 4-20% SDS PAGE gels, transferred to nitrocellulose, and probed for nitrated proteins using an anti-NT or antibovine-UBI. XO activity, a source of superoxide, was 2.3 times greater in I than C (P<0.01). Western blot demonstrated that >85% of the increase in NT was associated with an increased number of protein bands (P<0.04, I v C)with Mr >75 kD. IHC demonstrated very low levels of both NT and UBI staining in RF and PM of C but increased NT (42% more NT+ fibers, P<0.05) in both RF and PM of I. NT immunostaining could be categorized into three distinct forms: a) peripheral fiber (I and C), b) dispersed intrafiber (I), and c) cyst-specific (I). Both fast and slow fibers displayed the peripheral localization of NT and UBI. Only slow twitch oxidative fibers displayed extensive co-localized intrafiber NT staining regardless of muscle source. The sarcocyst itself was highly nitrated and muscle proteins in the immediate vicinity of the cyst displayed increased NT co-localized with UBI. The data suggest that the oxidative inflammatory response to chronic low-level muscle-resident parasitism generates nitrated muscle proteins. The nitration appears to be more pronounced in slow oxidative fibers and supports prior observations of more severe impact of this parasitism on muscles with higher percentages of slow twitch fibers.

**Key Words:** Stress, Health, Muscle

335 A relative comparison of diagnostic tests for Johne’s disease. T. Duffield1, D. Kelton1, K. Leslie1, K. Lissemore1, and M. Archambault2, 1Department of Population Medicine, University of Guelph, 2Animal Health Laboratory, University of Guelph.

Prevention and control of Johne’s disease (JD) could be improved if diagnostic tests were reliable, rapid and economical. The objective of this study is to evaluate a commercial milk ELISA test relative to other diagnostic tests. 32 dairy herds in Ontario with a suspected high prevalence of JD had fecal and serum samples collected from all milking and dry

**Key Words:** Equine industry, CAFO regulation, Environmental regulations
cows. Serum was tested for antibodies with an IDEXX ELISA (AHL). Preserved milk samples were collected at the following Dairy Herd Improvement (DHI) test day. These milk samples were sent to Antel Bio Corp. (Lansing, MI) for an in-house milk ELISA test. Cows positive on either the serum or milk ELISA test had their corresponding fecal sample tested with all three of the following: traditional fecal culture (FC) (Antel Bio), an IDEXX fecal PCR probe (AHL), and radiometric FC (BACTEC culturing system) (AHL). 286 of the 2148 serum samples were positive (13.4%). 124 of the 1699 cows milking on DHI test day were positive on milk ELISA (7.3%). The kappa between the milk and serum ELISA for the 1699 cows tested was 0.45 (0.38, 0.52). 326 cows were positive on one or both of the ELISA tests. 144 of the ELISA positive cows (either milk or serum) were positive on traditional FC (44.2%), while only 62 were identified positive on fecal PCR (24.1%). The BACTEC culture results are still pending. 686 fecal samples from ELISA negative cows are still being cultured. In total, complete FCs from nine herds (874 cows) will be analysed. Preliminary statistics were calculated for 257 cows having milk, serum, fecal PCR and FC results. Relative to FC, the positive predictive value for the milk and serum ELISA was 61.3% and 45.2%, respectively. The kappa between fecal PCR and FC was 0.57 (0.47, 0.68). The milk ELISA test reasonably predicts fecal shedding status and because of its convenience and cost, it has utility as a herd screening test.

Key Words: Johne’s disease, Fecal culture, Milk ELISA

336 Detection of Aspergillus fumigatus in hemorrhagic bowel syndrome in dairy cattle. S. Puntenney*, Y.-Q. Wang, and N. Forberg, Oregon State University, Corvallis OR.

The goal of the research was to investigate the association between Aspergillus fumigatus, Clostridium perfringens and hemorrhagic bowel syndrome (HBS) in lactating dairy cattle. Samples of gastrointestinal (GI) contents, GI wall, mesenteric lymph nodes and blood were obtained from HBS cows and from control cows in 4 states (IA, ID, OR and WA). Concentrations of A. fumigatus DNA in the samples were evaluated with a real-time quantitative Sybr Green PCR method using an ABI7700 thermocycler. A standard curve was constructed with purified A. fumigatus genomic DNA. Melt curve analysis was completed to ensure the specificity of the clones detected in each reaction. All samples were also tested for the presence of Clostridium perfringens in the samples using a multiplex PCR which detected five of the major C. perfringens toxins. Seven HBS cows were obtained and each of them contained high concentrations of A. fumigatus in hemorrhaging GI contents, GI wall, mesenteric lymph nodes and blood. Two idiopathic cases of abdominal hemorrhage (one dairy cow and one gazelle) were also evaluated. Both cases were positive for A. fumigatus. C. perfringens alpha and epsilon toxin genes were detected in some HBS samples; however, their presence was not associated with HBS. Some HBS cows did not harbor C. perfringens toxin genes. In humans, A. fumigatus is pathogenic in immunocompromised patients. It is harmless in immunocompetent individuals. Dairy cattle may be immunosuppressed, particularly in early lactation. Several studies have shown potential for A. fumigatus to infect the ruminant GI tract and to cause hemorrhage. Hence, we propose that A. fumigatus has similar potential in lactating dairy cattle. These observations do not preclude other pathogenic organisms from participating in HBS. Instead, we propose that A. fumigatus contributes to the etiology of a multi-factorial disease. Management of feed storage to minimize mold may reduce or eliminate incidence of HBS.

Key Words: Jejunal hemorrhage syndrome, Mold, Dairy herd health

337 The potential of infrared thermography as an early detection method for mastitis. Seasonal effects on predictability. R. J. Berry, A. D. Kennedy, S. L. Scott, D. Fulwarka, F. I. L. Hernandez, and A. L. Schaefer, University of Manitoba, Winnipeg, Manitoba, Canada, 1Ag Canada Research Station, Brandon, Manitoba, Canada, 2Ag Canada Research Station, Lacombe, Alberta, Canada.

In order to determine the potential of using Infrared thermography (IRT) for early detection of mastitis, seasonal variation in udder temperature was determined and a prediction model based on the results was developed. Two groups of 10 dairy cows (lactation range 1-6) were monitored every other day starting 5 days before calving until 120 days into lactation. A “summer” group was studied over the time period 5/1-01-10/15/01 and a “winter” group was studied between 12/24/01-05/3/02. IRT images of the posterior surface of the udder were collected approximately 2 h before milking, and stored onto digital video cassette recorders. Rectal temperatures were taken concurrently. Barn temperatures were monitored remotely every 10 min. A lagged regression model was applied at the individual level. Model description is as follows:

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U_{Stemp} = \text{Lag1U}_{Stemp} + \text{Lag2U}_{Stemp} + \text{Et}_{mpH2} + \text{MaxEt}_{mpH2} + \text{Et}_{mpH2} + \text{MaxEt}_{mpH2} + \text{Et}_{mpH2} + \text{MaxEt}_{mpH4} + \text{MaxEt}_{mpH4}.
\]

Where: UStemp = mean udder surface temp; Lag1 & Lag2Ustemp = lagged mean udder surface temp for the previous 1 or 2 measures, respectively; EtmpH2, EtmpH4, & EtmpH48 = mean environmental temperature for the previous 2, 24 and 48h, respectively. The model was insignificant for animals in both groups (p<0.05), giving r2 ranges of 0.41-0.88 and 0.27-0.63 for the Summer and Winter groups, respectively. Residuals for the model showed that the model more accurately predicted UStemp for the Summer group (mean residual =0.71, range 0.34-1.04; Winter group mean residual = 0.91, range 0.61-1.25). Residuals were below an endotoxin infusion-induced rise in UStemp of 2.3 C reported in an earlier study by Scott et al (2000). Therefore, IRT shows potential as an early detection method for mastitis.

Key Words: Thermography, Dairy cattle, Mastitis

338 Protective efficiency of a mix DNA-protein vaccine strategy against Staphylococcus aureus mastitis in dairy cows. L. Shkreta1, B. G. Talbot1, M. S. Diarra2, and P. Lacasse3, 1University of Sherbrooke, QC, Canada, 2Dairy and Swine RD & Centre, Lennoxville, QC, Canada.

The objective of this study was to test the protective efficiency of a vaccination strategy against Staphylococcus aureus mastitis. Four pregnant heifers were not vaccinated and used as control while four others were injected intramuscularly twice with a DNA vaccine (7 and 4 wks prior to calving) and once subcutaneously with a protein vaccine 17 days later. The DNA vaccine contained 2 mg of the bicistronic plasmid pCI-D1D3-ClfA that encodes epitopes of the S. aureus adhesin Clumping factor A (CfIA) and Fibronectin binding protein A (D1D3) and 2 µg of the plasmid pCI-GM-CSF that encodes the bovine Granulocyte macrophage-colony stimulation factor. The protein vaccine consisted of 200 µg of recombinant D1D3 and 300 µg of recombinant CfIA in incomplete Freund’s adjuvant. Three weeks after calving, 3 quarters per cow were challenged through the teat canal with 900 CFU of S. aureus Newbould 305 while the quarter was infused with saline. The DNA immunizations did not increase significantly the serum levels of anti-CfIA or anti-D1D3. However, the protein boost significantly increased the serum levels of anti-CfIA - IgG, IgG2, IgG1, IgM and IgA (respectively P<0.01; <0.01; < 0.01; < 0.05; and P<0.07), but only slightly those of anti-D1D3. Both antibodies were detected (P<0.05) in milk although levels of anti-D1D3 antibodies were low. The lymphoproliferative response induced by DNA vaccination was highly significant for both antigens (P< 0.001). All inoculated quarters developed mastitis. Over the following 3 weeks, the number of bacteria remained relatively constant in control cows but decreased gradually (time x treatment, P<0.05) in vaccinated cows. At the end of this period, the number of bacteria averaged 3.3 logCFU/ml in control and 1.4 (P<0.05) in vaccinated cows. Bacteria were still present in 11 of 12 quarters for the controls and 5 of 12 quarters in vaccinated cows. In the period 24-72 hrs post challenge, vaccinated cows tended to have lower serum haptoglobin (P<0.09), cardiac rhythm (P<0.04) and body temperature (P<0.09) than control cows. In conclusion, this mixed DNA and protein vaccination strategy against S. aureus adhesins induced not only humoral and cellular immune responses but also partial protection in dairy cows.

treated with antibiotic alone (control). Secondary objectives were to describe the effect of treatment on the prevalence of IML and linear score (LS) after calving, and on the incidence of clinical mastitis between dry off and 60 DIM. The study enrolled 437 cows from two dairy farms in western WI. On the day of dry off all four quarters were sampled for bacteriological culture and SCC measures. After the final milking all four quarters were routinely infused with a commercially available long-acting antibiotic. Two contra-lateral quarters (LF/RH or RF/LH) were then randomly assigned the treatment of infusion with an inert internal teat sealant (Oreaseal, Pfizer Animal Health, Groton, CT). The teat sealant was stripped out at first milking after calving and the quarters re-sampled at both 1-3 DIM and 6-8 DIM for bacteriological culture and SCC analysis. The incidence of new IML occurring between dry off and 1-3 DIM was 25.9% and 20.6% for control vs. treated quarters, respectively (odds ratio untreated = 0.72, P < 0.05). The prevalence of IML at 1-3 DIM was 29.5% and 23.3%, for control vs. treated quarters, respectively (odds ratio untreated = 0.71, P < 0.05). Mean LS was significantly lower for control vs. treated quarters at 1-3 DIM (control = 5.5; treat = 5.2, P < 0.05) and at 6-8 DIM (control = 3.2; treat = 2.9, P < 0.05). Finally, there were significantly fewer clinical mastitis events between dry off and 60 DIM occurring in quarters treated with teat sealant and an antibiotic (5.9%) than in quarters treated with antibiotic alone (8.0%) (odds ratio treated = 0.72, P < 0.05).

**Key Words:** Internal teat sealant, Mastitis, Dry period

### Breeding & Genetics: Beef cattle breeding


Age-of-dam adjustment factors now used by the Red Angus Association of America (RAAA) were evaluated to determine if they were still applicable for the current Red Angus population. After edits, 61,322 records were available for birth weight on bull calves, 64,056 for birth weight on heifer calves, 29,663 for weaning weight on bull calves, and 31,073 for weaning weight on heifer calves. Records of bulls and heifers were analyzed separately to estimate age-of-dam adjustment factors for bulls and heifers for each weight. Statistical models were similar to those used for national genetic evaluations by the Red Angus Association of America. Additive factors to adjust to a mature (5 – 10 yr old) dam basis for birth weight of bull calves were determined to be 3.13, 1.41, 0.41, and 1.13 kg for 2-, 3-, 4-, and 11-yr-old and older dams, respectively. For birth weight of heifer calves, adjustment factors were determined to be 3.08, 1.32, 0.45, and 1.04 kg for the same dam classifications. For weaning weight, adjustment factors for bull calves were 32.97, 17.19, 7.30, and 11.97 kg and for heifer calves were 25.80, 13.70, 4.90, and 10.48 kg. The adjustment factors currently used by the Red Angus Association of America under adjust birth weights at all ages for both sexes compared to these new estimates. For weaning weight, the adjustment factors currently used by the Red Angus Association of America under adjust birth weights at all ages for both sexes were recomputed for the current Red Angus population. The adjusted factors now used for birth weight on bull calves out of 3- and 4-yr-old dams are slightly overadjusted with the adjustment factors now used for birth weight on heifer calves and with dams that are 11 yr of age or older. Weaning weights for calves out of 3- and 4-yr-old dams are slightly overadjusted with the adjustment factors now used for both sexes, but the magnitude of differences for bull calves is greater than for heifer calves. New adjustment factors for age-of-dam are recommended for use in RAAA genetic evaluations.

**Key Words:** Adjustment factors, Beef cattle, Genetic evaluations

#### 341 Effects of genetic groups to account for selection on estimates of genetic parameters for a line of Hereford cattle. L. D. Van Vleck, K. J. Hanford, M. D. MacNeil, USDA, ARS, USMARC, Lincoln, NE, USDA, ARS, LARRL, Miles City, MT.

Robin Thompson originated the idea of an accumulated groups model to account for prior selection. Robin Westell’s rules made the coefficient matrix for group models as easy to compute as the A-inverse rules of Henderson and Quaas made use of the numerator relationship matrix for group models as easy to compute as the A-inverse rules of Henderson and Quaas. Adoption of methodology as easy to compute as the A-inverse rules of Henderson and Quaas is important to characterize reproduction and maternal traits of F1 cross females calving at 2 years of age in cycle VII of the Germplasm Evaluation Program at the U.S. Meat Animal Research Center. The females were produced in the spring of 1999 and 2000 as a result of artificial insemination matings of Hereford (H, 21 sires), Angus (A, 22), Red Angus (Ra, 21), Simmental (S, 20), Gelbvieh (G, 23), Limousin (L, 20), and Charolais (C, 22) bulls to Hereford, Angus, and composite MARC III (1/4 each Angus, Hereford, Red Poll, and Pinzgauer) cows. Data were obtained on 681 females exposed, 565 calves born, and 489 calves weaned in the fall of 2001 and 2002 as a result of natural service multi-sire matings to MARC III bulls. Data on calf crop born (CB, %) and weaned (CW, %), calving difficulty score (CDS, score), unassisted births (UB, %), birth weight (BW, kg), survival to weaning (SW), and 200-d weaning weight of progeny (WW, kg) were analyzed by least squares procedures using a model that included random effects for maternal grandsire in maternal grandsire breed, and fixed effects for maternal grandsire breed, maternal granddam breed, sex of calf (for BW, SW, WW only), birth year, and maternal grandsire breed x maternal granddam breed effects. Effects of maternal grandsire breed were significant (P < 0.05) for WW but not for any other trait. The means for WW of progeny with H, A, Ra, S, G, and L maternal grandsires were 187.4, 192.2, 188.1, 200.3, 195.2, 194.7, and 195.2 kg for WW, respectively. The mean least significant difference among maternal grandsire breeds for WW was 9.5 kg (P < 0.05). Breed of maternal grand sire means for S and G differed significantly from H and Ra, but not from any other breeds. Breed of maternal grandsire effects did not differ among H, A, Ra, L, and C breeds. Results for WW indicate that contrasts between British (H and A) and Continental European breeds (S, G, L, and C) are less than half as great for direct (3.5 vs 9.5) and maternal (4.8 vs. 11.5) kg breed effects in the current evaluation (Cycle VII of the GPE Program) as they were 25 to 30 years ago (Cycle I and II of the GPE Program).

**Key Words:** Beef cattle, Breeds, Germplasm


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**Key Words:** Beef cattle, Genetic correlation, Heritability

#### 343 Genetic trends resulting from selection based on an index of birth weight and yearling weight. M. D. MacNeil, USDA-ARS, Fort Keogh LARRL, Miles City, MT.

The CGC population is a stabilized composite of 1/2 Red Angus, 1/4 Charolais, and 1/4 Tarpan populations. The objectives of this research were to estimate genetic parameters for weight traits of CGC and to evaluate genetic responses resulting from selection based on the
index: I = 365-d weight minus 3.2(birth weight). In 1989, a randomly selected control line and a line selected for greater values of the index were established. Average generation intervals were 3.16 ± 0.04 yr and 3.90 ± 0.08 yr in the index and control lines, respectively. Over three generations, the index selection line (n = 950) accumulated approximately 212 kg greater selection differential than the control line (n = 912). Derivative-free multiple-trait REML methods were used to estimate (co)variance components and to predict breeding values upon convergence of estimates of (co)variance components. Heritability estimates for direct effects were: 0.32 ± 0.04, 0.49 ± 0.05, 0.49 ± 0.05, 0.30 ± 0.04, and 0.70 ± 0.04 for the index, birth weight, 365-d weight, 200-d weight, and cow weight, respectively. Heritability estimates for maternal effects were: 0.05 ± 0.02, 0.11 ± 0.03, 0.04 ± 0.02, and 0.19 ± 0.04 for the index, birth weight, 365-d weight, and 200-d weight, respectively. In the control line, direct genetic changes for the index and its components were small. For the index selection line, direct genetic changes for the index, birth weight, 365-d weight, 200-d weight, and cow weight were: 6.0 ± 0.3, 0.45 ± 0.09, 7.74 ± 0.55, 3.42 ± 0.25, and 6.3 ± 0.9 kg/generation, respectively. Maternal genetic changes were generally small for both the control and index selection lines. Thus, selection for the index produced positive correlated responses for direct genetic effects on body weight traits at all ages with only minor effects on maternal genetic effects. Results demonstrate that despite a genetic antagonism that compromises selection response for reduced birth weight and increased postnatal growth, favorable genetic responses can be achieved.

Key Words: Beef Cattle, Genetic Gain, Selection Index

344 Bayesian estimation of breed-specific and segregation genetic variances applied to a Nelore-Hereford population. F. F. Cardoso1, and R. J. Tempelman1, 1Michigan State University.

The objectives of this study were to apply a hierarchical multiple-breed animal model (MBAM) to estimate breed-composition effects, breed-specific additive genetic variances and variance due to the segregation between breeds, and to compare the MBAM with the regular animal model (AM), by simulation and on a dataset on post-weaning gain (PWG) of crossbred beef calves. Phenotypic records were modeled as function of breed composition means and animal additive genetic effects using the variance-covariance specifications as proposed by Lo et al. Bayesian inference was based on MCMC. We validated the model on five simulated datasets derived from a population based on crosses of two breeds having a two-fold difference in genetic variance. In each of the five populations, true values of all variance components in the MBAM were always contained within the corresponding 95% posterior probability intervals (PPI). We also analyzed a dataset of 22717 PWG records of a Nelore-Herford population (40,082 animals in the pedigree). MBAM inference for Nelore-Herford additive genetic effects (in kg2) differed substantially. Herefords had a posterior median genetic variance of 90.9 with a 95% PPI of [69.8, 114.5] whereas the corresponding values for the Nelore were 32.9 and [20.1, 50.1], respectively. The posterior median variance due to the segregation between these breeds was 13.1 with a 95% PPI of [5.0, 33.8]. The common residual variance posterior median was 333.9 with a 95% PPI of [317.6, 347.8] using MBAM; corresponding values using AM were 348.5 and [325.7, 360.8], respectively. Bayesian model choice criteria heavily favored the MBAM over the AM for the two simulated and PWG data, thereby having important implications for improved precision on breeding value predictions.

Key Words: Multiple-breed, Crossbreeding, Genetic evaluation

345 Feedlot performance and carcase traits of Bonsmara, Angus, and Brahman steers. J. J. Cleere1, F. M. Rouquette, Jr.1, R. D. Randel1, T. H. Welsh2, J. W. Holloway3, and M. F. Miller4, 1Texas Agricultural Experiment Station, Overton, 2Texas A&M University, College Station, 3Texas Agricultural Experiment Station, Uvalde, 4Texas Tech University, Lubbock.

Bonsmara cattle, a composite of Africander x Shorthorn x Hereford, have been recently introduced into the United States with a limited number of grazing-feeding trials conducted on half blood animals, but none with purebreds. For performance measurement to weaning to harvest, Bonsmara (BON) (n = 10), BON x Angus (BOA) (n = 9), Angus (ANG) (n = 8), and Brahman (BRM) (n = 10) steers grazed ‘TAM 90’ annual ryegrass (Lolium multiflorum) and ‘Maton’ rye (Secale cereale) from January 4 to May 16, 2002 at TAMU-Overton. The BON, BOA, and ANG steers had similar ADG during the grazing period (0.92, 0.84, and 0.91 kg/d; P > 0.05); whereas BRM had lower ADG (0.75 kg/d; P < 0.05) during the grazing period than BON and ANG. At termination of grazing, steers were assigned to pens (n = 8) by breed type and weight with 4 to 5 animals per pen at the Texas Tech University Alltech research feedlot on May 22, 2002. The BON and BRM steers entered the feedlot at lighter weights than BOA and ANG steers (292 and 285 vs. 351 and 360 kg, respectively; P < 0.10). Feedlot ADG for BOA steers (1.62 kg/d) was lower than ANG steers (1.87 kg/d; P = 0.02), lower than BOA steers (1.77 kg/d; P = 0.08), and greater than BRM steers (1.28 kg/d; P = 0.01). Final feedlot weights of steers fed to estimated one cm back fat thickness were 504 (BON), 512 (BOA), 530 (ANG), and 489 kg (BRM) (P > 0.05). Gain to feed ratios were similar among the four breed types. Also, adjusted fat thickness, kidney pelvic heart fat, and yield grades were similar among the four breed types. Hot carcass weights for the BON steers were similar to the ANG, ANG, and BRM steers (299 vs. 305, 314, and 296 kg). The BON steers had rib eye areas similar to the BOA, ANG, and BRM steers (79.7 vs. 78.3, 81.7, and 75.6 cm2, respectively). Marbling scores among the BON steers were similar to the BOA, ANG, and BRM steers (367 vs. 346, 413 and 352, respectively). This first U. S. grazing-feedlot study with BOB steers revealed that they are intermediate in feedlot performance and carcase quality to ANG and BRM steers.

Key Words: Bonsmara, Feedlot, Carcase


Designing beef to meet the nutritional demands of consumers is essential for beef to compete in a market where a healthful product is emphasized. We initiated studies to evaluate the extent to which genetic variation controls beef fatty acid composition. Gas chromatography was used to determine fatty acid composition of the triacylglycerol and phospholipid fractions of the trimmed, edible portion of rib steak from 615 steers and bulls slaughtered at a typical market weight. Contemporary groups were based on year, farm of origin, feedlot, and harvest date. Restricted maximum likelihood (REML) with a sire maternal grandsire relationship matrix was used to estimate variance components. There were three contemporary groups (1-59 cattle per group) and 63 sires (1-34 progeny per sire) represented in the data. In triacylglycerol, myristic acid (14:0) was highly heritable (h2 = 0.51 ± 0.23) and oleic acid (18:1) (0.58 ± 0.29). Heritability estimates for phospholipid fatty acids were nearly equal to the respective standard error. To evaluate enzyme systems (fatty acid desaturase and fatty acid elongases), ratios of product to precursor were evaluated. The fatty acid desaturase index (16:1+18:1/16:0+18:0) was heritable in triacylglycerol (0.49 ± 0.28). In contrast, heritabilities of the indices of fatty acid elongase activity were nearly equal to the respective standard error. Finally, an overall health index of the fatty acid composition ([λ4(14:0)+16:0])/all other fatty acids excluding 18:0 was evaluated and was heritable in triacylglycerol (0.60 ± 0.30). The most favorable EPD for overall health index was -0.045, which represents a >5.5% change from the average for this data set. EPDs for individual fatty acids, in some cases, represent a 5-12% improvement of the particular trait. We conclude that fatty acid composition of beef is in part an inherited trait and that the lipid composition of beef could be improved with respect to human health by genetic selection.

Key Words: Beef, Fatty acid, Heritability

347 Genetic relationships of body condition score with carcase traits in Limousin cattle. D. R. Eborn* and D. W. Moser, Kansas State University, Manhattan, KS.

Body condition score (BCS, n=19,506) on Limousin cows (n=12,439) and carcass weight (CWT), longissimus muscle area (LMA) and fat thickness (FT) at the 12th rib, marbling score (MS), and % kidney, pelvic, and heart fat (KPH) on 4, 326 Limousin sired animals were used to estimate genetic parameters. Heritabilities (diagonal) and genetic correlations (off-diagonal) were estimated by MTDFREML by single- and pair-wise analyses, respectively. The model for BCS included a fixed effect for contemporary group, covariates for age at measurement, and
random animal, permanent environment, and residual effects. Contemporary groups for BCS were defined by the cow’s calf weaning weight contemporary group. The model for carcass traits included a fixed effect for contemporary group, covariate for age at slaughter, and random animal and residual effects. Estimates of heritabilities for carcass traits ranged from 0.14 ± 0.04 for CWT to 0.34 ± 0.05 for REA. Heritability of BCS was 0.19 ± 0.02. The genetic correlations between BCS and CWT, LMA, FT, MS and KPH were 0.28, 0.60, -0.04, -0.64, and 0.16, respectively. Our findings suggest that selection on LMA or MS may impact BCS in the cowherd. However, no significant correlation was found between FT and BCS.

Key Words: Body condition score, Carcass, Genetic parameters

### Heritability and repeatability of back fat and rump fat thickness in Angus cattle

The current study included data from 912 purebred Angus bulls and heifers born during the spring of 1998 to 2001. Each year calves were serially measured for back fat thickness (BFT), rump fat thickness (RFT) and other ultrasound measurements starting at weaning time and with 4 to 6 weeks interval between scans. The objective of this study was to compare trends in variance components, heritability and repeatability of BFT and RFT measures of Angus cattle measured between mean ages of 27 to 62 weeks. Initially BFT and RFT observations were analyzed by scan session across years using multiple trait animal model. Data pooled across years and scan sessions were then analyzed using random regression models (RRM) to produce general trends in genetic parameter estimates. Bull and heifer RFT measures showed higher heritability values than BFT for all scan sessions. Heritability of BFT increased from 0.13 at the 1st scan (mean age = 35 weeks) to 0.29 at the 5th scan (mean age = 53 weeks). Heritability of RFT increased from 0.33 at the 1st scan to 0.44 at the 6th scan (mean age = 56 weeks). Genetic correlation between yearling BFT (5th scan) and earlier RFT measures including scans one to four were 0.58, 0.62, 0.77, and 0.83, respectively. Results from RRM showed higher additive genetic variance values for BFT measures within 46 weeks compared to RFT measures. Genetic variance for BFT during the rest of the ages. However, BFT measures showed larger direct permanent environmental variances than RFT for most measurement ages. Heritability of RFT ranged from 0.27 to 0.39, as compared to 0.24 to 0.34 for BFT measures. At a year of age heritability of BFT and RFT were 0.34 and 0.38, respectively. Both traits showed similar repeatability values ranging from 0.71 to 0.91. Repeatability of yearling BFT and RFT were 0.88 and 0.86, respectively. The relatively higher heritability values of early RFT measures and the strong genetic association with yearling BFT suggest that RFT measures could be considered as additional sources of information for earlier evaluation of Angus cattle for fat cover and other related traits.

Key Words: Composition, Ultrasound, Heritability

### Genetic parameter estimates of udder scores in Gelbvieh cattle

The objective of this study was to investigate genetic parameters for teat size score (T) and suspension (S) score in Gelbvieh (GV) cattle. Cows were scored, by the producer, within 24 hr of calving. The range of T and S is 0 (extremely large or very pendulous, respectively) to 50 (extremely small or extremely tight, respectively). Cows from sires that were at least 75 percent GV were retained for analysis. Bivariate analyses of data from first parity (FP) animals (n = 11,997) were performed. Second bivariate analyses of data with first and second parity (SP) records (n = 11,997) were performed, where T and S were considered different traits (T1, T2, S1, S2, respectively) across the two parities. A first parity animal was considered to be four yr of age or younger at first calving. Contemporaries, year, season, and birth group identification for both data sets. The model included the fixed effect of contemporary group, a covariate for the age at measurement, and random additive genetic effect. AIRELML90 was used to estimate variance components. Heritability estimates from FP data for T and S were 0.22 and 0.19, respectively; heritability estimates of 0.22, 0.18, 0.39 and 0.28 were found for T1, T2, S1, and S2, respectively, from SP data. The genetic correlation between T and S in FP data was 0.87. The genetic correlations between T1-S1, T1-T2, S1-S2, and T2-S2 were 0.86, 0.76, 0.73, and 0.98, respectively. The approximate SD for the genetic correlations were higher then we expected. The moderate heritability estimates suggest that selection for T and S is possible. It is interesting to note that the genetic correlations, estimated from SP data, is higher between T and S within a parity than the correlation between the same score across parities. This may suggest that producers consider T and S to be the same response instead of two separate measurements. Further research is needed to determine the relationship between udder scores and milk production.

Key Words: Udder score, Genetic parameters, Beef cattle

### Comparison of methods for handling missing fertility records in beef cattle data

The purpose of this study was to compare methods for handling missing fertility records in beef cattle data. Data were days to calving records from natural service matings of 33,176 first-calf females in Australian Angus herds. Three methods for handling records from females that did not calve (missing records) were evaluated, with three separate data sets created for analysis. Non-calfers were assigned penalty values on a within contemporary group basis in the first data set (DCPEN). In the second data set, records for non-calfers were treated as censored, and were drawn from their respective truncated normal distribution (DCSIM), while records on non-calfers were deleted from the third data set (DCMISS). Bayesian approach via Gibbs sampling was used to estimate variance components and predict breeding values. Posterior means (PM) (SD) of additive genetic variance for DCPEN, DCSIM and DCMISS were 29.87 (4.69), 25.74 (3.89), and 13.2 (2.91), respectively. PM (SD) of residual variance for DCPEN, DCSIM and DCMISS were 435.3 (5.38), 371.7 (4.69), and 262.4 (3.43), respectively. PM (SD) of heritability for DCPEN, DCSIM and DCMISS were 0.29 (0.01), 0.29 (0.01), and 0.29 (0.01), respectively. Simulating trait records for non-calving females resulted in similar heritability to the penalty method, but lower residual variance. Pearson correlation between posterior means of animal effects in DCPEN-DCSIM was 0.98, and for sires with more than 20 daughters with records, correlations between DCPEN-DCSIM, DCPEN-DCMISS and DCSIM-DCMISS were 0.98, 0.80 and 0.84, respectively. Of the 424 sires ranked in top 10% of sires in DCPEN, 88% were also ranked in top 10% in DCSIM. These results indicate that although most sires ranked similarly, there were exceptions. Further research to understand the differences in ranking of animals under these methods is underway.

Key Words: Fertility, Genetic evaluation, Beef cattle

### Estimates of genetic parameters for respiratory disease in beef calves before weaning

Respiratory disease is one of the most economically important illnesses affecting growth and survival of calves. The primary objective of this study was to estimate genetic parameters for respiratory disease in beef calves prior to weaning. Health records of 31,000 calves produced at the U.S. Meat Animal Research Center, Clay Center, NE from 1983 to 2001 were evaluated. Cows and calves were monitored daily for health until weaning at approximately 194 d of age. Herd groups consisted of nine purebred breeds (Angus, Brahman, Charolais, Gelbvieh, Hereford, Limousin, Pinzgauer, Red Poll, and Simmental), two reciprocal crosses
between Angus and Herefords, and three composite populations (MARC I, MARC II, and MARC III). Respiratory disease was detected by physical examination, necropsy, or laboratory analyses. To avoid multiple incidence, records on the same calf which may be due to lingering respiratory disease, only the initial infection during the preweaning period was considered. Overall average incidence of recorded respiratory disease was 11.6%. Incidence was highest in Braunvieh (18.1%) and MARC I (17.8%), a composite breed with one fourth Braunvieh heritage. Herefords and the Hereford x Angus cross had the lowest incidence (4.6 to 7.8%). Incidence was highest after d 84. Variance components were estimated using REML. Fixed effects included year of birth, age of dam, sex of calf, and breed type. Calf and dam of the calf were considered random effects. Variance due to permanent environmental effects of the dams was not significant. Phenotypic variance for respiratory disease was 0.095. Heritability estimates for the calf direct and maternal effects were low, 0.14 ± 0.01 and 0.04 ± 0.01, respectively. Estimate of the direct-maternal genetic correlation was large and negative, -0.93 ± 0.04. Large and significant breed differences for respiratory disease were found. Within breed, response to selection to reduce the incidence of respiratory disease in calves would be expected to be slow although breed differences suggest a potential to improve resistance by selection or crossbreeding.

Key Words: Pneumonia, Lung, Health

352 Simulation of net return using days to finish to estimate breeding values in beef production. M. A. Cleveland*, R. M. Enns, W. J. Umberger, and B. L. Golden, Colorado State University, Fort Collins, CO.

The objective of this study was to determine if sire genotype and choice of finish endpoint for progeny interact to affect net return. A model was developed to determine the distribution of progeny for three carcase traits, carcase weight (CW), backfat thickness (BF) and marbling score (MS), when feeding to a CW, BF or MS endpoint. Days to finish carcase weight (DCW), backfat thickness (DBF) and marbling score (DMS) estimated breeding values (EBV) were used to simulate feeding costs, grid revenue, and net return. Three sire days to finish genotypes, high (H), medium (M) and low (L), as indicated by EBV, were considered for each trait. An H EBV suggests above average days to finish, while an L EBV indicates a shorter than average time on feed. All possible combinations of EBV resulted in 27 distinct sire genotypes for days to finish. Assuming an average of 130 days to each endpoint, results showed that progeny from sires with H EBV for days to finish needed an average of 142 days to reach a constant CW, and 148 days to reach constant BF and MS endpoints, while progeny from L EBV sires needed an average of only 118 days or less to reach each endpoint. The results from the model indicated that considerable re-ranking occurred among sires for net return, suggesting an interaction between genotype and finish endpoint. Re-ranking resulted in changes of up to 20 positions at alternative endpoints for some sire genotypes. Net return was calculated using average yardage costs and grid revenue. When feeding to a constant CW or BF, the LHL sire (first character indicates the DCW, second, the DBF, and third, the DMS EBV) realized the highest return, while the LLL sire was most profitable at the BF endpoint. Progeny from sires with H EBV for DMS, when fed to the MS endpoint, were overall least profitable. With the inclusion of more precise costs of production, this type of model has the potential to become a selection and management tool using days to finish genetic predictions to assist producers in maximizing profitability.

Key Words: Beef cattle, Days to finish, Simulation

353 Comparison of different selection criteria in populations simulated under growth curve parameters of Brazilian zebu cattle. E. S. Sakaguti1, E. N. Martins1, and L.O.C. Silva1, 2 Universidade Estadual de Maringá, Maringá, Brazil, 2 Embrapa Gado de Corte, Campo Grande, Brazil.

Recently the Brazilian Association of Zebu Breeders started to report the EPDs for a new growth trait, the number of days that an animal would take to gain 240 kg in the postweaning period (D240). This new trait can be used as a substitute of the traditional postweaning average daily gain (ADG) and is calculated as D240 = 240/ADG. However, there is some uncertainty about the consequences of this change. Then the objective of the present work is to evaluate the response to selection for four different traits (ADG, D240, live weight at 205 (WW) and 550 (YW) days of age) were individually considered in populations generated by Monte Carlo simulations. A FORTRAN 90 program generated the parameters (A, B and K) of the Von Bertalanffy function for each animal. The parameters were implemented as biological traits with Mendelian inheritance, polygenic effect and phenotypic and genetic correlations. Estimates of genetic parameters from live weight data of Tabapaua breed were employed. Two levels of heritability (approximately .1 and .5) were considered and 10 base populations were generated for each level of heritability. Approximately 25,000 progenies of 200 sires and 10,000 dams composed a population in each generation. Simulations of a random mating system with single calf per parturition produced populations with half-sib family structure that were evaluated by 10 generations of BLUP selection on each trait. The selection for ADW and D240 produced similar results. Both showed the highest increases of the mature weight (A) and the lowest decreases of the maturing rate (K). In the other hand, the selection for WW had the lowest increases of A and the highest decreases of K. Intermediate results were found with the selection for YW. The selection for D240 produced the highest inbreeding increases that can be a consequence of the smallest estimates of heritability of this trait in the early generations.

Key Words: Monte Carlo simulation, Growth curve, Selection responses

Companion Animals

354 A new approach to testing nutraceuticals in animals: A placebo-controlled evaluation of a milk-based “immuno-nutritional” product in dogs. D. A. Gingerich* and J. D. Strobel, SMBI, Cincinnati, OH, USA.

Functional foods and dietary supplements with structure/function claims have become important in the health care system in USA, especially since the passage DSHEA in 1994. Pet owners are interested in therapeutic value of such products for their pets. However, few dietary supplements have been rigorously evaluated in animals. Furthermore, it is FDA/CVM’s position that DSHEA does not apply to animal products. Milk is a food with biological functions in addition to its nutritional value. A special milk protein concentrate (SMPC) prepared from the milk of hyperimmunized cows was shown to express anti-inflammatory and anti-artheritic activity in humans. To determine if SMPC is also beneficial to dogs, an 8-week, placebo-controlled clinical study was conducted in older dogs with osteoarthritis. The study was designed to test the product and also to evaluate an owner-based questionnaire designed specifically for dogs. Fifty dogs in 5 veterinary practices were enrolled, of which 35 completed the study. Significant (p < 0.05) improvement in mean questionnaire scores and owner global assessments was detected in dogs in the SMPC group but not the placebo group. The treatment responses were significantly greater in the SMPC group than in the placebo group (p<0.005). The effect sizes (treatment response - placebo response/SD placebo response) for case-specific and client global outcomes were 1.61 and 0.90 respectively, which are considered large. No treatment-related adverse effects or changes in serum chemistry findings were detected. Unlike many dietary supplements with no recognized nutritional value, SMPC contains high quality dairy protein. Because there is laboratory evidence that the anti-inflammatory activity in the milk from hyperimmunized cows is exerted through immunological mechanisms, we describe SMPC as an “immuno-nutritional”. The results of this study also indicate that the individualized owner-based questionnaire is a valuable tool in testing nutraceuticals and can be adapted to evaluate a variety of new products in pets.

Key Words: Nutraceutical, Milk-based, Anti-inflammatory


Lutein is one of numerous carotenoids with potential health benefits for companion animals. Natural sources include green leafy vegetables, marigolds, and maize, in which lutein is present as a fatty acid ester.
Lutein esters are commercially obtained via a solvent extraction process from marigolds and are commonly used as a pigment in poultry diets. Saponified (un-esterified) lutein exists in animal tissues and may play a beneficial role in eye and immune health for companion animals. A purified (>90%) source of free lutein is a promising functional ingredient for animal feed. A minimally invasive canine model for measuring uptake from consumption of a crystalline lutein feed additive will be described. Factors affecting the presentation of lutein to the digestive system must be controlled to produce reliable results. These factors include fat content of the total diet in which the lutein additive is included and individual animal variability. Monitoring bioavailability of lutein additive forms is critical to demonstrating the utility of lutein for intended purposes. Utility data is crucial to justifying using functional ingredients in feeds for companion animals as well as for preparing a submission for regulatory clearance of an ingredient.

Key Words: Lutein, Absorption, Canine model

356 Evaluation of stabilized rice bran as an ingredient in dry extruded dog diets. J. K. Spears*, C. M. Grieshop, and G. C. Fahey, Jr., University of Illinois at Urbana-Champaign, Urbana, IL. USA.

During rice processing, lipase from testa and cross-cells hydrolyzes oil in the aleurone layer and germ, resulting in an unpalatable byproduct. Inactivating lipase prevents hydrolysis, resulting in stabilized rice bran (SRB). The purpose of this research was to evaluate the effect of SRB and defatted rice bran (DRB) on food intake, digestibility, fecal characteristics, and blood fatty acid, phospholipid, and eicosanoid concentrations in dogs. Diets contained 12% SRB or DRB, and poultry fat, beef tallow, or poultry fat:soybean oil (50:50) as the main fat sources. Two blocks of 18 dogs were used, with each block fed the diets for 42 d. Days 1 through 38 constituted an adaptation phase and d 39 through 42 was the collection phase during which a total fecal collection was made. Blood samples were collected on d 1 and 42. Blood fatty acid profile and eicosanoid data were analyzed as differences from baseline values (d 1 vs d 42). No differences (P > 0.05) were noted in food intake, digestibility, or fecal characteristics. Changes in blood profiles due to rice bran source could not be explained by diet because differences in rice bran fatty acid profiles were negated by the dietary fat sources. Dogs consuming DRB diets had lower (P < 0.05) plasma phospholipid total monounsaturated fatty acids, while plasma concentrations tended (P < 0.12) to decrease. Dogs consuming beef tallow diets tended to have lower (P < 0.11) RBC phospholipid PUFA and higher total saturated fatty acids (P < 0.15), while dogs consuming poultry fat diets tended to have higher (P < 0.09) n-6 PUFA. Dogs consuming beef tallow diets had lower (P < 0.05) RBC phospholipid 18:2 n6 and 20:2 n6 and increased 20:3 n6. Trends were detected in individual fatty acids due to rice bran source, fat source, and the interaction. Eicosanoid concentrations did not change due to treatment. Stabilized rice bran is an acceptable ingredient when included in dog diets, but did not elicit an effect on inflammatory immune mediators in stabilized dogs.

Key Words: Canine, Stabilized Rice Bran, Digestibility

357 Defining Safe Lower and Upper Limits for Selenium (Se) in Adult Cats. K. Wedekind*, E. L. Spitznagel, Jr., and R. Nachreiner1, 1University of Illinois at Urbana-Champaign, Urbana, IL. USA.

Pet food regulatory recommendations for minimum Se in adult cat foods are 0.1 mg Se/kg diet. No recommendations are given for safe maxima for the cat; however, 2 mg Se/kg diet is recommended as a maximum for the dog. Given the higher Se concentrations contained in cat vs dog diets, we felt it was important to define, if possible, both a safe lower and upper limit for Se in adult cats. Our study used 33 adult cats. Cats were fed a low Se diet containing Se (<0.02 mg Se/kg diet) for 3 wk after which this same diet was supplemented with 6 levels of selenomethionine (0, 0.1, 1, 2.5, 5, and 10 mg Se/kg diet) and fed for 6 mo. Response variables measured included Se concentration, Se-dependent glutathione peroxidase (GSHPx) activity in serum and RBC, complete thyroid hormone profile, complete blood count (CBC), serum chemistry profile (SCP), hair growth rate and immune function measures. No significant changes in body weight, CBC, SCP or clinical signs were observed. All serum thyroid hormone concentrations were within normal ranges. A definitive breakpoint for serum GSHPx yielded a minimum recommendation of 0.10 mg Se/kg diet. Serum Se concentrations in cats, were significantly higher than dogs, even when fed similar Se levels. Unlike chicks and dogs, serum Se did not plateau above the cat’s requirement for Se, but increased linearly. Hair growth rate was significantly decreased at Se concentrations below the breakpoint, but was unchanged at high Se concentrations. We were unable to define in our study, a safe upper limit or lowest observable adverse effect level (LOAEL) for Se in cats. Results indicate a minimum requirement of 0.1 mg Se/kg diet in adult cat foods.

Key Words: Selenium, Cat, Requirement

358 Docosapentaenoic acid accumulates in plasma phosphatidyl choline but not cholesteryl ester fractions in linseed oil fed dogs. J. E. Bauer*, J. K. Spears*, C. M. Grieshop, and E. L. Spitznagel, Jr., 1College of Veterinary Medicine, Texas A&M University, College Station, TX, 2Nestle-Purina Pet Care, St. Louis, MO.

We have previously observed that total plasma phospholipid is enriched with docosapentaenoic acid (DPA, 22:5n-3) when flaxseed supplemented diets are fed to dogs, but that cholesteryl ester is not. This observation suggests that DPA is not a substrate for the plasma enzyme, lecithin:cholesterol acyl transferase (LCAT). The present work was undertaken to determine whether the preferred substrate for LCAT, specifically the phosphatidyl choline (PC) and cholesteryl ester (CE) fatty acid contents are similarly composed in dogs when a diet containing a high concentration of alpha-linolenic acid from linseed oil is consumed and when compared to dogs fed preformed sources of long chain n-3 PUFA (including DPA). Forty adult mixed breed dogs were divided into 4 groups (n=10). A low fat basal diet was supplemented with either safflower oil (SFO), beef tallow (BTO), linseed oil (LSO), or Menhaden fish oil (MHO) for 28 days at a dosage of 18 g oil per 100 g basal diet. Blood samples were collected, plasma total lipids were extracted with chloroform:methanol (2:1, v/v), PC and CE were fractionated via thin-layer chromatography, and methyl ester derivatives of these fractions were analyzed by capillary gas chromatography. Fatty acid compositions were expressed as relative percent and ANOVA was performed. The PC fraction of dogs fed the LSO diet contained significantly increased amounts of eicosapentaenoic acid (EPA) but no accumulation of either DPA or DHA was seen beyond that found in the BTO or SFO groups. By contrast, significantly increased amounts of EPA, DPA and DHA were found in the MHO group PC fraction. In the CE fractions, neither DPA nor DHA were seen with linseed oil feeding. Unexpectedly, DPA in CE fractions of dogs fed the menhaden oil also did not accumulate although there was an increase in DHA in this fraction. These data confirm that, when diets high in ALA (LSO group) or fish oil (MHO group) are fed, DPA is present in plasma PC but not in plasma CE. It is concluded that transfer of DPA from PC to CE mediated by LCAT may not occur under these conditions and that DPA may not be a suitable substrate for the enzyme. Such a mechanism would help assure that DPA is transported to tissues using n-3 fatty acids in some preferential manner via plasma phospholipids.

Key Words: DPA fatty acids, Cholesteryl ester, linseed oil

359 Lifetime diet restriction impact on carbohydrate metabolism affects survival and time-to-first treatment for chronic disease in dogs. B. T. Larson*, D. F. Lawler1, E. L. Spitznagel, Jr., and R. D. Kealy1, 1Nestle Purina PetCare Company, St. Louis MO, 2Washington University, St. Louis MO.

Labrador retrievers (48) were used to assess carbohydrate metabolism effects on survival and time-to-first chronic disease treatment during lifetime diet restriction. Restricted dogs were fed 75% of same diet consumed by control-fed pair-mates. Intravenous glucose tolerance testing (IVGTT) was done annually (maximal stimulation, non-steady-state, ages 9-12). Time when it became necessary to treat a specific chronic disease condition for humane reasons was recorded for each dog. Forty-six of 48 dogs were eventually euthanized for humane reasons and two died spontaneously. Euthanasia was carried out only after extensive diagnostic evaluation, careful monitoring and response-to-treatment assessment, serial clinical condition evaluation, and prognosis consideration, according to practices established for entire colony. Cox proportional hazards regression models analyzed IVGTT parameter relationships to survival. The Cox model was used to explain differences in survival due to varying IVGTT covariate levels, in terms of impact on the hazard function. As hazard increases, survival rates decrease more

rapidly. Survival was modeled in three ways: 1) time to death, 2) time to death or treatment for osteoarthritis, or 3) time to death or treatment for any chronic disease. Time-to-first osteoarthritis treatment or death was longer with lower basal glucose and higher insulin sensitivity (P = 0.021, P = 0.023), and median survival time tended to be greater with lower basal glucose and insulin (P = 0.065, P = 0.090) but diet restriction explained most variation. Higher insulinogenic indices associated with greater median survival (P = 0.053) and those with higher insulin sensitivity had less (P = 0.018) hazard of dying or receiving chronic disease treatment. These insulin indices added more information than diet restriction alone (P = 0.057, P = 0.055). Lifelong diet restriction glucose disposal efficiency and insulin response was associated with increased life quality and quantity.

Key Words: Diet restriction, Chronic disease, Dog

Forages & Pastures: Grasslands, forage supplementation

360 Effect of defoliation system and nitrogen input on nitrate losses from grassland systems. M. Wachendorf, M. Buechter, H. Trotz, and F. Taube, University of Kiel, Kiel, Germany.

Nitrogen (N) recovery in specialized dairy farms is known to be low. This causes serious environmental problems due to increased losses of N as nitrate (NO\(_3\)) to the watercourse, as in northern central Europe intensive dairy farming is mainly located on freely draining sandy soils. As part of an integrated research project, a field experiment was conducted over a 4 year period to determine NO\(_3\) leaching losses on grassland, which is the predominant forage crop in this region. The experiment consisted of all combinations of five defoliation systems, i.e., cutting-only, rotational grazing, mixed systems with one or two silage cuts plus succeeding rotational grazing respectively, and simulated grazing, four mineral N application rates (0, 100, 200, and 300 kg N ha\(^{-1}\) yr\(^{-1}\)), and two slurry levels (0 and 20 m\(^3\) slurry ha\(^{-1}\) yr\(^{-1}\)). Prior to the start of the experiment, white clover was established in all plots by oversowing. Samples of leachate were taken by ceramic suction cups. Water fluxes were derived from water balance calculations. Due to the high N return by grazing animals leaching losses in rotational grazing systems generally caused NO\(_3\)-N concentrations exceeding the European Union (EU) limit for drinking water (50 mg NO\(_3\)\(^-1\))\(^{-1}\)). NO\(_3\) leaching losses in a rotational grazing system could be reduced by lowering the N fertilizer intensity and inclusion of one or two silage cuts in spring. However, even in unfertilized mixed systems NO\(_3\) concentrations were well above the EU limit. In terms of leaching losses, the cutting-only system was the most advantageous. NO\(_3\) leaching losses (y; kg N ha\(^{-1}\)) could be predicted by the amount of soil mineral N at the end of the growing season (x\(_{soil}\); kg N ha\(^{-1}\)) with: y = - 5.95498 + 0.6758 x\(_{soil}\); r\(^2\) = 0.74; s.e. 11.2 and by the N surplus calculated from N balances at the field scale (x\(_i\); kg N ha\(^{-1}\)) with: y = 17.2200 + 0.1907 x\(_i\); r\(^2\) = 0.77; s.e. 10.4. From the results obtained an adapted N fertilization and a reduced grazing intensity by integrating silage cuts are suggested.

Key Words: Grassland, Nitrogen losses, Environment

361 Metabolic changes in Brangus stocker calves grazing wheat pasture. L. A. Aппedu, M. A. Brown, and W. A. Rhoads, 1Southwestern Oklahoma State University, Weatherford, OK, 2USDA-ARS Grazinglands Research Laboratory, El Reno, OK.

Previous research suggests stocker calves do not effectively convert forage to gain when first placed on pasture. The objective of this research was to investigate metabolic changes in stockers over the first 21 to 49 d on fall wheat pasture (39% CP, 35% NDF) by evaluating serum metabolites and rumen function in Brangus x Hereford calves. Calves were weaned (n = 24; 268 ± 36.4 kg), and offered Prairie hay ad libitum (6% CP, 76% NDF) and 40% CP supplement daily (1362 g \(\mu\)g ergovaline/kg BW). Daily high temperature ranged between 5.0 and 21.2°C. Data were analyzed using the mixed models, repeated measures procedure of SAS and heterogeneity of regression. Signs of feed intoxicosis in E1 fed rams included increased rectal temperature.

Key Words: Calves, Intake, Digestion


The objective of this study was to examine the influence of endophyte-infected tall fescue on reproductive development and function and carcass characteristics of ram lambs. Hampshire and Suffolk rams, 214 d of age, were fed individually a diet of endophyte-free (EF; n = 8) or infected (EI; n = 9) fescue seed (34% of diet; 4.8 µg/g ergovaline) for six weeks. Intake was similar between treatments and averaged 2.7% BW (33.7 µg ergovaline/kg BW). Daily high temperature ranged between 16 and 27°C. Data were analyzed using the mixed models, repeated measures procedure of SAS and heterogeneity of regression. Signs of fescue toxicosis in EI fed rams included increased rectal temperature.
(treatment × day, P < 0.001, R² = 0.11), increased respiration rate at higher ambient temperatures (treatment × day, P < 0.003, R² = 0.07), and reduced serum concentrations of prolactin (treatment × day, P < 0.001). Body weight of EI fed rams tended to decrease after 36 d of feeding (<3.0 vs 0.51 kg; P < 0.07). BCS was similar between treatments throughout the trial. Serum concentrations of testosterone were greater in EI compared with EF fed rams (treatment × day, P < 0.005, R² = 0.08). Spermatozoa concentration tended to be greater in EF compared with EI fed rams after 43 days of feeding (P < 0.07). Rate of forward movement of spermatozoa tended to be greater in EF compared with EI fed rams between Days 15 and 29 of feeding (treatment × day, P < 0.08). Scrotal skin temperature, scrotal circumference, semen volume, percent sperm motility, and percent abnormal sperm were similar between treatments. Weights of reproductive and vital organs, carcass cutability and quality characteristics were similar between EF and EI fed rams. Feeding of EI fescue seed to ram lambs led to decreased concentrations of spermatozoa in semen and increased serum concentrations of testosterone, perhaps due to decreased steroid clearance rate.

Key Words: Rams, Reproduction, Tail Fescue

364 Comparison of urea and soybean meal as nitrogen supplements to cool-season, low-quality forage: I. Daily and alternate day supplementation effects on digestion and ruminal fermentation in steers. D. W. Bohnert*, S. Schauer1, S. J. Falck1, and D. L. Harmon2,1 Eastern Oregon Agriculture Research Center, Burns, 2University of Kentucky, Lexington.

Five steers (464 ± 26 kg BW) were used in an incomplete 5 × 4 Latin square with four 18-d periods to determine the influence of supplemental N source and supplementation frequency (SF) on nutrient intake and ruminal fermentation in steers. Daily and alternate day supplements were provided with little change noted as SF increased on the day all supplements were provided and decreased on the day only daily supplements were provided. Straw and total DMI increased (P < 0.03) with CP supplementation; however, DM and OM digestibility was not influenced (P > 0.19) by CP supplementation or SF. Ruminal indigestible ADF passage rate and NH₃-N increased (P < 0.04) with supplemental CP on the day all supplements and the day only daily supplements were provided. However, CP source × SF interactions (P < 0.05) indicate that, as urea SF decreased, ruminal NH₃-N increased on the day all supplements were provided and decreased on the day only daily supplements were provided with little change noted as SF of SBM decreased. These results suggest that urea or SBM can be used effectively as supplemental N sources by steers consuming low-quality forage without adversely affecting DMI and DM digestibility, even when provided every-other-day.

Key Words: Protein, Supplementation, Forage

365 Comparison of urea and soybean meal as nitrogen supplements to cool-season, low-quality forage: II. Daily and alternate day supplementation effects on efficiency of nitrogen use in lambs. D. W. Bohnert1, S. J. Falck2,3, and C. S. Schauer1,2 Eastern Oregon Agriculture Research Center, Burns.

Five wethers (52 ± 2 kg BW) were used in an incomplete 5 × 4 Latin square with four 18-d periods to determine the influence of supplemented N source and supplementation frequency (SF) on efficiency of N use in lambs offered hard fescue straw (4.7% CP; 77% NDF). Treatments (TRT) included an unsupplemented control (CON) and a urea (29% CP) or soybean meal (SBM; 26% CP) supplement provided daily (D) or every-other-day (2D) at 0700. The D TRT were supplemented CP at 0.10% of BW/day while the 2D TRT were supplemented at 0.20% of BW every-other-day. Therefore, all supplemented TRT were the same quantity of supplemental CP over a 2-d period. Lambs were provided straw at 120% of the previous 5 d average intake in two equal portions at 0730 and 1900. Experimental periods were 18 d with feces and urine collected on d 13 to 18. Blood samples were obtained 4 h post-supplementation on d 13 to 18 for analysis of plasma urea-N (PUN). Dry matter intake, OM intake, N intake, N retention, DM, OM, and N digestibility, and digested N retained were greater (P < 0.01) for supplemented wethers compared with CON with no differences (P > 0.05) because of N source or SF. There were no differences in fecal or urinary N excretion because of N supplementation or SF (P > 0.10). However, PUN was increased (P < 0.01) in supplemented lambs compared with CON (5.8 compared with 3.7 mM) and urea TRT had greater (P < 0.01) PUN compared with SBM. Also, PUN was increased (P = 0.05) for D compared with 2D TRT. These results suggest that supplements containing urea or SBM as the supplemental N source can be effectively used by lambs consuming cool-season, low-quality forage without adversely affecting N efficiency, even when provided every-other-day. However, SBM should have greater utility for use in supplements offered infrequently to ruminants because it is comparatively nontoxic compared with urea.

Key Words: Protein, Frequency, Supplementation

366 Animal performance and forage quality effects on steers intensively grazing summer perennialials. A. M. Bowers*, M. E. Boyd, and D. J. Lang, Mississippi State University.

A study to compare the performance of four forage systems Sumrall 007 bermudagrass (Cynodon dactylon) (S007), Tifton 44 bermudagrass (Cynodon dactylon) (T44), common bermudagrass (Cynodon dactylon)/dallisgrass (Paspalum dilatatum) (CD) and Alamo switchgrass (Panicum virgatum) (AS) in a summer stocker system was conducted from 2000-2002 at the Leveck Animal Research Center, Starkville, MS. Steers were intensively grazed with stocking rates varying by year, forage and forage availability. Forage systems were replicated three times. Pastures were 1.6 ha in size and were divided into 10 paddocks with electric fence. Fertilization was identical for all pastures and at a level suitable for the hybrid bermudagrasses. Animal and forage system performance measures were initial stocking rate, periodic (28 d) and overall average daily gain, and cumulative weight gains. Forages, samples collected monthly from each pasture, were analyzed for DM, IVDM, IVDM followed by a NDF wash, NDF, and ADF. A mixed model analysis was used to analyze both the animal and forage data. Bermudagrasses systems were analyzed against each other for three years. AS was included in only the last two years due to slow initial development. Stocking rate, kg/ha, was consistently greater (P<0.05) across all periods for the S007 and T44 than for the CD or AS, 2812.3 and 2851.6 vs. 2182.6 and 2073.8 respectively. All other animal measurements were not significant. Cumulative ADG, kg/d, for each forage were 1.6 (CD), 1.5 (S007), 1.46 (AS), and 1.41 (T44). Forage analysis is available for the first two years. IVDM (p=0.009) was significant for period over month with May less than all other months. BD (58.93) for IVDMD/NDF. NDF (64.65) and ADF (30.21) were significant for period with May less than all other months.

Key Words: Stocker steers, Intensive grazing, Summer perennials

367 Effect of protein supplementation of warm versus cool season forages on intake, digestibility, and ruminal fill in beef steers. G. D. Pulispehr*, D. W. Bohnert, T. DeCurto, K. J. Walburger, M. S. Wells, and J. J. White, Eastern Oregon Agriculture Research Center, Union, OR.

Sixteen ruminantly cannulated steers (BW 243 ± 4 kg) were used to evaluate the effects of warm vs cool season forages with or without protein supplementation on intake, digestibility, and ruminal fill in a completely random design. Treatments were arranged in a 2 x 2 factorial. Factors were: (1) forage type, warm season (WS, 6.3% CP 66% NDF) or cool season (CS, 6.3% CP 67% NDF), and (2) protein supplementation, no supplement (NC) or 0.45 kg/d of a 34% CP supplement (S). The trial was 28 d in length. Intake was determined on d 17 to 21, total fecal collections were conducted on d 18 to 22, and in situ digestibility was determined on d 23 to 24. Total ruminal evacuations were conducted four h after feeding, all steers averaged 9.3 kg. There was an interaction (P = 0.01) in BW change with CSNCS and CSS steers having similar BW change (1.0 vs 0.0 kg respectively) while WSNC steers lost more weight than WSS steers

Key Words: Protein, Supplementation, Forage
Meat quality was evaluated from 72 Angus cross steers finished on forage (FOR) or concentrate (CONC), after being backgrounded at low (LOW, ADG=0.36 kg), medium (MED, ADG=0.55), or high (HIGH, ADG=0.82) growth rates. Steers were harvested at a commercial meat plant, and rib (IMPS107) removed and transported to the USDA. The 9-10-11 rib section was dissected into lean, fat and bone. Data were analyzed as a 3 x 2 factorial design with backgrounding treatment, finishing treatment, and two-way interaction in the model. Total rib weight tended to be greater (P < 0.10) for HIGH than LOW backgrounding treatments, and greater (P < 0.01) for CONC than FOR finishing treatments. Percent lean was greater and percent fat lower for MED than LOW. Ribs from FOR had greater (P < 0.01) bone and lean percent, and lower (P < 0.01) fat percent than ribs from CONC. Backgrounding growth rate had no effect (P > 0.05) on longissimus or subcutaneous fat color (L* lightness, a* redness, and b* yellowness). Longissimus color of CONC was lighter (P < 0.01, higher L*) and redder (P < 0.01, higher a*) than FOR with the differences in yellowness. Subcutaneous fat color of FOR was darker (P < 0.01) and more yellow (P < 0.01) than CONC. Backgrounding did not alter (P > 0.05) shear force of longissimus steaks. Warner-Braztler shear force was higher (P < 0.05) for CONC than FOR at 14 d postmortem; but did not differ (P > 0.05) at 28 d. Increased growth rate during backgrounding period (MED and HIGH) reduced (P < 0.05) fatness scores for CONC but not for FOR. Juiciness was higher (P < 0.01) for FOR than CONC when animals were backgrounded on HIGH, with no differences at LOW or MED growth rates. Panelists assigned higher (P < 0.05) beef flavor and lower (P < 0.01) off flavor scores to CONC compared to FOR. Increased growth rate during backgrounding period increased rib weight and altered composition. Finishing cattle on CONC resulted in greater rib weight and percent fat, and lower percent of lean and bone than FOR. Forage finishing reduced longissimus shear force at 14 d and increased sensory tenderness scores for higher backgrounding growth rates.

Key Words: Forage, Concentrate, Backgrounding
was highest for the 3SP mix. The 2SP mix had the highest NDF and lowest IVDMD. DMI, milk yield, milk fat and protein, and rumen NH3-N were not affected by treatment. Milk urea N increased on the most complex mix (95%). Rumen pH and VFA tended to be higher for the 2SP mix. Acetate:propionate decreased with increasing level of pasture diversity. Level of forage diversity did not have a major impact on DMI or productivity of grazing dairy cows. However, forage production and carrying capacity were greater on the complex mixtures than on the 2SP mix.

### Growth & Development: Somatotropic axis and adipose development

372 Preadipocyte recruitment is enhanced by ciglitazone or troglitazone in subcutaneous adipose stromal-vascular (S-V) cell cultures, but not intramuscular S-V cell cultures. S. Poulos* and G. Hausman, Univ. of GA and USDA-ARS.

Intramuscular adiposity enhances marketability of meat products. Our understanding of intramuscular adipocyte development is limited. Though studies have shown marbling fat can be modified, intramuscular S-V cultures show these cells do not respond to dexamethasone as do subcutaneous cells. The aim of this study was to determine the adipogenic potential of porcine S-V cells from subcutaneous adipose tissue (SQ) and semitendinosus muscles (STM) using the insulin sensitizing agents, ciglitazone or troglitazone. SQ and both STM from 5-7 day old pigs were ascetically removed and S-V cells obtained from each tissue following a standard collagenase digestion. S-V cells from each tissue were plated in media containing fetal bovine serum and 0.01%DMSO supplemented with 0, 10, 25, 50 µM ciglitazone or troglitazone. Upon confluence, cells were switched to insulin containing media for 3 days. Immunohistochemical evaluation for AD3, a preadipocyte antibody, was used to assess preadipocyte recruitment. Differences between treatments were determined using least squares contrasts and p<0.05 was considered significant. AD3 cell number per microscopic field was increased in SQ cultures as compared to STM cultures (24.1 ± 16.4 vs 9.8 ± 5.5; p<0.0001) regardless of treatment. A dose response curve reveals 10 nM ciglitazone or troglitazone treatment increases AD3 cell number per field in SQ-S-V cultures (15.3 ± 7.8, DMSO control; 30.5 ± 7.8, ciglitazone; 38.9 ± 7.8, troglitazone; p<0.05) though increasing doses in either treatment did not increase AD3 cell number. This is in contrast to STM-S-V cultures which did not show an increase in AD3 number at 10, 25, or 50 µM ciglitazone or troglitazone treatment (p>0.05). Myotube formation in STM-S-V cultures was maintained regardless of treatment. These results suggest intramuscular adipogenesis regulation may be different than that of adipogenesis in subcutaneous adipose. This information is key to the use of STM-S-V cultures as cell model systems for marbling fat.

**Key Words:** Adipose, Porcine, Intramuscular

373 Investigation of the molecular mechanism underlying the anti-adipogenic action of retinoic acid in cultured pig preadipocytes. T. D. Brandeburg* and C. Y. Hu, Oregon State University, Corvallis, OR / USA.

Retinoic acid (RA), the active metabolite of vitamin A, inhibits adipocyte differentiation in vitro. However the mechanism by which RA exerts this effect is poorly understood. The objective of this study was to investigate the molecular mechanism underlying the anti-adipogenic action of RA in cultured pig preadipocytes. In order to determine which member of the RA receptor superfamily mediates this action, porcine stromal-vascular cells were cultured in induction medium (DME/F12 medium containing 100 nM insulin, 10 ng/ml transferrin and 500 ng/ml hydrocortisone) and treated with either carrier (DMSO) or increasing amounts (10 nM to 25 µM) of individual retinoid ligands. On day 8 of culture, glycerol-3-phosphate dehydrogenase activity (GPDH) was measured as a late marker of preadipocyte differentiation. Addition of either RA or 9-cis retinoic acid (9c-RA) to the medium reduced GPDH activity (P<0.001). However, 9c-RA was less potent requiring a higher dose in order to exert an effect. Addition of TTNPB, a RAR-selective ligand, potently inhibited GPDH activity (P<0.01). In contrast, methoprene acid, a RXR-selective ligand, significantly increased GPDH activity (P<0.001). Next, increasing amounts (10 nM to 25 µM) of Ro61, a potent RAR-selective antagonist, were added in the presence of 10 nM TTNPB. Ro61 significantly blunted the ability of TTNPB to inhibit differentiation at all concentrations tested (P<0.0002). These data taken together indicate that the RAR receptor mediates the anti-adipogenic action of RA in pig preadipocytes. We next investigated whether RA action is dependent upon MAP kinase activity by testing the ability of 10 nM TTNPB to inhibit differentiation in the presence of either 10 µM or 25 µM of PD98059 (MAP kinase inhibitor). PD98059 failed to blunt the anti-adipogenic action of TTNPB at either concentration. These results indicate that the anti-adipogenic action of RA is mediated by the RAR receptor and is independent of the MAP kinase pathway in cultured pig preadipocytes.

**Key Words:** Retinoic acid, Adipocyte differentiation, Pig


Objectives were to determine effects of an estrogenic compound (Ralgro; R) on maternal and neonatal piglet performance and components of the somatotropic axis. On d 60 of gestation, sows were divided into two groups: R (n=7) and control (C; n=4). Treated sows were administered 36 mg R subcutaneously in the ear, and C sows were administered a sham implant. Sow blood samples were collected on d 60 and 80 of gestation and at parturition. Piglet blood samples were collected on d 60 and 80 of gestation and at parturition. Piglet blood samples and BW were collected within 12 hrs of birth. Thereafter, piglet BW were collected on d 7 and 14 of age. Serum was collected from blood samples and stored at -80°C until analyzed for serum concentrations of IGF-I, IGF-II, and growth hormone (GH). Data were analyzed using ANOVA with treatment and pig sex as main effects. There were no differences in serum concentrations of IGF-I or GH between C and R sows; however, there was a trend (P<0.14) for increased serum concentrations of IGF-I in R sows d 60 of gestation to parturition. There was no difference in litter size (P<0.14), number born alive (P<0.33), or piglet survival to weaning (P<0.21); however, there was a trend (P<0.11) for greater total litter weight in C sows (19.4 ± 2.3 vs 15.4 ± 1.2 kg; C vs R). There was no difference in litter size (P<0.47) in piglet BW at birth (1.4 ± 0.04 kg), but there was a treatment effect (P<0.002) on ADG to 7 d of age, with increased ADG in R pigs (0.19 ± 0.01 vs 0.16 ± 0.01 kg/d; R vs C). There was a tendency (P<0.07) for increased ADG in R pigs to 14 d of age (0.254 ± 0.01 vs 0.231 ± 0.01 kg/d; R vs C). Treatment affected piglet serum concentrations of IGF-I (P<0.006; 52.8 ± 3.7 vs 38.4 ± 3.8 ng/mL; R vs C) and IGF-II (P<0.0004; 83.2 ± 1.5 vs 74.6 ± 1.8 ng/mL; R vs C).

**Key Words:** Ralgro, pregnancy, Adipogenesis

### Table 1

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2SP</th>
<th>3SP</th>
<th>6SP</th>
<th>9SP</th>
<th>SEM</th>
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<tbody>
<tr>
<td>Pasture CP, % DM</td>
<td>21.8</td>
<td>22.1</td>
<td>20.3</td>
<td>19.0</td>
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<td>Pasture NDF, % DM</td>
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<td>31.7</td>
<td>29.2</td>
<td>24.7</td>
<td>1.57</td>
<td>&lt;0.001</td>
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<tr>
<td>Pasture IVDMD, % DM</td>
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<td>70.4</td>
<td>67.2</td>
<td>70.9</td>
<td>1.20</td>
<td>0.02</td>
</tr>
<tr>
<td>Total DMI, kg/d</td>
<td>23.9</td>
<td>22.9</td>
<td>22.8</td>
<td>22.0</td>
<td>0.53</td>
<td>0.13</td>
</tr>
<tr>
<td>Pasture DMI, kg/d</td>
<td>14.7</td>
<td>13.7</td>
<td>13.6</td>
<td>12.8</td>
<td>0.46</td>
<td>0.08</td>
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<tr>
<td>Milk, kg/d</td>
<td>35.4</td>
<td>36.3</td>
<td>35.2</td>
<td>35.3</td>
<td>0.31</td>
<td>0.10</td>
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<tr>
<td>Milk Fat, %</td>
<td>3.55</td>
<td>3.38</td>
<td>3.44</td>
<td>3.46</td>
<td>0.07</td>
<td>0.41</td>
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<tr>
<td>Milk Protein, %</td>
<td>2.73</td>
<td>2.72</td>
<td>2.74</td>
<td>2.72</td>
<td>0.02</td>
<td>0.95</td>
</tr>
<tr>
<td>MUN, mg/dl</td>
<td>12.9</td>
<td>11.8</td>
<td>12.7</td>
<td>13.3</td>
<td>0.27</td>
<td>0.03</td>
</tr>
<tr>
<td>Rumen pH</td>
<td>5.84</td>
<td>5.68</td>
<td>5.64</td>
<td>5.76</td>
<td>0.06</td>
<td>0.11</td>
</tr>
<tr>
<td>VFA, mmol/mL</td>
<td>156.4</td>
<td>140.8</td>
<td>144.0</td>
<td>145.6</td>
<td>4.45</td>
<td>0.09</td>
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<tr>
<td>Acetate:Propionate</td>
<td>2.93</td>
<td>2.83</td>
<td>2.68</td>
<td>2.65</td>
<td>0.02</td>
<td>&lt;0.001</td>
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<tr>
<td>NH3-N, mg/dl</td>
<td>17.4</td>
<td>14.9</td>
<td>16.1</td>
<td>15.4</td>
<td>0.87</td>
<td>0.20</td>
</tr>
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</table>
Peripheral leptin administration alters hormone and metabolite levels in the young pig. T. G. Ramsay1, J. A. Bush2, J. P. McMurtry1, M. C. Thivierge2, and T. A. Davis2.

The present study was conducted to determine if peripheral leptin administration can alter GH secretion or feed intake in the young pigs. Six to 8 kg female pigs were fed twice daily at 0800 (35%BW) and 1500 h (30%BW) a diet containing 24% crude protein prior to the study. Animals were fasted overnight and randomly chosen to receive porcine recombinant leptin or saline. The dose of leptin given per pig was initially 500 µg/kg body weight (BW) (L500) in 0.2% BSA as a bolus injection into the carotid artery. Blood samples were obtained from the jugular vein over a 24-h period. Feed was presented to each pig at 1 h following leptin injection with subsequent re-weighing of food every 2 h. Three days later in a cross-over design, the experiment was repeated with a leptin dose of 100 µg/kg BW (L100) or saline. Three days following this experiment, the experimental protocol was repeated with a leptin dose at 200 µg/kg BW (L200) or saline. Leptin reduced intake in pigs treated with L500 and L200 (P<.05), but did not affect pigs treated with L100 (P>.05). Blood glucose was depressed in pigs treated with L500 or L200 (P<.05). Plasma non-esterified fatty acid (NEFA) concentrations in Merinos and crossbreeds when fed at 1.5 M (.43 v .47 mM), basal plasma NEFA concentrations were increased to a lesser extent in Merinos than in crossbreds when fed at .5 M (.61 v .93 mM). CLEN caused an increase in plasma NEFA, with the response above basal being greater in wethers fed at .5M as compared to 1.5M (.89 v .61, P=.004). There was no effect of breed (P=.60) or dose of CLEN (P=.72) on the increase in plasma NEFA in response to CLEN. These data suggest that breed and level of nutrition can influence basal and β-adrenergic stimulation of fat mobilization.

Key Words: Lambs, Clenbuterol, Fat mobilization
379 Dose dependent growth suppression of broiler chicks injected with 5a-dihydrotestosterone. S. E. Nicolich1, T. D. Faidley, and D. R. Thompson, Merck Research Laboratories, Somerville, NJ.

Selective androgen receptor modulation may offer some potential to influence musculature and skeletal structure of broilers. To examine the effects of the anabolic steroid 5α-dihydrotestosterone (DHT) on growth, broiler chicks were injected (5X weekly) with 0, 1, 3, or 10 mg/kg. Petersen Farm or Acres, scale broiler growers ages of 2 weeks, were injected 5 per pen and given free access to water and a commercial broiler mash. There were 5 pens of chicks on each treatment level. After 3 weeks of injections, all the 10 mg/kg birds and 10 chicks from each of the other treatment levels were necropsied. Feed consumption, weight gain, and efficiency of gain were decreased with increasing DHT. Weights of breast fillet, thigh muscle, metatarsus, and femur were also decreased with increasing DHT. Heart weight, when expressed as a percent of carcass weight, was increased with DHT, as was comb weight and comb redness. DHT in broiler chicks did not improve growth performance or demonstrate anabolic effects on skeletal muscle.

Dose (mg/kg day) 0 1.0 3.0 10.0 SEM

Feed consumption (g/bird) 1509.8a 1483.0b 1324.2c 1149.6b 34.5
Wt. gain (g/bird) 1083.0a 1035.0b 893.6b 681.0b 48.2

Efficiency of gain (gain/feed) 0.72a 0.70b 0.67b 0.63c 0.01
Comb wt. (g) 0.8a 2.1b 3.3b 4.7b 0.2
Comb color (a*) 11a 20a 22c 14c 1

(1*) 59a 48b 44b 42b 1

(b*) 16a 15b 14c 12c 1

Body wt. (g) 1284a 1236a 1029b 843c 48

Heart wt. (g) 7.3 7.6 7.2 7.0 0.6

Whole breast (g) 29a 28a 23b 175c 12.1
Breast fillet (g) 29a 28a 23b 175c 12.1

Breast right leg (g) 160a 156b 127b 109b 6.3
Right thigh muscle (g) 54a 53a 45b 40b 2.7

Right metatarsus (cm) 13.0a 12.9b 11.8b 10.9c 0.2

Right femur (g) 10a 9.4b 7.5b 6.3c 0.5

Right metatarsus (g) 29a 29a 28b 23a 1.3

abcd Values with different superscripts differ (P<0.05).

Key Words: Growth, Anabolic steroid, Broiler

380 Expression of myostatin and myogenin in Landrace barrows selected for increased loin eye compared to a control line. G. N. Scheuermann1,2, K. Nadarajah1, D. L. Kuhlers1, S. P. Lino1, and D. R. Mulvany1,2, Auburn University, Auburn, AL, 2EMBRAPA, Brazil.

Myogenin (MG) genotype or gene expression has been shown to be related to leanness in pigs and myostatin (MSTN), a member of the TGF-β family of growth factors, is a negative regulator of muscle mass through involvement in the myogenic regulatory gene pathway. Our objective was to compare their expression in 100 kg Landrace barrows (n=11) resulting from five generations of selection for increased ultrasound loin eye area (ULEA) compared to controls (n=9). Data characterizing these lines have been previously reported but in general, select line ULEA were involved in the myogenic regulatory gene pathway. Our objective was to compare their expression in 100 kg Landrace barrows (n=11) resulting from five generations of selection for increased ultrasound loin eye area (ULEA) compared to controls (n=9). Data characterizing these lines have been previously reported but in general, select line ULEA were involved in the myogenic regulatory gene pathway. Our objective was to compare their expression in 100 kg Landrace barrows (n=11) resulting from five generations of selection for increased ultrasound loin eye area (ULEA) compared to controls (n=9). Data characterizing these lines have been previously reported but in general, select line ULEA were involved in the myogenic regulatory gene pathway. Our objective was to compare their expression in 100 kg Landrace barrows (n=11) resulting from five generations of selection for increased ultrasound loin eye area (ULEA) compared to controls (n=9). Data characterizing these lines have been previously reported but in general, select line ULEA were involved in the myogenic regulatory gene pathway. Our objective was to compare their expression in 100 kg Landrace barrows (n=11) resulting from five generations of selection for increased ultrasound loin eye area (ULEA) compared to controls (n=9). Data characterizing these lines have been previously reported but in general, select line ULEA were involved in the myogenic regulatory gene pathway.

Dose (mg/kg day) 0 1.0 3.0 10.0 SEM

Key Words: Insulin signaling, Phosphatidylinositol-3-hydroxy kinase (PI3-K), Muscle

381 Insulin signaling in bovine myogenic cells. R. A. Hill1, M. V. Dodson2, A. Gutter1, N. J. Hughes1, D. Henderson1, and T. A. Kokta1, 1University of Idaho, 2Washington State University, 3Hebrew University of Jerusalem, Israel.

Intracellular insulin-signaling pathways have been well characterized across species, but the precise mechanisms in production animals are still not clear. Insulin mediates energy substrate uptake, storage, and oxidation in peripheral tissues; promotes protein accretion (particularly in muscle) and cell proliferation. Thus, insulin-signaling pathways are complex and interact with a host of other mediators in regulation of each specific metabolic activity. Our present investigations focused upon insulin mediation of energy substrate utilization, and aimed to characterize the signaling pathways activated in bovine muscle. Our data suggest that insulin receptor (IR) signaling results in activation of phosphatidylinositol-3-hydroxy kinase (PI3-K) in primary myogenic cell (PMC) cultures. PMC were cultured in complete medium (CM), washed and exposed to various insulin concentrations (850, 85, 8.5 or 0.85 nM) in a defined medium, or CM control for 24 hr. Cells were then rapidly frozen in liquid nitrogen and the cell lysate harvested and stored at -80°C. Lysates were immunoprecipitated with specific anti-insulin receptor antibodies or anti-PI3-K antibodies, resolved on SDS-PAGE, transferred to nitrocellulose and total and phosphorylated specific protein detected using the Li-Cor Odyssey infrared imaging system. Precipitating antibodies (raised in rabbits, used for total protein detection) or anti-phosphorytosine antibodies (raised in mice, for detection of phosphorylated proteins) were used for simultaneous evaluation of immobilized proteins on immunoblots. Phosphorylated proteins were expressed as a proportion of total specific protein detected. Approximately 0.01 IR appeared to be phosphorylated, and no variation across treatments was detected (P>0.5). However, PI3-K was detected as a doublet (52 and 55 kDa) and the proportion phosphorylated was greater (P<0.01) compared to CM in response to the highest insulin concentration (850 nM). At lower insulin concentrations PI3-K phosphorylation was similar to CM (P>0.5). Although a differential response in IR activation was not detected, it was evident in the highly abundant PI3-K. These data suggest that a more complete characterization of insulin-mediated activation of PI3-K and other signaling molecules in beef animals is warranted.

Key Words: Insulin signaling, Phosphatidylinositol-3-hydroxy kinase (PI3-K), Muscle

382 Two-site evaluation of the relation between in vivo and carcass dual energy x-ray absorptiometry (DXA) in pigs. A. M. Scholz1, A. D. Mitchell2, M. Foerster1, and V. G. Purser2, 1University of Munich, Experimental Farm, Germany, 2USDA, Agricultural Research Service, Beltsville, MD.

An evaluation study was performed to compare the compatibility of body composition results of two pencil-beam DXA scanners of the same manufacturer (GE Lunar, Madison). One DXA scanner (DPX-L) is located at the USDA in Beltsville and the upgraded version (DPX-IQ) at the Experimental Farm in Oberschleissheim, Germany (LVG). Pigs between 60 and 138 kg live body weight were scanned in vivo (IV) and subsequently post mortem using the right carcass (C) half (without head and viscera) as DXA reference side – with n=220 for the USDA data and n=62 for the LVG data. A linear regression was used to analyze the relationship between the in vivo and carcass data (DXA); and chemical analysis or dissection – left C half). Basically, both devices share the same technical platform. The regression coefficient (R²) for the relation between the DXA soft tissue attenuation coefficient and the DXA fat percentage (Fat%) is very high for the joint data IV and for the C data (R²=.99, √MSE<.75). Generally, there is a medium to high relation between the IV and C DXA data considering the joint data of both sites. Fat% has a R²=.66 (√MSE=.03) for the relation between IV and C half results, while lean percentage (LEAN%) has a R²=.59 (√MSE=.59). The smallest agreement between IV and C data exists for the bone mineral percentage (BM%; R²=.09, √MSE=.30). The IV and C measurement results for bone mineral density (BMD) are highly related: R²=.87, √MSE=.02 (only LVG). The R² values are higher within each of the two sites. Fat% has a R²=.79 (√MSE=3.46).

Key Words: Growth, Anabolic steroid, Broiler

and LEAN%; R² = 0.76 (√MSE=3.77) for USDA. Slightly higher relationships exist for LVG (FAT%: R²=0.85, √MSE=1.6; LEAN%: R²=0.84, √MSE=1.65; BM%: R²=0.38, √MSE=1.9). In addition, there is a high agreement between DXA fat% and chemical lipid% (IV: R²=0.84, √MSE=1.94, USDA) or dissemination fat% (IV: R²=0.74, √MSE=1.70, LVG). The observed site differences in the relationship between in vivo (IV) and carcass (C) results may depend on several factors like different genetic material (distribution of fat tissue within the body), software versions, beam hardening due to ‘age’ differences of the DXA scanners, feeding, and housing conditions. Though, there is a moderate to high general agreement between in vivo and carcass results, site-specific constraints have to be considered in multi-site studies using comparable DXA scanners.

Key Words: Dual energy x-ray absorptiometry, Body composition, Accuracy.
For the weekly collections, there were no effects of treatment or treatment x time (P > 0.1) for volume (165.1 ± 2.3 mL) or total (47.8 ± 1.1 billion) or motile (72.4 ± 0.7 %) spermatozoa. Sperm concentrations were similar between groups at wk 0 (0.18 ± 0.03 billion/mL) but from then on were generally higher for L-carnitine-treated boars (treatments x time, P < 0.01). During the intensive collections, volume was affected by treatment (P = 0.07; controls: 176.4, L-carnitine: 144.5, SE = 12.1) but not treatment x time (P > 0.1). Sperm concentration was affected by treatment x time (P < 0.01), with concentrations being higher for L-carnitine-treated boars on d 0, 1, and 2, but not 3 (0.12 ± 0.07 billion/mL). Total spermatozoa was not affected by treatment or treatment x time (P > 0.1). Overall, there were no consistent positive effects of dietary L-carnitine supplementation on semen characteristics in boars.

Key Words: L-carnitine, Semen, Boars

388 Vitamins B9 (folic acid), B12 and methionine in growing-finishing pigs. A. Giguere*, C. L. Girard, and J. J. Matte, Agriculture and Agri-Food Canada, Lennnow (QC), Canada.

The utilization of dietary methionine and its modulation by the supply in vitamins B9 and B12 was investigated in growing-finishing pigs using criteria such as growth performance, serum vitamin B12, sulfur amino acids and urea N. Seventy-eight pigs were distributed in 13 repetitions of six factorial treatments with (M) or without (C) supplements of 0.2% synthetic DL-methionine (Met) and 3 combinations of dietary additions of vitamins B9 (ppm) and B12 (ppb), respectively, 0 and 0 (V1), 10 and 25 (V2) and 10 and 150 (V3). The basal corn-soybean meal diet contained 0.25 and 0.28% of Met (0.32 and 0.27%) of cysteine (Cys) for growing and finishing periods, respectively. Growth performance was recorded and blood samples were collected every 2 wk during 8 wk for determinations of serum B12, homocysteine (Hcy), Met, Cys, FRAP (as total antioxidant activity) and TBARS (as an index of oxidative stress). During the growing period (0 to 4 wk), ADG tended to be higher (P<0.08) in M than in C pigs (1.07 ± 0.02 vs.1.02 ± 0.02 kg/day, respectively), an effect probably related to a decrease (P<0.05) of feed conversion ratio, 5.1 ± 0.4 for M and 2.43 ± 0.04 for C pigs, respectively. During the finishing period (4 to 8 weeks), ADG tended to be higher (P<0.07) in V2 than in V1 pigs (1.0 ± 0.03 and 1.04 ± 0.02 kg/day, respectively), and apparently linked to an increase (P<0.05) in ADFI (3.10 ± 0.6 to 3.28 ± 0.08 kg/day for V1 and V2 pigs, respectively). There was no treatment effect on profiles of serum Cys (P>0.13), Met (P>0.12), FRAP (P>0.15) and TBARS (P>0.17). Plasma B12 was increased (P<0.01) (137.7 ± 4.8, 185.3 ± 6.4, 212.3 ± 9.0 nM for V1, V2 and V3 pigs, respectively) and Hcy was decreased (P<0.01) (23.6 ± 0.5, 19.9 ± 0.6, 18.1 ± 0.5 µM for V1, V2 and V3 pigs, respectively) by the vitamin treatments. There was no interaction between Met and vitamin treatments whatever the criteria. Additional Met, during the growing period, and the additional supplements of B9 and B12, during the finishing period, appeared beneficial for growth performance. The importance of the Hcy response to B9 and B12 remained to be further investigated on other aspects of metabolism in pigs.

Key Words: Vitamins, Methionine, Pigs

389 Transport of zinc chloride radiotracer in small intestine brush border membrane vesicles prepared from weanling pigs. C. E. Huntington1, D. W. Bollinger1, J. S. Morris2, and T. L. Veum2, 1University of Missouri, Columbia, MO USA, 2University of Missouri Research Reactor Columbia, MO USA.

This study was conducted to measure the transport of Zn into a pig intestinal brush border membrane vesicle (BBMV) preparation using radiolabeled Zn with cellulose as the carrier. Fresh samples of duodenum, jejunum and ileum were obtained from the small intestines of five crossbred pigs at 21 days of age. The BBMV were prepared using a magnesium chloride aggregation method. Assays for two apical enzyme markers, sucrase and alkaline phosphatase, were used to determine the purity of the BBMV. An increase in the marker enzymatic activities in the BBMV indicates an increase in the markers relative to crude lysate. An in vitro procedure designed to simulate the digestive system of the pig (Liu et al., 1998; Tsunoda et al., 2001) was used to ‘digest’ the sample prior to BBMV uptake studies. Preliminary trials with non-radiolabeled Zn found effective digestion of Zn with cellulose carrier between 0.25-0.5 g. Based on these results, we conducted transport assays at 2.0 and 10.0 ppm Zn as ZnCl4 with 65Zn radiotracer using the BBMV to determine Zn uptake. T1/2 of Zn uptake in duodenum was between 1.0 and 2.5 minutes. Maximal duodenal uptake at 2.0 and 10.0 ppm Zn was ~12.0 and 27.0 nmol Zn/mg protein, respectively. In the jejunum, T1/2 of Zn uptake was less than 1 minute. Maximal jejunal uptake at 2.0 and 10.0 ppm Zn was ~3.5 and 9.0 nmol Zn/mg protein, respectively. T1/2 of Zn uptake in ileal vesicles was between 1.0 and 2.5 minutes. Maximal ileal uptake at 2.0 and 10.0 ppm Zn was ~6.0 and 25.0 nmol Zn/mg protein, respectively. This suggests that BBMV from the duodenum and the ileum have a higher capacity for Zn uptake than the jejunum. This in vitro technique will allow us to determine if the rate of Zn transport in BBMV is affected by dietary source and concentration of Zn, factors that are important in minimizing supplementation and reducing excretion in manure.

Key Words: Weanling pigs, Zinc transport, Small intestine

390 Available phosphorus requirement to maximize growth and bone mineralization in 24 to 50-kg pigs. R. W. Fent1, G. L. Alle1, D. M. Weibel2, J. D. Spencer2, A. M. Gaines1, D. C. Kendall1, and J. W. Frank1. 1University of Missouri-Columbia, 2United Feeds Inc., Sheridan, IN

Eighty barrows initially weighing 23.7 kg BW were utilized in a 30-d feeding experiment to determine the dietary available phosphorus (aP) concentration for growth performance and bone mineralization. Prior to experimentation, pigs received dietary aP concentrations as recommended by NRC (1998) from weaning to 24 kg BW. Pigs were individually penned and allotted by weight to one of eight dietary treatments in a completely randomized design with eight replications per treatment. Experimental diets were formulated with varying concentrations of 0.975% Ca in the diet to maintain a 2:1 molar ratio of monosodium phosphate (MSP). All diets were corn-soybean meal based (1.15% true digestible lysine) and formulated to a fixed 1.21 calcium:total P ratio. The basal diet contained no added MSP. Average daily gain (ADG) was measured and feed intake calculated at the end of the 30-d test period. Breaking load and ash content of the left fibula were also determined on all pigs at termination of the experiment. ADG increased (quadratically, P = 0.05) as aP concentration increased in the diet with ADFI having a tendency to increase quadratically (P = 0.09). Bone breaking load, grams of fibula ash, and percentage of fibula ash increased quadratically (P < 0.01) as dietary aP concentration increased. Two-slope regression was performed to estimate dietary aP requirements. Although the growth responses to increasing aP did not lend itself to accurate break-point analysis, the point of inflexion for bone breaking load and grams of fibula ash both occurred at 0.32% dietary aP concentration. These results indicate a dietary aP requirement of 0.32% for maximal bone mineralization for the 24 to 50-kg pig.

Key Words: Phosphorus, Pigs, Bone


Pigs were self-fed diets containing 2, 3, 4, 5, 6 or 7% bioavailable P (aP*, based on analyzed P x % availability [NRC, 1998] of P in each ingredient) from 7 to 32 kg BW. Fifteen sets of six littermate barrows were allotted within litter to one of six P regimens consisting of a basal, corn-soy-whey diet (.56% P supplemented with incremental additions of dicalcium phosphate at the expense of starch-limestone. Dietary calcium was either fixed in each of 6 diets at 1.15% (1.1 to 1 g P/total P ratio in highest P diet) or adjusted in each diet to achieve a 2.5 to 1 Ca/aP ratio. P and N digestibility and accretion were determined in each pig for 4 days at BW (± 1.3 kg) of 10 and 30 kg. Digestible dietary P (dP) was determined to be .32, .42, .51, .56, .63 and .70% for the 6 regimens. The P digestibility values for the basal and dP were 1.6 and 1.7 times, respectively, of the bioavailable mineral values. Daily body P accretion (3.1, 4.1, 5.1, 5.5, 5.6, 6.0 g, P<0.01) and N accretion (22.6, 24.2, 26.2, 26.0, 23.5, 25.2 g, P<0.03) increased but at a diminishing rate (quadratic response) as dietary concentrations of dP increased (pooled across Ca/P regimen and BW). The magnitude of responses in P accretion to increased dP was greater (P<0.05) in 2.5/1 Ca/aP regimen and at 12-wk of age compared to 3.0/1 Ca/aP regimen (1.3 kg) of 10 and 30 kg BW. These results indicate a dietary aP requirement of 0.32% for maximal bone mineralization for the 24 to 50-kg pig.
increased with the greatest responses in body P contents occurring in the 2.5:1 Ca/aP regimen and at 10 kg BW. Based on these data, the dietary dP concentration needed to optimize accretion of proteinous tissues as well as efficiency of phosphorus utilization in 10 to 30 kg pigs is 0.48-0.53% in both Ca/P regimens. But, the biological response (i.e., accretion-excretion of P) to ingestion of higher amounts of dP is dependent on the dietary Ca/dP regimen which influences whether the additional dP is retained (likely in bone because N accretion not altered) or excreted in urine.

Key Words: Phosphorus, Nitrogen, Calcium

### 392 Evaluation of EcoPhos™ phytase in growing pigs weighing 36 to 56 kg. R.W. Fenton1, D.M. Weibel2, J.D. Spencer3, T.S. Torrance4, B.W. Ratliff5, and G.L. Allee1, 1University of Missouri-Columbia, 2United Feeds Inc., Sheridan, IN.

Sixty-four barrows initially weighing 35.7 kg BW were utilized in a 24-d feeding experiment to examine the phosphorus-releasing efficacy of increasing dietary concentrations of phytase (EcoPhos™, Phytex LLC, Portland, ME). Pigs were individually penned and allotted by weight to one of eight dietary treatments in a randomized complete block design with eight replications per treatment. A corn-soybean meal-based basal diet (1.0% digestible lysine) was formulated to contain 0.06% available phosphorus (aP) (0.71% calcium). A standard curve, from which bioavailable phosphorus release could be calculated, was achieved by supplementing nonosodium phosphate to the basal diet at 0.06, 0.12, and 0.18%. Four concentrations (250, 500, 1000, and 2000 FTU/kg) of phytase premix were added to the basal diet to comprise the other four experimental diets. Average daily gain (ADG) was measured and feed intake calculated at the end of the 24-d test period. Following termination of the experiment, breaking load and ash content of the right fibula were also determined for all pigs. Increasing aP quadratically increased ADG (P < 0.01) and gain/feed (P < 0.03). No effect (P > 0.10) was observed for feed intake. Bone breaking load and grams of fibula ash increased linearly (P < 0.02 and P < 0.01, respectively) with increasing dietary aP from MSP. Increasing phytase supplementation from 0 to 2000 FTU/kg quadratically increased ADG (P < 0.01) and gain/feed (P < 0.01). Phytase supplementation quadratically increased grams of fibula ash (P < 0.01) and linearly increased bone breaking load (P < 0.06). Based on the linear regression of grams of fibula ash on supplemental phytase intake (r² = 0.50), phosphorus-releasing values for 250, 500, 1000, and 2000 FTU/kg dietary phytase concentrations were 0.136, 0.140, 0.184, and 0.196%, respectively. These results demonstrate the efficacy of EcoPhos phytase to improve the availability of dietary phosphorus for the 36 to 56-kg pig.

Key Words: Phytase, Phosphorus, Pigs

### 393 Effects of a solid-state fermented phytase on growth performance, bone traits and P digestibility of growing pigs fed corn-soybean meal diets containing wheat middlings. J. S. Park*, J. D. Schneider‡, T. B. Morillo†, and J. L. Pierce‡, 1Oklahoma State University, Stillwater, 2Alltech, Inc., Nicholasville, KY.

A total of 24 barrows (avg BW = 20.9 kg) was used in a 35-d study to determine the effects of the addition of a solid-state fermented phytase complex (Allzyme SSF; Alltech, Inc) to low available P, corn-soybean meal (SBM) diets containing 20% wheat middlings (WM) on growth performance, bone traits, and P utilization. Pigs were blocked by weight and ancestry, and randomly allotted to one of four dietary treatments (6 pigs/trt). A basal diet (Diet 1) consisted of corn, SBM, and WM (20%) and was adequate in all nutrients, except available P. This diet contained 0.50% total P (0.13% avail. P), all of which was provided by corn, SBM, and WM. Diets 2 and 3 were the basal plus SSF to provide 250 and 500 phytase units (PU)/kg, respectively. The positive control diet (Diet 4) was corn-SBM-based with 20% corn starch (0.50% total P; 0.24% avail. P). All diets were formulated to contain 0.06% estimated available P, 129 mg/kg Zn). Diets included three graded levels of supplemental Zn from two sources on the efficacy of phytase in promoting levels of Zn from two sources on the efficacy of phytase in young pigs fed phosphorus (P)-deficient diets. Ninety-nine individually-fed pigs (7.2 kg) were given ad libitum access to one of 11 experimental diets for a period of 21 d. Pigs were fasted overnight before final body weights were taken, after which the five median-weight blocks of pigs were euthanized and the right fibula was harvested for determination of bone ash. Fibula ash (mg) was regressed against supplemental inorganic P (iP) intake (g) to set up the standard curve to which phytase treatments were compared to determine iP-releasing efficacy. The basal diet was a corn/SBM-based meal diet with no supplemental P (21% CP, 0.075% estimated available P, 129 mg/kg/Kg). Diets included three graded levels of supplemental iP (0, 0.075, 0.150%) from reagent-grade KH₂PO₄, two levels of phytase (500 and 1,000 FTU/kg) from EcoPhos™ (Phytex LLC, Portland, ME), 1.500 mg/kg of Zn from either Waclaw ZnO or tetra-basic Zn chloride (TBZC, ZnCl₂·OH₂), Micronutrients Corp., Indiana, IN), and all combinations of EcoPhos™ and Zn. All response criteria responded linearly (P < 0.01) to supplemental iP. EcoPhos™ improved (P < 0.01) weight gain, feed intake and gain/feed ratio, as well as fibula ash (% and mg). Bone ash (mg) was highest (P < 0.01) for 1,000 FTU/kg EcoPhos™. Supplemental Zn had no effect (P > 0.10) on growth performance, but reduced (P < 0.05) fibula ash (% and mg) and feed intake. Fibula ash on supplemented iP and iP intake responded in an excellent fit (r² = 0.87). In the absence of Zn, 500 FTU/kg of EcoPhos™ released 0.130% iP, while in the presence of TBZC or ZnO.

Key Words: Phytase, Pigs, Bone

### 394 Comparative effectiveness of Aspergillus niger wild-type and variant phytases in the hydrolysis of phytate-phosphorus in the diets for weaning pigs. S. E. Crowe*, T. W. Kim, K. R. Roncker, and X. G. Lei, Cornell University, Ithaca, NY, USA.

Aspergillus niger PhyA phytase has a pH optimum (5.5) above the pH level in the stomach of swine. To improve its feeding efficacy, we have developed a series of PhyA mutants with altered pH profiles. The objective of this experiment was to test the relative effectiveness of two mutants with single mutations in the 300th amino acid sequence (Lys300Arg, Lys300Thr), compared with the wild-type enzyme, in diets for young pigs. Thirty-five male weaning pigs (5-wk old, 9.5 kg BW) were divided into five treatment groups. A corn-soybean meal basal diet (BD, no added inorganic phosphorus) was fed for 4 wk to each of the groups either alone, with 0.15% inorganic phosphorus, or with wild-type, Lys300Arg, or Lys300Thr phytases at 300 units per kg feed. At the end of the trial, pigs fed BD alone had lower (P < 0.05) ADG, ADFI, and plasma inorganic phosphorus concentration, but higher (P < 0.05) plasma alkaline phosphatase activity than those fed BD + 0.15% inorganic phosphorus. Pigs fed the wild-type enzyme had improved growth performance and higher (P < 0.05) plasma inorganic phosphorus concentration than pigs fed BD. However, there was no significant difference in any of the measures between the pigs fed the wild-type and the mutant enzymes. In conclusion, the two mutants did not show efficacy improvements over the wild-type enzyme, indicating possible inadequate alterations in pH profile of these two mutants or inappropriate dietary and stomach conditions in the present study for an overall feeding effectiveness difference.

Key Words: Phytase, Pig, Mutation

### 395 Pharmacological levels of zinc reduce phytase efficacy in vitro. N. R. Augspurger1, D. M. Weibel2, J. D. Spencer2, and D. H. Baker1, 1University of Illinois at Urbana-Champaign, 2United Feeds Inc., Sheridan, IN.

The efficacy of phytase has been shown to be negatively affected by zinc (Zn) and several other cations in vivo (Maenz et al., 1999). Therefore, the objective of this work was to determine the effect of growth-promoting levels of Zn from two sources on the efficacy of phytase in young pigs fed phosphorus (P)-deficient diets. Ninety-nine individually-fed pigs (7.2 kg) were given ad libitum access to one of 11 experimental diets for a period of 21 d. Pigs were fasted overnight before final body weights were taken, after which the five median-weight blocks of pigs were euthanized and the right fibula was harvested for determination of bone ash. Fibula ash (mg) was regressed against supplemental inorganic P (iP) intake (g) to set up the standard curve to which phytase treatments were compared to determine iP-releasing efficacy. The basal diet was a corn/SBM-based meal diet with no supplemental P (21% CP, 0.075% estimated available P, 129 mg/kg/Kg). Diets included three graded levels of supplemental iP (0, 0.075, 0.150%) from reagent-grade KH₂PO₄, two levels of phytase (500 and 1,000 FTU/kg) from EcoPhos™ (Phytex LLC, Portland, ME), 1.500 mg/kg of Zn from either Waclaw ZnO or tetra-basic Zn chloride (TBZC, ZnCl₂·OH₂), Micronutrients Corp., Indiana, IN), and all combinations of EcoPhos™ and Zn. All response criteria responded linearly (P < 0.01) to supplemental iP. EcoPhos™ improved (P < 0.01) weight gain, feed intake and gain/feed ratio, as well as fibula ash (% and mg). Bone ash (mg) was highest (P < 0.01) for 1,000 FTU/kg EcoPhos™. Supplemental Zn had no effect (P > 0.10) on growth performance, but reduced (P < 0.05) fibula ash (% and mg) and feed intake. Fibula ash on supplemental iP and iP intake responded in an excellent fit (r² = 0.87). In the absence of Zn, 500 FTU/kg of EcoPhos™ released 0.130% iP, while in the presence of TBZC or ZnO.
P-release values were reduced (P < 0.01) to 0.085 and 0.099% P, respectively. At 1.000 FTU/kg of EcoPhos™ Zn reduced (P < 0.01) P-releasing efficacy from 0.195% P to 0.140 and 0.124% P for the TBZC and ZnO treatments, respectively. These results suggest that growth-promoting levels of Zn chelate the phytate complex, thereby reducing its availability for hydrolysis by phytase.

Key Words: Pigs, Phytase, Zinc

396 Differences in total tract and ileal digestibility coefficients of calcium and phosphorus in growing pigs fed low phytate corn, normal corn, soybean meal, and corn soybean meal based diets. R. A. Bohle*, H. H. Stein, A. R. Wirt, and R. C. Thaler, South Dakota State University.

The primary objective of this experiment was to determine the apparent ileal digestibility coefficients (AID) and the apparent total tract digestibility coefficients (ATTD) of calcium (Ca) and phosphorus (P) in low phytate corn (LPC), normal corn (NC), soybean meal (SBM), and corn-soybean meal-based diets by growing pigs. The second objective was to determine if there were differences between the AID and the ATTD for Ca and P. Eight diets were formulated and fed to nine growing barrows. Three diets contained LPC, NC, and SBM as the sole source of Ca and P. Three similar diets contained supplemental inorganic Ca (iCa) and P (iP) to bring the contents up to the requirements of the animals (i.e. 0.5% Ca and 0.2% digestible P). Two diets containing LPC-SBM and NC-SBM were also supplemented with iCa and iP to reach the animals requirements. Each diet was fed to the pigs for nine days with ileal digesta being collected from 0800 to 2000 on d 8 and d 9. Fecal samples were collected on d 7 and d 8. The AID and the ATTD (70 and 69%, respectively) of Ca in LPC were higher (P < 0.05) than in NC (47 and 50%) and SBM (51 and 47%). The addition of iP did not affect (P > 0.05) the AID or the ATTD of Ca for any of the three feed ingredients. No differences (P > 0.05) in the AID of Ca were found between the LPC-SBM (55%) and NC-SBM (51%) diets. The AID and the ATTD of P in the LPC diet were higher (P < 0.05) than that of the NC and SBM diets (57 and 55% vs. 28 and 29% and 37 and 38%). When iP was added to NC and SBM, the AID and the ATTD of P increased (P < 0.05). However, the addition of iP did not (P > 0.05) improve the AID or the ATTD of P in LPC. For both Ca and P, there were no differences (P > 0.15) between the AID and the ATTD. In conclusion, LPC has a higher Ca and P digestibility than NC and SBM. There appears to be no net absorption or excretion of Ca and P in the large intestine of growing pigs fed corn or soybean meal based diets.

Key Words: Pigs, Digestibility, Low phytate corn

397 Phytase additions to conventional or low-phytate corn-soybean meal diets on performance, bone traits, and phosphorus excretion of growing pigs. E. G. Xavier*, G. L. Cromwell, and M. D. Lindemann, University of Kentucky, Lexington.

Effects of phytase in diets containing low-phytate (LP) or normal (N) corn and LP, low-oligosaccharide or N soybean meal (SBM) were evaluated. The corn and SBM were provided by Pioneer Hi-Bred International, Johnston, IA. The LP-corn, N-corn, LP-SBM, and N-SBM contained 0.26, 0.31, 0.77, and 0.70% total P and 0.09, 0.25, 0.22, and 0.48% phytate P with estimated P bioavailabilities of 75, 20, 50, and 20%, respectively. Individually-penned pigs (six/treatment) were fed eight corn-SBM diets (1.05% lysine, 0.65% Ca) from 15 to 42 kg (40 d). Diets 1-5 were N-corn + N-SBM with 0.20, 0.10, 0.10, 0.00, and 0.00% added P from monocalcium phosphate. Diets 6-8 were LP-corn + LP-SBM with 0.10, 0.00, and 0.00% added P. Phytase (Natuphos™, BASF) was added to Diets 3, 5, and 8 at 750 units/kg. The N and LP diets without added P contained 0.39 and 0.37% total P and 0.08 and 0.23% bioavailable P, respectively. Diet 1 met the P requirement for pigs of this weight range (NRC, 1998). At termination, metatarsals, metacarpals, and femurs were obtained from all pigs. Reducing dietary P negatively affected (P < 0.01) growth rate, feed/gain, and mean bone strength (relative to pigs fed Diet 1) to a greater extent in pigs fed N vs LP diets (751, 790, 723, 571, 760, 785, and 706 g/d; 1.80, 1.95, 2.01, 2.55, 2.25, 1.86, 1.87, and 1.88; 100, 73, 98, 45, 67, 103, 78, and 97 for Diets 1-8), and phytase prevented (P < 0.01) some of the effects of reducing dietary P level. Apparent digestibility of P (using Cr2O3) for Diets 1-8 was 44, 33, 49, 25, 40, 60, 55, and 70% (P < 0.01). FECAL P excretion was influenced (P < 0.01) by type of corn-SBM, P level, and phytase addition (4.49, 4.45, 3.67, 4.26, 3.39, 2.79, 2.11, and 1.45 g/d). Soluble P in feces was low (1.69, 1.74, 1.61, 1.56, 1.96, 1.81, 1.94, and 2.16% of total P), but increased when phytase was added to the low-P, N (P < 0.01) or LP (P < 0.05) diets. The results indicate that growing pigs fed LP-corn and LP-SBM require less P to optimize performance and bone density; and when phytase is included in LP-corn-SBM diets, pigs excrete up to 68% less fecal P than pigs fed conventional corn-SBM diets without phytase.

Key Words: Pigs, Phosphorus, Phytase

Physiology: Nutrition-reproduction, stress, and growth

398 Effects of experimental fascioliasis on pubertal development in heifers. M. J. Paczkowski*, T. M. Craig, D. D. Magee, J. A. Thompson, and D. W. Forrest, Texas A&M University, College Station, TX. 

Angus-sired heifers were allotted by age (mean=4 mo), BW (mean=135 kg), and sire (n=4) to either a control (uninfected, n=10) or infected group (n=11). Metacercariae of Fasciola hepatica were administered (intraruminally, d 0) to study effects on interval to puberty, circulating ovarian steroids, serum liver enzymes and BW. Blood samples were collected bimonthly from d 0 to 56 and biweekly from d 60 through 210 for analysis of serum estradiol 17β (E2) and progesterone (P4) concentrations by RIA. At 2-wk intervals, BW was recorded, a blood sample was obtained to quantify serum aspartate-aminotransferase (AST) and γ-glutamyltranspeptidase (GGT) and a fecal sample was collected to assess excretion of F. hepatica eggs. Puberty was defined by the occurrence of the first luteal phase (serum P4 concentrations >1.0 ng/ml for a minimum duration of 10 d). A univariate ANOVA using the RANDOM statement in PROC GLM was used to determine significant linear and curvilinear responses to treatment in prepubertal heifers (from d 0 to 113) for BW, E2, P4, AST, and GGT. Treatment effects at d 113 were determined by one way ANOVA. F. hepatica eggs were detected in all infected heifers after day 92. Linear (P<0.01) and curvilinear (P<0.05) responses for GGT concentrations were detected over time in infected heifers. On d 113, mean GGT concentrations were higher (P<0.01) in infected than in control heifers (116.4 ± 31.2 vs 20.2 ± 2.8 U/L, respectively). Mean BW, serum AST, E2, and P4 concentrations did not differ between treatment groups on d 113. By d 210, 60% (six of 10) of heifers in the control group and 36% (four of 11) of heifers in the infected group attained puberty. We conclude that F. hepatica infection induced elevated levels of serum enzymes which are indicative of liver damage, and there was a more persistent elevation in GGT than the elevation in AST levels. Experimental fascioliasis resulted in a lower percentage of heifers that reached puberty within 7 mo of infection as compared to control heifers.

Key Words: Heifer, Fascioliasis, Puberty

399 Leptin modulates fertility in oMt1a-oGH transgenic mice. A. T. Thomas*, T. R. Famula, J. D. Murray, and A. M. Oberbauer, University of California, Davis, California.

Elevated growth hormone (GH) changes body composition and suppresses fertility in livestock and rodents. The ovine metallothionein 1a-ovine growth hormone (oMt1a-oGH) transgenic mouse model allows the study of GH effects on body composition and fertility, as the transgene is easily activated and inactivated to express GH by provision of 25 mM zinc in the drinking water. Chronic expression of the transgene results in a lean phenotype and activation followed by inactivation of the transgene causes obesity. Plasma leptin concentrations reflect adipose stores within the body and also influence reproduction. We hypothesize that reproductive function will be reduced in oMt1a-oGH mice due to elevated leptin levels. Thus, the purpose of this study was to determine how fertility changes as a function of body composition
and how plasma leptin levels vary with transgene expression and reproductive performance in oMt1a-oGH mice. At weaning oMt1a-oGH transgenic (TG) and wild type (WT) females were allocated to a treatment: oMt1a-oGH females chronically expressing the transgene (TG ON, n=170), oMt1a-oGH females expressing the transgene from 3 to 8 weeks of age (TG ON/OFF, n=172), WT females receiving the transgene stimulus from 3 to 8 weeks of age (WT ON/OFF, n=177), and WT females never receiving the transgene stimulus (WT OFF, n=190). Eight-week-old females were housed with males for a 2-week period, after which females were isolated from males and allowed to carry pregnancies to term. Body and gonadal fat pad (GFP) weight, plasma leptin concentrations, and pregnancy rate for each animal were recorded. The transgene stimulus did not affect any parameter measured in the WT animals (P>0.1) and the data for the WT animals were pooled. TG ON mice were larger and leaner than TG ON/OFF mice that became obese (P<0.001). Plasma leptin correlated with GFP (r²=0.63) and were approximately 2 and 2.5 fold higher in TG ON/OFF than WT and TG ON, respectively (P<0.05). Leptin was elevated in infertile versus fertile females in all groups, suggesting that elevated leptin, reflecting altered adipose depots, in combination with GH, may impair fertility in these animals.

**Key Words:** Leptin, Obesity, Infertility

### 400 Oxirin-B modulates LH and GH secretion: Interaction with the brain-pituitary axis in the pig. C. R. Barb*1, J. B. Barrett1, R. R. Kraeling1, and R. L. Matteri2, 1USDA-ARS, Athens, GA, 2USDA-ARS, Columbia, MO.

Two experiments (EXP) were conducted to test the hypothesis that oxirin-B (OXB) and ghrelin interact with the brain-pituitary axis in the pig. In EXP I, peripheral gut rec- ceived intracerebroventricular (ICV) injections of 0.9% saline (S; n = 2), 10 µg (n = 2) or 100 µg (n = 2) of oxirin-B in S. Blood was collected every 15 min for 2 hr before and 2 hr after ICV injections. In EXP II, anterior pituitary cells from prepuberal guts were studied in primary culture. On d 4 of culture, 105 cells/well were challenged with 10−5 M GnRH, 10−6 M GnRH, 10−7 M GnRH, or 10−8 M [Ala12]-hGRF-(1-29)NH2 or 10−10, 10−9, 10−8 or 10−7 M OXB. LH and GH secretion (secreted LH and GH were measured at 4 hr after treatment. In EXP I, serum LH and GH concentrations were similar among pigs before treatment and were unaffected by oxirin-B treatment; averaging 0.3, 0.2, 0.2 and 0.2 ng/ml for LH and 2.1, 3.4, 6.1 and 3.4 ng/ml for GH after ICV injection of S, 10 µg or 100 µg oxirin-B, respectively. In EXP II, basal LH and GH secretion (control; n = 9 wells) was 183 ± 18 and 48 ± 11 ng/ml. Relative to control at 4 hr, all doses of GnRH and GRF increased (P<0.001) LH and GH secretion. All doses of oxirin-B increased (P <0.001) GH secretion, while only the 10−6 M dose increased (P<0.005) LH secretion. Secreted LH and GH were unaffected by addition of 10−9, 10−8 or 10−7 M OXB in combinations with 10−10 and 10−6 M GnRH or 10−8 and 10−6 M GRF compared to GnRH or GRF alone, except 10−9 M oxirin-B suppressed (P<0.02) the LH response to 10−6 M GnRH. These results indicate that oxirin may directly modulate LH and GH secretion at the level of the pituitary gland, but not the brain.

**Key Words:** Oxirin, Hormone, Pig

### 401 Associations among circulating concentrations of IGF-1 and GH during the postpartum period with re- sumption of estrus, calf weights, and milk production in mature crossbred cows fed varying levels of energy intake. A. J. Robertson1, T. G. Jenkins, 2USDA-ARS, Fort Keogh LARRL, Miles City, MT, 2USDA-ARS, MARC, Clay Center, NE.

Circulating concentrations of IGF-1 and GH fluctuate in response to nutritional status. Objectives of this study were to evaluate usefulness of circulating profiles of IGF-1 and GH during the postpartum period as predictors of capacity to resume estrus and level of milk production (in calf growth). Mature crossbred cows produced from Angus, Hereford, Shorthorn, Galloway, Longhorn, Nellore, or Salers sire breeds were fed at 132 or 189 kcal ME/kg metabolic BW or ad libitum (6 to 8 cows/sire breed/feed level). Concentrations of progesterone in weekly blood samples collected 2 through 14 wk post-calving were used to estimate length of anestrus. Correlations of IGF-1 and GH concentrations in samples collected at wk 2, 4, 8, and 14 postpartum. With in-cow samples collected were used to obtain estimates (i.e., slopes) of changes in IGF-1 and GH concentrations over time. Analyses of covariance were used to evaluate linear effects of concentration at wk 2 and slope of IGF-1 or GH, fixed effects of sire breed, and interactions among linear and fixed effects on length of anestrus, peak week and level of milk production, and adjusted weaning weight (WW) of calf. Breed of sire accounted for variation (P <0.02) in all variables except peak week of milk pro-duction. Length of anestrus was influenced (P<0.03) by interactions between IGF-1 covariate terms with breed of sire. Peak level of milk pro-duction was associated negatively (P<0.01) with IGF-1 at wk 2. Time of peak milk production was influenced (P<0.1) by the interaction of GH at wk 2 with breed of sire. Adjusted WW of calf was associated negatively with both GH covariate terms (P<0.01). Within breed, ini- tial concentrations (wk 2) and pattern of change in IGF-1 and (or) GH concentration during the postpartum period are predictive of capacity to resume cycling and potential for productivity (milk and calf wt).

**Key Words:** GH, IGF-1, Postpartum

### 402 Endocrine responses to 72 h feed deprivation in weanling pigs. B. E. Salen,1 J. A. Carroll1, and D. H. Keisler2, 1Animal Physiology Research Unit, Agricultural Research Service-USDA, 2University of Missouri-Columbia.

The study objective was to assess endocrine and tissue responses to 72 h feed deprivation in weanling pigs. Thirty-two barrows were weaned at 18 d of age and placed on a complex nursery diet. At 27 d of age, pigs were surgically fitted with an indwelling jugular vein catheter. Starting at 28 d of age, pigs were either fed for 72 h (CON72; n = 8), fed for 96 h (CON96; n = 8), fed deprived for 72 h (FD72; n = 8), or FD72 and then re-fed from 72-96 h (FD72/RF24; n = 8). Pigs were sacrificed at 18 d of age (CON72 and FD72) or 96 h (CON96 and FD72/RF24) for collection of tissues. Body weights were determined at cannulation and sacrifice, and feed consumption was determined at 23 d, 26 d and at sacrifice. Blood was collected at 12 h intervals starting at -12 h relative to the start of the feed deprivation period and continuing until sacrifice. Mean body weights of pigs in the FD72 treatment was less than 2 kg at sacrifice (P<0.05) however, the mean body weight of FD72/RF24 pigs did not differ from that of the CON pigs (P>0.05). Concentrations of ghrelin in the FD72 and FD72/RF24 groups differed throughout time (P<0.001) and when presented as values relative to 0 h were 89% at 12 h (P<0.03), then increased to 112% at 36 h and 48 h (P<0.10), then decreased to 75% at 72 h (P<0.001). Serum IGF-1 and leptin decreased following feed deprivation (P<0.001) and remained low until re-feeding. Cortisol was elevated from 12 h to 72 h during feed depri-vation (P<0.01). Expression of ghrelin mRNA tended to be lower in the FD72 pigs’ stomachs, pituitary glands, and hypothalami (P = 0.06, 0.07, and 0.08, respectively), compared to CON pigs. These results provide evidence that feed deprivation is accompanied by multiple changes in the endocrine and neuroendocrine axis which influences feed intake, somatotrophic regulation and stress hormone concentrations.

**Key Words:** Piglet, Food deprivation, Weaning


The objective of this experiment was to determine if fasting during the luteal phase of the estrous cycle influenced ovarian follicular develop-ment during the ensuing proestrus. Fasted (n=15) ewes were not fed from d 7 to 12 of the estrous cycle. Control (n = 10) ewes were fed ad libitum. On d 12 ewes were treated with PGF2α and ovarian follicles presented after 0 and 2 h in control and 0, 72 and 96 h in fasted ewes were enumerated and categorized as small (<2 mm), medium (3 to 4 mm) or large (>5 mm). At 0 h, ovaries from fasted ewes contained fewer small (P <0.05) and medium (P <0.05) follicles than control [19.6 ± 9.4 (± 2.9) and 8.4 vs. 3.4 (± 1.5) for small and medium follicles, respectively]. Three fasted ewes exhibited an LH surge and ovulated by 96 h and were removed from analysis. When follicular populations were compared the remaining animals at approximately 16 to 21 h prior to the antici-pated preovulatory LH surge no differences (P = 0.63) were detected among groups. Serum concentrations of estradiol following administra-tion of PGF2α were influenced by a treatment by time interaction (P <0.01). At comparable times prior to the anticipated LH surge (i.e. 72 h in C vs. 96 h in F) concentrations of estradiol were nearly 2-fold greater in control than fasted ewes. Serum concentrations of FSH were influ-enced (P <0.01) by a treatment by time interaction and were greater
404 Effect of fish meal supplementation on endometrial sensitivity to oxytocin in beef heifers having low luteal phase progesterone.

N. E. Wamberg*, N. E. Burns, T. E. Engle, and R. M. Enns, Colorado State University, Fort Collins, CO.

The objective of this study was to evaluate the ability of n-3 fatty acids in fish meal to attenuate oxytocin-induced release of uterine prostaglandin F2a (PGF) in heifers having low luteal phase concentrations of progesterone (P4). Heifers were individually fed a corn silage-based diet supplemented with either fish meal (FM; 5% DM; n=12) or corn gluten meal (CM; 6% DM; n=13). After d 25 of supplementation, heifers were given 25 mg of PGF to induce estrus. On d 3 after estrus, half of the heifers in each supplement group were given 3 injections of PGF (25 mg/injection) at 12 h intervals to induce formation of corpora lutea that secrete lower concentrations of PGF. Jugal blood samples were collected daily from d 1 to d 16 after observed estrus and assayed for P4. On d 16, heifers were challenged with oxytocin (100 IU; iv). Jugal blood samples were collected at -60, -30, -15, 0, 15, 30, 45, 60, 90, and 120 min post oxytocin injection and assayed for 13, 14 dihydro-15-keto PGF2a (PGFM). Administration of PGF on d 3 induced low luteal phase concentrations of P4 in 5 FM heifers and 3 CM heifers. Non-responding heifers were sorted to the high luteal phase group. One FM heifer and 3 CM heifers receiving no PGF on d 3 had low luteal phase P4 and were sorted to the low group. After sorting, treatments consisted of high luteal P4 + FM (n=6), low luteal P4 + FM (n=6), high luteal P4 + CM (n=6), and low luteal P4 + CM (n=7). Dietary supplement had no effect (P>0.20) on serum concentrations of P4, but concentrations of P4 were lower in heifers in the low luteal phase group than those in the high luteal phase group (P<0.01). Serum concentrations of PGFM following oxytocin stimulation were higher in heifers having low luteal phase concentrations of P4 compared to heifers having high luteal phase P4 (P<0.01). Fish meal supplementation attenuated this response in heifers having low luteal phase concentrations of P4 (P<0.05), but had no effect on heifers having high luteal phase concentrations of P4 (P>0.10). In conclusion, the n-3 fatty acids in fish meal appear to decrease uterine PGF synthesis in heifers having low luteal phase concentrations of P4.

Key Words: Heifer, Fish meal, Prostaglandin

405 Growth hormone (GH) binding in liver of periparturient Holstein cows is correlated with growth hormone receptor (GHR) 1A mRNA. R. P. Radcliffe*, B. L. McCormack1, B. A. Cooker2, and M. C. Lucy1, 1University of Missouri, Columbia, 2University of Minnesota, St. Paul.

Growth hormone plays a central role in metabolic adaptations that occur during the initiation of lactation. The primary liver GHR transcript (GHR 1A mRNA) is transiently decreased around parturition. The decrease in liver GHR 1A mRNA may cause a reduction in GH-dependent signaling that leads to low blood IGF-I concentrations in periparturient cattle. We tested the hypothesis that the decrease in GHR 1A mRNA at parturition is associated with a decrease in GH binding (i.e., GHR protein expression) in liver. Blood and liver samples were collected from Holstein cows (n = 12) on d -12, +1, +3 and +17 relative to parturition. Total cellular RNA was isolated from a sub-sample of liver and reverse transcribed (RT) to cDNA. The GHR 1A and IGF-I cDNA were measured by quantitative real-time polymerase chain reaction. Microsomal membranes were isolated from the remaining liver sample and assayed for GH binding. Liver GHR 1A mRNA (183, 31 and 132 ± 27 fg/25 ng RT, P < 0.004), liver IGF-I mRNA (172, 31 and 83 ± 20 fg/25 ng RT, P < 0.001), and blood IGF-I concentrations (130, 55 and 71 ± 8 ng/ml on d -12, +3 and +17, respectively, P < 0.001) were coordinately decreased on d -3. A decrease (P < 0.03) in specific binding also occurred on d +3 (5.2 ± 0.8, 1.7 ± 1.0 and 5.1 ± 0.8% on d -12, +3 and +17, respectively). Across all days, GH-specific binding was correlated with GHR 1A mRNA (R² = 0.68; P < 0.001). Saturation binding analysis of pooled microsomal membranes demonstrated a 30- and a 3-fold decrease in GH receptor number (Bmax) for liver on d +3 and +17 relative to d -12 (4.95 ± 0.57, 1.61 ± 0.03 and 1.38 ± 0.06 fmole/mg protein on d -12, +3 and +17, respectively). We conclude that the decrease in GHR 1A mRNA leads to a decrease in GHR protein and a decrease in GH binding to liver. This reduced GH binding likely contributes to decreased liver IGF-I synthesis and secretion and the postpartum reduction in circulating IGF-I in periparturient cows.

Key Words: Equine, Obesity, Estrus cycle

407 Characterization of equine bacterial artificial chromosomes (BACs) relevant to endocrine and immune system regulation. T. M. Bryan*, C. A. Abbey, T. Raudsepp, B. P. Chowdhary, C. A. Gill, T. L. Blanchard, N. H. Ing, and T. H. Welsh, Jr., Texas A&M University System College Station.

The long-term objectives of this project are to increase the number of endocrine and immune system genes on the horse cytogenetic map and to develop horse specific cDNA probes for use in physiological studies. The glucocorticoid (GR), luteinizing hormone (LHR), and Toll-like receptors (TLR4) are pivotal regulators of adrenal, gonadal, and immune functions, respectively. Consensus primer sequences were designed for the GR, LHR and TLR4 using multiple species sequence alignment.

Based on human genome sequence data, these genes are predicted to develop horse specific cDNA probes for use in physiological studies. The glucocorticoid (GR), luteinizing hormone (LHR), and Toll-like receptors (TLR4) are pivotal regulators of adrenal, gonadal, and immune functions, respectively. Consensus primer sequences were designed for the GR, LHR and TLR4 using multiple species sequence alignment.

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A BAC clone amplifying a product of the expected size has been identified for TLR4 and will be verified by sequencing prior to FISH. These methods overcome the disadvantage associated with limited availability of whole genomic sequence information for domestic animals. Confirmed sequence analysis of equine BAC clones permits chromosome assignment and physiological investigation of genes that are primary regulators of stress responsiveness, fertility and immunity in the horse.

Key Words: Glucocorticoid receptor, Luteinizing hormone receptor, Toll-like receptor 4

408 Breedtype influences adrenal responsiveness to corticotropin-releasing hormone (CRH) in beef steers. R. J. Hollenbeck1,2, D. A. Neudorff2, A. W. Lewis2, T. A. Strauch2, R. D. Rande12, and T. H. Welsh, Jr.1, 2 Texas Agricultural Experiment Station, College Station, 2Texas Agricultural Experiment Station, Overton.

Adrenal responsiveness to exogenous bovine CRH was studied using Angus, Brahman, Bonsmara and Bonsmara X Angus steers (BW=3323 kg; n=6 for each breedtype). Blood samples were collected via indwelling jugular cannula at 120, 90, 60, and 30 min prior to, and at 10, 20, 30, 60, and 120 min after CRH administration (Time 0; 0.1 ug/kg BW). Plasma cortisol (CS) concentration was determined by RIA. During the 120-min period prior to CRH administration Brahman steers had higher plasma CS (19.32 ng/ml) than Angus (14.22 ng/ml, P<0.01), Bonsmara X Angus (11.32 ng/ml, P<0.01), and Bonsmara (6.92 ng/ml, P<0.01). Plasma CS did not differ (P>0.10) among breeds at Time 0. Amplitude of the CS response was lower (P=0.08) in Bonsmara X Angus (14.33 ng/ml) than Angus (22.73 ng/ml), Bonsmara (20.43 ng/ml) and Brahman steers (20.33 ng/ml); peak plasma CS was greater in Angus (18.53 ng/ml, P<0.07) and Brahman steers (28.73 ng/ml). Angus and Bonsmara X Angus steers displayed a more rapid CS peak response to CRH (11.72 and 13.32 min, respectively) than Brahman (21.72 min, P<0.01), or Bonsmara steers (26.72 min, P<0.01). Plasma CS returned to basal concentration more slowly in Bonsmara (83.314 min) than Angus (50.144 min, P<0.01), Brahman (40.144 min, P<0.04), or Bonsmara X Angus steers (40.144 min, P<0.04). Following re-establishment of normal baseline post-CRH, the Brahman steers had higher plasma CS (14.31.8 ng/ml) than the Angus (8.71.8 ng/ml, P<0.04), Bonsmara (6.61.9 ng/ml, P<0.01), or Bonsmara X Angus (5.91.8 ng/ml, P<0.01). Relative to the other breedtypes, the Bonsmara and Bonsmara X Angus maintained lower plasma CS throughout the pre- and post-CRH sampling periods. In summary, plasma CS varied among breedtypes prior to and after administration of CRH. These data are useful in evaluating adrenal function and/or stress-responsiveness in various tropically-influenced cattle breeds.

Key Words: Corticotropin-releasing hormone, Cortisol, Beef cattle

409 Effect of transportation on hypothalamic-pituitary-adrenal axis activation and subsequent responsiveness to trophic hormone stimulation in cattle. M. Knights* and G. W. Smith, Michigan State University, East Lansing, MI.

In the present study, we examined the effect of transportation on circulating ACTH and cortisol concentrations and the subsequent responsiveness of the anterior pituitary (AP) to corticotropin releasing factor (CRF) and arginine vasopressin (AVP) stimulation in cattle. Holstein steers (n=13; 227.3 5.1 kg, 5.4 0.1 months of age) were transported (CRF) and arginine vasopressin (AVP) stimulation in cattle. Holstein steers (n=6) exposed to 12:12 lighting for acclimation, then maintained under LD or SD. Steers were exposed to LD for two periods of 14 d each and SD for one period. Bromocriptine (0.05 mg/kg) was administered subcutaneously to each animal during one of the periods when they were on LD in a balanced randomized design. Bromocriptine was administered to reduce PRL in LD animals to concentrations similar to that of SD steers. Each steer was injected daily for 7 d with either bromocriptine (LD-b) in vehicle (ethanol:methanol) or vehicle alone (LD-v, SD-v). Blood was collected daily during each treatment period and PRL was measured using RIA. Lymphocytes were isolated from heparinized blood and used for RNA isolation or a proliferation assay. Neutrophils were isolated from heparinized blood into saline, washed, and cultured in vitro. Our results suggest that shifts in PRL sensitivity may mediate the SD photoperiod enhancement of certain immune cell functions in cattle.

Key Words: Transport stress, HPA axis, Tropic hormones

410 Effects of bromocriptine treatment on prolactin, prolactin receptor, and immune function of calves on different photoperiods. T. L. Auchting* and G. E. Dahl, University of Illinois, Urbana, IL.

Photoperiod enhances milk production in lactating cattle. In addition, we have observed photoperiod manipulation alters function of immune cells. For example, dry cows exposed to short day photoperiod (SD: 8h light; 16h dark) have increased immune cell competence relative to cows maintained on long days (LD: 16L: 8D). Photoperiod also has a profound effect on prolactin (PRL) concentrations and PRL is known to be a mediator of various functions of the immune system. The objective of this study was to determine if PRL mediates changes in immune cell function seen under different photoperiods. Our model was Holstein steers (n=6) exposed to 12:12 lighting for acclimation, then maintained under LD or SD. ADG was calculated using the selected backfat fold (BF). The average backfat thickness was 11.9 mm for LD and SD steers. Weights and muscle percentage compared with the other two groups. Both castrated and immunized animals had greater marbling (3.5 and 4.3, respectively), but not Brahman steers (28.73 ng/ml). Angus and Bonsmara X Angus steers displayed a more rapid CS peak response to CRH (11.72 and 13.32 min, respectively) than Brahman (21.72 min, P<0.01), or Bonsmara steers (26.72 min, P<0.01). Plasma CS returned to basal concentration more slowly in Bonsmara (83.314 min) than Angus (50.144 min, P<0.01), Brahman (40.144 min, P<0.04), or Bonsmara X Angus steers (40.144 min, P<0.04). Following re-establishment of normal baseline post-CRH, the Brahman steers had higher plasma CS (14.31.8 ng/ml) than the Angus (8.71.8 ng/ml, P<0.04), Bonsmara (6.61.9 ng/ml, P<0.01), or Bonsmara X Angus (5.91.8 ng/ml, P<0.01). Relative to the other breedtypes, the Bonsmara and Bonsmara X Angus maintained lower plasma CS throughout the pre- and post-CRH sampling periods. In summary, plasma CS varied among breedtypes prior to and after administration of CRH. These data are useful in evaluating adrenal function and/or stress-responsiveness in various tropically-influenced cattle breeds.

Key Words: Corticotropin-releasing hormone, Cortisol, Beef cattle

411 Weight gain, carcass and meat characteristics of pasture fed LHRH immunocastrated, castrated and intact bulls. E. Ribeiro1, J. Hernandez2, E. Zane1, M. Shimokomaki1, S. Ferreira1, E. Yousef1, H. Ribeiro1, and J. Reeves2, 1Universidad Estadual de Londrina, 2Washington State University, 3Universidade E Passo Fundo.

This experiment was carried out to evaluate the effect of surgical and immunocastration on growth and carcass characteristics of beef cattle slaughtered at 3 years of age. Seventy bulls (Nellore-cross) were divided into three groups: 1) immunized against LHRH fusion protein, 2) castrated and 3) intact control. The animals were 24 mo old at the initiation of the study and ranged on Brachiaria grass, in Mato Grosso, Brazil. Testes and epididymides weights were heavier (P<0.05) for intact bulls than immunized bulls (460, 140 g and 45, 20 g, respectively). At slaughter intact bulls had higher body weights, and ADG compared to immunized and surgically castrated animals (517, 485, 478 kg and 0.672, 0.513, 0.488 kg/d, respectively). Intact bulls had higher carcass weights and muscle percentage compared with the other two groups. Both castrated and immunized animals had greater marbling (3.5 and 5.0) and percent carcass fat (23.9 and 25.2 %) than the intact bulls (2.1 and 17.9 %, respectively). Although averages for tenderness, measured by a trained panel (scale from 1 to 9) and by a texturometer (Newton’s force), were inferior for intact bulls, they did not reach statistical significance (P=0.12 and P=0.13, respectively). The tenderness averages for castrate, immunized and intact bulls determined by the panel were 5.5, 5.8 and 5.0, and by the texturometer, 119, 125 and 145, respectively.

Key Words: Cattle, Photoperiod, Bromocriptine

Studies have shown that glycerol supplementation can have practical utility in the management and castration of grazing bulls in Brazil.

**Key Words:** LHRH immunization, Carcass, Bulls

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**Ruminant Nutrition: Nutritional management & transition**


Successful lactation depends on sound nutrition and management programs that are interdependent. Attention to detail in these areas, especially during the periparturient period, is a major determinant of farm profitability. Sound reproductive and nutritional management during the breeding period and gestation are required to achieve optimal body condition (BCS) at parturition. Typical recommendations for BCS at parturition are 3.5 to 3.75; however, recent data indicate that cows of BCS ~3.0 may have improved health and early lactation performance. Management of periparturient BCS is critical to minimize the extent of negative energy balance and its associated mobilization of adipose that results in elevated plasma NEFA levels. Plasma NEFA can accumulate in the liver as triacylglycerol (TAG) and impair both metabolic and immune function. Superior nutrition and management can avert excessive TAG accumulation during the periparturient period. Dietary supplementation or oral administration of nutrients or compounds such as choline, niacin, calcium propionate, propylene glycol, glycerol, fat, and trace minerals are used as prophylactic measures when nutrition or management is suboptimal. Though commercial use of these supplements is common, recent data and review of the research literature indicates efficacy only under certain circumstances and when administered by specific methods. Recent data also have provided possible physiological links between the associations of primary infectious disease with the occurrence of secondary metabolic disorders, thereby emphasizing the importance of sound energy, protein, and macromineral nutrition for immunocompetence of the periparturient cow. Dietary vitamin and trace mineral supplementation above NRC requirements or from alternative sources have been emphasized to promote immune function. Although in vitro data sometimes are supportive of this practice, research into the requirements of these nutrients to optimize immune function in lactating dairy cows needs to be conducted.

**Key Words:** periparturient cow, metabolism, immune function

413 Feeding glycerol to transition dairy cows: Effects on dry matter intake, milk production, and blood metabolites. J. M. DeFaeain1, A. R. Hippen2, K. F. Kalscheur2, and P. W. Jarden2.1 South Dakota State University, Brookings, SD; 2West Central Soy, Ralston, IA.

Twenty-one multiparous and nine primiparous Holstein cows blocked by parity and expected calving date were used in a randomized block design to evaluate the effects of feeding glycerol from 14 d prepartum until 21 DIM. Energy density and crude protein were 1.50 and 1.65 Mcal/kg and 16.5 and 18.6 % for pre- and postpartum diets, respectively. Treatments (kg/d) were: 1 of corn starch (CON), 0.5 corn starch + 0.5 glycerol (MIX), or 1 glycerol (GLY), topdressed, and hand-mixed into the upper 1/3 of the TMR. Prepartum DMI was greater for cows fed CON compared with MIX or GLY (13.0, 10.9, and 10.9 ± 0.36 kg/d, respectively). Postpartum DMI was not affected by treatments. Milk yields during the first 70 DIM were greater for multiparous cows fed CON or MIX than for GLY (44.7, 44.1, and 39.9 ± 1.48 kg/d, respectively) whereas milk yields of primiparous cows fed CON or GLY were greater than for MIX (29.2, 29.1, and 26.1 ± 2.32 kg/d). The MIX and GLY diets decreased MUN relative to CON (14.0, 12.5, and 12.59 ± 0.46 mg/dl, respectively). Prepartum plasma glucose, BHBA, and NEFA were not affected by treatments. At 7 and 14 DIM, plasma glucose was similar among treatments; however, plasma glucose in cows fed CON and MIX were greater than those fed GLY at 21 DIM (67.5, 64.9, and 50.2 ± 3.71 mg/dl, respectively). Feeding GLY decreased plasma NEFA at 7 DIM compared with CON and MIX (458, 855, 896 ± 118 µEq/L, respectively); however, NEFA were similar among treatments at 14 and 21 DIM. There was a linear (p<0.05) trend (-0.65 µEq/L/kg) for cows fed GLY to have greater concentrations of plasma BHBA postpartum (7, 14, and 21 DIM) compared with CON, but BHBA levels in cows fed MIX were intermediate to those fed CON and GLY. These data indicate glycerol fed at 1 kg/d delayed the onset and degree of fat mobilization during the first 3 wk postpartum. The greatest potential for glycerol to prevent ketosis was observed during the first 7 DIM and the optimal inclusion rate is between 0.5 and 1 kg/d.

**Key Words:** Periparturient, Glycerol, Metabolites


This study was a 2 x 3 factorial with 3 prepartum dietary treatments and a propylene glycol (PG) drench of 0 (+) or 300 (+) ml on day 1 and 2 postpartum. Prepartum diets were control (C), anionic supreme (A), and base supreme (B). Diet C was 75% forage and a 25% mixture of corn, soybean meal, minerals and vitamins. Supreme diets were 61% forages and a 39% mixture of corn, soybean meal, sugar, soluble fiber, yeast, enhanced minerals and vitamins with (A) and without (B) anionic salts. All cows received the same postpartum diet the first nine weeks of lactation. Seventy multiparous (M) cows were assigned to diets A, B, and C and 32 primiparous (P) cows were assigned to diets B and C starting 21 days before parturition. Half of the M and P cows assigned to each dietary treatment received the PG drench. Diet A reduced DMI prepartum of M cows compared to cows fed diet B and C over the 21 days prepartum (12.1, 13.5 and 14.4 kg/d for diet A, B, and C), however, cows fed diet C had the largest decline in DMI week -1 prepartum (20%, 13%, and 12% for diet C, A, and B). There was no effect of diet, drench or diet by drench interaction within parity on milk yield or milk components the first nine weeks of lactation. Milk production for M cows was 49.1, 48.1, 49.3, 48.2, 46.9, and 46.7 kg/d for treatments A-, A+, B-, B+, C-, and C+ the first nine weeks of lactation. Milk production for P cows was 34.4, 32.6, 33.0, and 33.3 kg/d for treatments B-, B+, C-, and C+ for the first nine weeks of lactation. Milk fever incidences of M cows fed diets A, B, and C were 0%, 4.8%, and 22.7%. Ketosis incidences were 12% and 25% for P cows and 17% and 15% for M cows on drench (+) and (-), respectively. Blood calcium concentrations of M cows fed diet A were higher (P<0.05) at parturition (8.3 mg/dl) than for cows fed diet B and C (7.9 and 7.4 mg/dl). Blood glucose concentrations of P cows were higher (P<0.05) the first 7 days of lactation (87.4 vs 76.8 mg/dl) with drenching (+).

**Key Words:** Transition, Metabolic, Drench

415 Interrelationships of prepartum dry matter intake with postpartum intake and hepatic lipid accumulation. J. K. Drackley*, University of Illinois, Urbana, IL.

Grummer (JAS 73:2820) reported a correlation (r=0.54) between dry matter intake (DMI) 1 d prepartum and DMI 21 d postpartum. We reported previously, however, that cows fed restricted amounts of diet during the dry period had greater DMI postpartum and less lipid accumulation in liver (JDS 81[Suppl. 1]:295). The hypothesis tested here was that extent of prepartum DMI decrease is more important than actual prepartum DMI for postpartum DMI and hepatic lipid content. Multiparous Holstein cows (n=50) were fed 1 of 5 diets during the dry period; anionic salts were added during the last 14 d prepartum. Three diets were fed for ad libium intake; two were fed to supply only 80% of calculated NE requirements. All cows received a lactation diet postpartum. Mean DMI for wk -3 and wk -1 were 12.0 kg/d (range 6.2 to 21.3 kg/d) and 9.2 kg/d (3.0 to 18.3 kg/d). Decreases in DMI at wk -1 from wk -3 and at d -1 from d -7 averaged -20.0% (-10.0 to -77.1%) and -23.3% (-31.5 to -93.0%), respectively. Contents (wt weight) of total lipid and triglyceride (TG) at d 1 postpartum averaged 7.0% (3.7 to 16.9%) and 4.6% (0.3 to 15.5%), respectively. DMI for wk 3 postpartum was not correlated with postpartum DMI. DMI for wk 1 postpartum was
correlated with DMI for wk -1 (r=0.44, P<0.01). In contrast, DMI for wk 3 postpartum was correlated (P<0.01) with percent changes in DMI during the last 3 wk (r=0.43) or last 2 wk (r=0.41) prepartum. DMI for wk 1 postpartum was correlated (P<0.01) with percent changes in DMI during the last 3 wk (r=0.34), last 2 wk (r=0.49), or last week (r=0.39) prepartum. Contents of total lipid and TG in liver at d 1 postpartum were negatively related to decreases in DMI during the last 3 wk (r=-0.63 and -0.63), last 2 wk (r=-0.67 and -0.65), and last 1 wk (r=-0.42 and -0.38) prepartum. Liver total lipid and TG were positively correlated to actual DMI for wk -3 or -2, and were not correlated with DMI for wk -1. Early postpartum DMI and hepatic lipid content are more highly related to changes in DMI during the last 3 wk prepartum than to actual DMI prepartum.

Key Words: Dry matter intake, Dry period, Liver


Thirty-three multiparous and 27 primiparous Holstein cows were utilized in a randomized block design to evaluate the impact of long-term alfalfa hay top dress to a total mixed ration (TMR) on lactation performance and plasma metabolites of early lactation dairy cows. Cows were blocked by parity and calving date with 11 replicates for multiparous cows (BW=722 ± 11.9 kg; BCS=2.73 ± 0.12) and nine replicates for primiparous cows (BW=609 ± 13.2 kg; BCS=3.30 ± 0.18). All cows were fed a total mixed ration (TMR) containing 22% chopped alfalfa hay, 27% ground corn, 10% corn silage, 6% whole cottonseed, 7% soybean expeller meal, 1% molasses, 2.7% mineral-vitamin premix. Treatments were: 1) TMR (R), 2) TMR top dressed with 1.36 kg long-stem alfalfa hay at 0600 h (A), 3) TMR top dressed with 1.36 kg long-stem alfalfa hay at 0600 h and 1.36 kg dry rolled corn at 1200 h (AC). The TMR was offered for ad libidum intake at 0600, 1200, and 1600 h daily. For the initial 5 d of lactation body temperature, BW, BCS, rumen contractions, and milk ketones were recorded, and plasma was harvested from coxycel blood. Milk yield was recorded for 30 d postpartum with samples (a.m. / p.m. composite) analyzed for fat, protein, lactose, and urea content weekly. Milk and milk components were similar among treatments. Plasma glucose and urea nitrogen was not affected by treatment but significantly affected by day (P<0.05) and age (P<0.05). Primiparous cows were lighter and had a higher BCS (P<0.05) than multiparous cows. Average plasma NEFA concentration, as well as those on d 2 and 3 were lower (P<0.05) for multiparous cows consuming diet R (693, 743, and 661 mmol/L, respectively) than for multiparous cows consuming diet A (928, 1099, and 1039 mmol/L, respectively). Rumen contractions were greater (P<0.05) for multiparous cows than for primiparous cows. Top dresses of long-stem alfalfa hay or of long-stem alfalfa hay and ground corn was not beneficial for the TMR fed in this study.

Key Words: Alfalfa hay, Fresh cow, NEFA

417 Effects of prepartum dietary energy concentration and Ca-propionate on transition performance. A. E. Beem*, H. G. Bateman1, C. C. Williams1, C. C. Stanley1, D. G. Gantt1, Y. H. Chung1, and F. R. Valdez2, LSU AgCenter, Baton Rouge, LA, 1Kemtin America's, Des Moines, IA.

Forty-one Holstein cows (mean BWT 669 kg) were grouped by anticipated calving date and assigned to one of four treatments that were arranged as a 2x2 factorial of 105 or 145% (NRC, 2001) of prepartum dietary energy requirements with or without addition of 113.5 g Ca-Propionate/d (NutroCAL,™ Kemtin America's, Des Moines, IA). All cows were fed the same basal diet postpartum. Ca-propionate supplement was included in prepartum. Cows were individually fed and DMI was measured daily. Milk production was measured and sampled at each milking. Blood samples were collected 3x/wk and analyzed for β-hydroxybutyrate (BHBA). Urine was collected 3x/wk and analyzed for pH, acetocetate, and BHBA. Due to factors unrelated to treatment diets, there was a high incidence of health disorders such as retained fetal membranes, uterine infections, displaced abomasums, and laminitis observed during this trial that probably impacted any observed treatment responses. There were no statistical differences (P > 0.05) observed in these data.

Key Words: Transition cow, Nutrient intake, Liver

418 Prepartum dry matter intake, serum nonesterified fatty acids, liver lipid and glycogen contents, body weight, and body condition score for cows fed different diets during the dry period. H. M. Dann*, N. B. Litherland, J. P. Underwood, M. Bionaz, and J. K. Drackley, University of Illinois, Urbana.

Multiparous Holstein cows (n=74) were fed different diets during the far-off (FO; dry-off to -25 d before expected parturition) and close-up (CU; -24 d to parturition) periods in a 3 (FO) x 2 (CU) factorial arrangement to determine the effects of prepartum nutrient intake on prepartum dry matter intake (DMI), concentration of nonesterified fatty acids (NEFA) in serum, liver lipid and glycogen contents, body weight (BW), and body condition score (BCS). During the FO period, cows were fed a control diet (FOC; 1.29 Mcal NE/kg, 12.7% CP) at ad libitum (A) or a diet with excess nutrients (FOE; 1.59 Mcal NE/kg, 15.1% CP) at either A or restricted (R; 80% of calculated NE requirement at dry-off) intake. During the CU period, cows were fed a diet (CU; 1.54 Mcal NE/kg, 14.5% CP) at either A or R (80% of calculated NE requirement at dry-off) intake. During the CU period, cows fed R had higher (P<0.05) DMI (3.16 Mcal NE/kg) than cows fed A (2.98 Mcal NE/kg). Cows fed R had higher (P<0.05) serum NEFA, BW, and BCS compared with cows fed A. Cows fed R had lower (P<0.05) serum BHBA, liver lipid and glycogen contents, and body weight compared with cows fed A. The FO diets affected (P<0.05) NEFA, BW, and BCS during the CU period. Cows fed FOA had higher serum NEFA, BW, and BCS compared with FOE and FOER in the CU period. Prepartum changes in serum NEFA, BW, BCS, and liver lipid content were consistent with plane of nutrition.

Key Words: Calcium propionate, Transition cow, Ketone


Understanding impacts of plane of nutrition before parturition on hepatic partitioning of long chain fatty acids to CO2 acid soluble products (ASP) and esterified products (EP) may provide a basis for improved health and productivity. Multiparous Holstein cows (n = 71) were fed different amounts of nutrients during the far-off (FO) and close-up (CU) dry periods in a 3 (FO diet)x 2 (CU diet) factorial arrangement. During the FO period (d -60 to -25) cows received a control diet fed ad libitum (FOCA) to meet NRC (2001) recommendations, a diet fed ad libitum to exceed NRC recommendations for NE by 20% (FOEA), or a diet fed ad restricted intake to meet 80% of FO NE requirement.
(FOER). During the CU period (d -24 until parturition), cows were fed a diet ad libitum (CUA) to meet NRC recommendations or in restricted (CUR) amounts to provide 80% of calculated NE\textsubscript{L} requirements. All cows received a lactation diet postpartum. Liver slices from biopsies at d -30, -14, +1, +14, and +28 relative to parturition were utilized to determine in vitro conversion of [\textsuperscript{14}C] palmitate (PALM) to CO\textsubscript{2}, ASP, and EP. Conversion of PALM to CO\textsubscript{2} decreased on d 1 for FOEA (FO × day, P < .03). As a percent of total PALM metabolism, conversion to CO\textsubscript{2} decreased at d 1 for all FO treatments; FOEA declined most (FO × day, P < .07). Conversion of PALM to ASP increased on d 1 for FOCA and FOER, with FOCA significantly higher than FOEA (P < .03). Esterification of PALM increased on d 1 for all treatments. As a percent of total PALM metabolism, EP formation tended to be greater on d 1 for the combination of FOEA plus CUR than for cows fed FOCA or FOER (FO × CUR × day, P = .06). Total PALM metabolism increased on d 1; cows fed FOCA had greater rates than FOEA (P = .05). Excessive energy intake during FO and CU promotes decreased hepatic oxidation and increased esterification of PALM, consistent with triglyceride accumulation postpartum; CU diet had less effect than did FO diet. Supported by USDA-NRI no. 2001-55206-10946 and Illinois C-FAR.

**Key Words:** Liver, Dry period, Fatty acid metabolism

### 420 Prepartum nutrient intake has minimal effects on postpartum dry matter intake, serum nonesterified fatty acids, liver lipid and glycogen contents, and milk yield.


Multiparous Holstein cows (n=74) were fed different diets during the far-off (FO; dry-off to -25 d before expected parturition) and close-up (CU; -24 d to parturition) periods in a 3 (FO) × 2 (CU) factorial arrangement to determine the effects of prepartum nutrient intake on postpartum dry matter intake (DMI), serum nonesterified fatty acids (NEFA), liver lipid and glycogen contents, body weight (BW), body condition score (BCS), and milk yield. During the FO period, cows were fed a control diet (FOC; 1.29 Mcal NE\textsubscript{L}/kg, 12.7% CP) at ad libitum (A) intake or a diet with excess nutrients (FOE: 1.59 Mcal NE\textsubscript{L}/kg, 15.1% CP) at either A or restricted (R; 80% of calculated NE\textsubscript{L} requirement) intake. During the CU period, cows were fed a diet (CU: 1.54 Mcal NE\textsubscript{L}/kg, 14.5% CP) at either A or R intake. Cows were fed a lactation diet (1.61 Mcal NE\textsubscript{L}/kg, 17.5% CP) from 0 to 56 days in milk (DIM). From 0 to 21 DIM, cows fed FOEA tended (P <.01) to have lower DMI (2.59% BW) and higher BCS (2.57) than cows fed FOER (2.89% BW; 2.34) or FOCA (2.87% BW; 2.42). Cows fed FOER tended (P <.01) to have greater postpartum milk yield (28.8, 28.8, 28.8 kg/d for FOEA, FOER, and FOCA, respectively). Prepartum DMI (14.5 and 12.2 kg/d for LMP and HMP, respectively, P=0.29), postpartum DMI (22.9 and 21.1 kg/d for LMP and HMP, P=0.25), and 4% FCM (37.0 and 36.8 kg/d for LMP and HMP, P=0.95) were similar between diets. Cows fed HMP had higher concentrations of urea-N prepartum (P <.01) than cows fed LMP (14 vs 9 mg/dL). Cows fed HMP tended (P=0.11) to have greater prepartum concentrations of total protein in plasma than those fed LMP (7.4 vs 6.9 g/dL). Area under the curve (AUC) for NEFA response to epinephrine did not differ between diets (P=0.25) but differed by day (P<0.001) relative to parturition (8,282; 28,854; and 21,027 μg (L x min) for d -10, d 7, and d 14, respectively). Glucose AUC did not differ between diets or among days (P=0.91). Lipolytic response, but not glucose response, to epinephrine increased during the early postpartum period relative to the late dry period. However, those responses are not affected by prepartum MP supply.

**Key Words:** Epinephrine, Metabolizable protein, Lipolysis

### 422 Metabolism of dairy cows as affected by prepartum dietary carbohydrate source and supplementation with chromium throughout the periparturient period.

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Holstein cows (n=74) entering second or later lactation were used to determine whether metabolic parameters are affected by source of carbohydrate in the prepartum diet and chromium-L-methionine (CrMet) supplementation throughout the periparturient period. From 21 d before expected parturition until parturition, cows were fed either a TMR with the concentrate portion based on starch-based cereals (NFC) or a TMR with the concentrate portion based on nonforage fiber sources (NFFS). The CrMet was supplemented once daily via gelatin capsule at 0, 0.03, or 0.06 mg/kg BW 75 days before parturition. During the CU period, cows were fed a diet (CU; 1.61 Mcal NE\textsubscript{L}/kg, 17.5% CP) from 0 to 56 days in milk (DIM). From 0 to 21 DIM, cows fed FOEA tended (P <.01) to lower NEFA (0.03) and insulin concentrations were affected quadratically (P <.03) for CUR (3.0%) than CUA (2.7%). Preventing excessive carbohydrate intake prepartum increased prepartum (60.3, 59.1 mg/dl; P<0.02) and postpartum (46.5, 45.0 mg/dl; P<0.09) glucose concentrations. BHBA concentrations were not different (6.0, 5.9 mg/dl) prepartum, but tended (0.4, 11.0 mg/dl; P<0.12) to be lower postpartum for cows fed NFFS. Liver triglyceride concentrations were greater on d 1 postpartum and lower on d 21 postpartum for NFC (P<0.04). Cows fed NFFS prepartum tended (P <.10) to have greater prepartum liver glycogen content. Insulin and NEFA did not differ (P>0.15) pre- or postpartum between NFFS and NFC. Supplementing 0.05 mg/kg BW 75 days before parturition increased prepartum (59.4, 60.9, 58.8 mg/dl; P<0.01) prepartum plasma glucose concentrations (P<0.1), and increased prepartum insulin concentrations (P<0.01) to 104 ng/ml for NFFS. Prepartum NEFA concentrations (206, 179, 208 μEq/l) for 0, 0.03, and 0.06 mg/kg BW 75 days before parturition decreased linearly (46.7, 46.0, 44.5 mg; P<0.04) and insulin concentrations were affected quadratically (P<0.03) by CrMet (0.21, 0.16, 0.20 μg/ml). Supplementing CrMet did not affect prepartum insulin and BHBA, postpartum NEFA or BHBA, or liver composition. Overall, prepartum carbohydrate source and CrMet had modest effects on metabolic variables.

**Key Words:** periparturient cow, carbohydrate, chromium

### 423 Influence of cobalt supplementation to dry and lactating dairy cow diets with monensin on microbial fermentation in continuous culture.

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An experiment was conducted to determine if the level of cobalt supplementation to dry and lactating dairy cow diets with monensin would affect fermentation by ruminal microbes maintained in dual flow continuous culture fermenters. A dry cow diet and a lactating cow diet formulated to contain monensin at 200 and 300 mg/h/d, respectively, were supplemented with 0.5, 1, 2, and 4 ppm of cobalt glucoheptonate. These treatments were evaluated in eight flask cultures inoculated with ruminal fluid from a cannulated cow during four 10-d experimental periods to achieve four replications for each of the eight dietary treatments. The experimental design was a completely randomized 4 x 2 factorial arrangement.
of treatments with four concentrations of cobalt glucoheptanate and two diet types (dry and lactating dairy cow diets). Differences (P < 0.05) between dry and lactating dairy cow diets, respectively, were observed for pH (6.40 vs 6.12), true OM digestion (42.8 vs 59.3 %), ADF digestion (42.3 vs 50.7 %) and total VFA concentration (75.1 vs 163.8 mM). Neutra- l detergent fiber digestion (35.6 vs 55.8 %) was similar between diets. Carbohydrate digestion (80.9 vs 83.4 %) were similar (P > 0.05) between dry and lactating dairy cow diets. Crude protein digestion (22.8 vs 33.7 %) and N flow (2.18 vs 2.88 g/d) were lower (P < 0.05) for the dry cow diets compared with the lactating dairy cow diets. Efficiency of bacterial synthesis (20.2 vs 21.6 g of N/kg of OM truly digested) was similar (P > 0.05) between diets. There were no effects (P > 0.05) of cobalt supplementation on nutrient digestion and microbial fermentation nor were there any interactions (P > 0.05) with type of diet. Results indicate that supplementation with cobalt at various concentrations in either a dry or lactating dairy cow diet with monensin did not have any impact on fermentation by ruminal microbes.

Key Words: Cobalt, Continuous culture, Monensin

424 Prediction of urine volume and urinary output of nitrogen and minerals in lactating dairy cows. J. D. Folmer*, T. D. Nennich1, J. H. Harrison1, L. Johnson1, D. Meyer2, W. Weiss3, N. St-Pierre1, R. L. Kladivko1, M. Nattiaux2, and D. L. Davidson1, 1 Washington State University, Pullman; 2 University of California, Davis; 3 The Ohio State University, 4 Washington State University, Pullman; 5 University of Wisconsin.

The objective of this study was to develop prediction equations for estimating urinary volume, nitrogen, and mineral excretion of lactating dairy cows. A data set was assembled from total urine collection studies (n = 25) that used multiparous Holstein cows. The studies were conducted by Washington State University, University of California-Davis, The Ohio State University, and the University of Wisconsin. Metabolizable protein (MP) supply was estimated for each individual cow using the 2001 Dairy NRC Model. Based upon their estimated MP intake, cows were assigned into treatments of LOWMP that included cows with MP supply at 110% or less of their calculated MP requirements, and HIGHMP that included cows with MP supply greater than 110% of MP requirements. Milk production for cows in LOWMP ranged from 9.8 to 86.1 kg/d and 1.4 to 52.6 kg/d for HIGHMP. Dietary crude protein (CP) concentration was 17.1±5.9% and 19.2±5.8% for LOWMP and HIGHMP, respectively. Urinary nitrogen ranged from 63 to 499 g/d for LOWMP and 90 to 436 g/d for HIGHMP. Regression analysis performed using the PROC MIXED procedure of SAS included study as a random variable. The regression equations predict urine volume, urinary nitrogen, and urinary excretion of P, K, Na, Ca, Mg, Cu, and Zn. Predictors used in the equations include days in milk (DIM), body weight (BW), dry matter intake (DMI), dietary CP concentration, milk CP content, and milk urea nitrogen (MUN). The best equation for the prediction of urinary nitrogen (g/d) using the LOWMP data set was: 0.12×DMI + 0.18×BW + 4.29×DMI + 14.47×diet CP% + 4.35×MUN # 321 (n = 230) compared to: 0.28×BW + 4.85×DMI + 7.95×diet CP% + 4.62×MUN + 20.77×milk CP% - 334 (n = 154) for the HIGHMP data set. Prediction equations can be used to more accurately estimate urinary nitrogen and mineral excretion of lactating dairy cows than current tabular values.

Key Words: Urine, Nitrogen, Dairy cows

Ruminant Nutrition: Feedlot

425 Effect of wintering system and feedlot sorting on performance and economics of yearling steer production systems. J. D. Folmer1, C. N. Macken1, M. P. Blackford1, G. E. Erickson1, and T. J. Klopfenstein1, 1 University of Nebraska, Lincoln, NE.

An experiment was conducted to evaluate the effects of different winter management and feedlot sorting on the performance and economics of a yearling steer production system. Two hundred steers (239 kg) were stratified by weight and assigned randomly (n = 100) to one of two winter management strategies (INT or NOR). INT managed steers 0.83 vs. 0.68 kg/d, respectively. Feedlot initial DMI, ADG, gain:feed, and hot carcass weight. In addition, dressing per-
centr, longissimus muscle area, fat thickness at the 12 th rib, percentage of this study decreased fecal EC shedding, which might be related to the incidence of EC shedding than CON and B steers. Under the conditions of this study, live cultures of LA plus PF did not greatly affect feedlot performance and carcass characteristics, and Escherichia coli O157:H7 shedding of finishing beef steers. N. A. Elam*, J. F. Glieghorn, J. D. Rivera, M. L. Galyean, M. M. Brashears, and S. M. Younts-Dahl, Texas Tech University.

Two hundred forty beef steers (British and Continental; initial BW = 332.8 ± 23.1 kg) were used to determine the effects of live cultures of Lactobacillus acidophilus (LA) and Propionibacterium freudenreichii (PF) on performance, carcass and intestinal characteristics, and prevalence of Escherichia coli O157:H7 (EC) shedding during the finishing phase. Cattle were fed a steam-flaked corn-based 92% concentrate diet for an average of 170 d. The four treatments included INT or NOR management strategy treatments. Intensive (INT) or normal (NOR) management strategies consisted of 91 d of winter corn residue grazing (WCGF) supplementation. NOR steers received 2.27 kg of WCGF DM daily while INT steers received 2.72 kg. INT steers also received Bovatec (170 mg/d) with the WCGF, and were implanted with Ralgro on d 1, and with Synovex S on d 91. All steers received a Revolver G implant on d 143 and began the summer grazing period. INT steers were placed on feed at d 220 and NOR steers on d 264. At initiation of feedlot fin-
ishing, steers were implanted with Revolver S, and stratified by weight and assigned randomly (n = 50) to one of two additional treatments in two replications, sorted (S) or unsorted (U). S steers were divided in to three weight groups, the heavy 25%, the middle 50%, and the light 25%, and marketed at a common fat thickness target of 1.14 cm fat thickness. Heavy steers were marketed 14 d prior, middle 7 d after, and light 21 d after the unsorted control group. Results from the experiment indicate that INT managed steers had greater wintering phase ADG than the NOR managed steers 0.83 vs. 0.68 kg/d, respectively. Feedlot initial weights were 446 kg for INT steers on d 220, and 456 kg for NOR steers on d 264. NOR (P<0.01) and S (P<0.05) steers had significantly greater ADG, DMI, hot carcase weight (HCW), final weight (FW), and lower feed conversion than INT and U steers. NOR steers had fewer days on feed, while S had additional days on feed. INT steers performed better resulting in heavier, more profitable steers after the wintering phase. NOR steers were heavier and more profitable after the summer grazing and feedlot finishing phases. Sorting steers into marketing groups when they enter the feedlot resulted in heavier, more profitable steers versus unsorted controls.

Key Words: Steers, Systems, Sorting


The objective was to evaluate residual feed intake (RFI) as an indicator of efficiency. Steers (107) sired by Angus (A), Hereford (H), Belgian

Blue (B), Piedmontese (P), Boran (Bo), Brahman (Br), and Tuli (T) and from A, H, or MARC III dams were used. Eight additional steers of each sire breed were used as initial slaughter animals. Steers were individually fed (half near maintenance and half at ad libitum) a high-concentrate diet (83.8% corn) in pens of eight for 140 d. Steers were weighed at 14 d intervals, and feed allotments were adjusted at those times. Steers were slaughtered at the MARC abattoir and retained energy (RE) was determined by comparative slaughter procedures. Initial weight (IWT), final weight (FWT) and ADG were calculated from regressions of weight on time for each steer. Similarly, DMI and MEI was calculated from regressions of cumulative feed consumed on time for each steer. Residual feed intake (RFI) was determined as the residual from within feed level regressions of MEI (kcal/kg<sup>0.75</sup>/d) on retained energy (kcal/kg<sup>0.75</sup>/d), and residual retained energy (RRE) was determined as the residual from the regression of RE (kcal/kg<sup>0.75</sup>/d) on MEI (kcal/kg<sup>0.75</sup>/d). Increased feed level increased intake and retained energy (P<0.01), RRE (P=0.06), but not RFI (P=0.99). Sire breed influenced all traits (P<0.01), but feed level × sire breed did not influence RRE (P=0.25) or RFI (P=0.35). Mean RRE and RFI for A, B, H, Br, P, Bo, T and Sire breed were: 2.17, 0.52; -10.04, 7.3; 3.28, 6.25; 3.65, -16.34; -8.68, 24.95; 4.83, -10.74; and 3.34, -11.77, respectively. The five of 107 steers identified as most efficient based on RFI were from the ad libitum group and averaged 1.95 kg DMI/d and 5.02 Mcal RE/d (means for ad libitum were 7.11 kg/d and 5.67 Mcal/d) suggesting potential negative consequences of over emphasizing RFI as a means to improve efficiency. These results suggest important differences exist among sire breeds in efficiency as measured by RRE or RFI.

**Key Words:** Breed, Efficiency, Feed level

### 428 Ruminal bihydrogenation and conjugated linoleic acid formation in beef cattle fed finishing diets containing crude fish oil and/or different oil sources. S. K. Duckett, B. Jacob, M. H. Gillis, C. E. Realini, K. R. Smith, A. Parks, and R. Eggleston, The University of Georgia.

Four Hereford steers (550 kg) cullulated in the proximal duodenum were used to assess the effect of dietary oil source with or without the addition of fish oil on ruminal bihydrogenation (BH) and flow of long chain fatty acids to the duodenum. The steers were fed one of four diets in a 2 by 2 factorial arrangement of treatments (oil source: canola vs. corn oil; fish oil level: 0 or 1%) in a 4 x 4 Latin square design. The dietary treatments included: 1) 4% corn oil (CO), 2) 4% canola oil (CA), 3) 3% corn oil plus 1% fish oil (COFISH), and 4) 3% canola oil plus 1% fish oil (CAFISH) added to a high concentrate diet (12% grass hay, 84% concentrate). All four diets were designed to be isonitrogenous and isocaloric. Cofractionated acid was added to the diets as an external marker for the determination of duodenal output. Experimental periods lasted 14 d with 10 d for diet adaptation and 4 d for sample collection. Data were analyzed with animal, period, oil source, fish oil and oil source by fish oil interaction in the model. Addition of canola oil increased (P < 0.05) BH of oleic and linoleic acids compared to corn oil addition. Fish oil addition increased (P < 0.05) linoleic acid BH in canola oil but did not alter BH of linoleic acid in corn oil diets. Overall BH of unsaturated 18:1 fatty acids was lower (P < 0.05) for CA and COFISH than CAFISH with CO being intermediate. Oil source did not alter (P > 0.05) flow of stearic, trans-octadecenoic, and oleic acids to the duodenum. Linoleic acid flow to the duodenum was greater (P < 0.05) for corn than canola oil; whereas, linoleic acid flow was greater (P < 0.05) for canola than corn oil. Addition of fish oil reduced (P < 0.05) the flow of stearic and linoleic acids to the duodenum, and increased (P < 0.05) flow of trans-11 vaccenic acid by 1.5 fold. Flow of conjugated linoleic acid (CLA) and omega-3 fatty acids was greater (P < 0.05) for diets containing fish oil regardless of oil source. Addition of fish oil increased flow of trans-11 vaccenic, CLA, and omega-3 fatty acids to the duodenum regardless of oil source.

**Key Words:** Beef, Conjugated linoleic acid, Fish oil


One hundred and eighty four steers (init. BW 161.7 ± 3.4 kg) were used to determine the effect of source and amount of energy in the growing phase on performance and carcass characteristics. Steers were allotted to one of four growing phase regimens. For three regimens steers were weaned at 119 d of age and 1) fed a high grain diet ad libitum (ALC), 2) limit-fed a high grain diet to achieve a gain of 0.8 kg/d from 119 to 192 d of age, and 1.2 kg/d from 193 to 259 d of age (LFC), or 3) fed a high forage diet ad libitum from 119 to 192 d of age, and an intermediate level forage diet ad libitum from 193 to 259 d of age (ALF). For the fourth regimen, steers were weaned at 204 d of age and fed a high grain diet from 205 to 259 d of age (NW). From 260 d of age to slaughter all steers consumed a common diet. LFC and ALF spent the most, and NW the least amount of time (P<0.01) in the feedlot to achieve a target fat depth of 1.25 cm. ALC steers were the youngest, and NW the oldest at slaughter (P<0.01). Overall ADG was greatest for ALC, and lowest for NW steers (P<0.01). ALC steers consumed the most DM (P<0.01). While in the feedlot, LFC and ALF steers were more efficient in converting feed to BW gain (P<0.01), than ALF and NW steers. NW had the lowest and ALC the greatest (P<0.01) fat depth at 260 d of age. Consequently, NW steers produced the heaviest, and ALC the lightest (P<0.01) carcases at slaughter. Fat depth at slaughter did not differ among treatments (P>0.76). NW steers had the largest, and ALC and LFC steers had the smallest longissimus muscle area (P<0.06). Growing phase dietary treatments did not affect (P>0.20) yield grade. Marbling score did not differ (P>0.35), but laboratory analysis revealed that ALC steers had the lowest percent fat (P<0.02) in the longissimus muscle. Searce health was greatest (P<0.08) for steaks from ALC and LFC steers, and lowest for steaks from ALF and NW steers. Feeding steers an ad libitum forage regimen from 160 to 260 d of age, as well as normal-weaning extended the growth curve, improved intramuscular fat content, and increased muscle tenderness. Limit feeding a high concentrate diet did not extend the growth curve or increase muscle tenderness, but did improve intramuscular fat content, indicating that source and amount of energy affected partitioning of fat deposition.

**Key Words:** Beef cattle, Early-weaned, Limit-feeding

### 430 Effect of source of energy, and rate of growth in the growing phase on adipocytecellularity, and lipogenic enzyme activity in the intramuscular and subcutaneous fat depots of Holstein steers. J. P. Schoonmaker, F. L. Fluharty, and S. C. Loerch, The Ohio State University, Wooster, OH.

Seventy-three Holstein steers (init. BW 138.5 ± 4.3 kg), approximately three months of age, were allotted by BW to one of three growing phase treatments to determine the effect of source and amount of energy on feedlot performance, and characteristics of subcutaneous (SC) and intramuscular (IM) adipose tissue. Treatments were: 1) high concentrate diet fed ad libitum (ALC), 2) high forage diet fed ad libitum for 55 d, then a mid-level forage diet fed ad libitum for 98 d (ALF) or 3) limit-fed a high concentrate diet to achieve a gain of 0.8 kg/d for 55 d, then 1.2 kg/d for 98 d (LFC). All steers were fed the ALC diet from d 154 to slaughter. Eight steers per treatment were selected after an average of 145 and 334 d on feed for determination of adipocyte cellularity and lipogenic enzyme activity. Remaining steers were slaughtered after an average of 344 d on feed. At initial slaughter, ALC steers had approximately twice as much (P<0.01) SC and IM fat. At final slaughter, LFC steers had the greatest (P<0.09) fat depth, and greatest (P<0.08) longissimus muscle ether extract. Increased fat depth for ALC steers at initial slaughter was a result of a greater (P<0.01) mean adipocyte diameter in the SC depot. Mean IM adipocyte diameter followed the same trend (P=0.16). The number of adipocytes/g of SC fat was lowest for ALC and greatest for ALF (P<0.09) at initial slaughter. Mean diameter and number of adipocytes/g of IM and SC fat did not differ (P>0.52) among treatments at final slaughter (after 174 d on a common finishing diet). Amount of energy (ALC) increased activities of ATP-citrate lyase, fatty acid synthetase, 6-phosphogluconate dehydrogenase, glucose-6-phosphate dehydrogenase, and malate dehydrogenase in the SC depot (P<0.02), and increased activities of ATP-citrate lyase and glucose-6-phosphate dehydrogenase in the IM depot (P<0.10) at initial
slaughter. Lipogenic enzyme activity in the SC depot at final slaughter, did not differ (P>0.33) among treatments. Glucose-6-phosphate dehydrogenase activity in the IM depot at final slaughter was decreased (P<0.08) in ALF. Hypertrophy made a greater contribution to fat tissue growth than hyperplasia. Hypertrophy was affected by amount, whereas hyperplasia was affected by source of energy. Differences diminished when cattle were placed on the common finishing diet.

Key Words: Early-weaning, Limit-feeding, Adipocyte characteristics


Ground flaxseed fed to feeder cattle at approximately 10% of the diet has been shown to increase plasma and longissimus muscle concentrations of alpha linolenic acid and ricinocapentanoic acid, and to increase quality grades, while decreasing retail display life of the product. An experiment was conducted to determine the effects of combinations of ground flaxseed and vitamin E on feedlot performance, carcass quality, retail display life, and fatty acid composition. Steers (n=79; 338 kg BW) were individually fed diets containing ground flaxseed at 0, 5, 10, or 15% of the diet and without and without the addition of 220 IU vitamin E/kg DM. All diets were fed throughout a 120-d finishing period. After completion of the finishing period, carcass data, including hot carcase weight, yield grade, marbling score, subcutaneous fat thickness, ribeye area, and percentage of kidney, pelvic and heart fat, were determined for each animal. Also, retail display life, 2-Thiobarbituric Acid Reactive Substances of retail display life, 2-Thiobarbituric Acid Reactive Substances, and sensory attributes of longissimus dorsi muscles were evaluated. Cattle fed flax had a linear tendency (P=0.08) for increased average daily gain, DMI was increased (P<0.05), but gain/feed was not affected. There was a quadratic effect (P=0.05) of flax level on KPH, and the amount of fat over the 12th rib (P<0.05). Additionally, there was a linear increase in dressing percent as level of flax was increased (P<0.05). Feeding flaxseed tended (P=0.08) to increase the percentage of carcass USDA Choice, with 5% flax as the optimum level. There were no differences in TBARS or Warner Bratzler shear force among any of the treatments. A trained taste panel evaluated myofibrillar tenderness, juiciness, flavor intensity, connective tissue amount, overall tenderness, and off-flavor intensity on the steaks, but observed no differences among treatments. Retail display life displayed was improved (P<0.05) by feeding any level of flax with vitamin E. Vitamin E did not improve retail shelf life in the absence of flax. Dietary treatments combining vitamin E and ground flaxseed produced no negative effects on meat quality. Flax is an acceptable source of energy and may enhance growth and carcass quality attributes of cattle.

Key Words: Flaxseed, Vitamin E, Carcass quality


Low-glucose heifers had lower final plasma glucose (P = 0.009; 114 vs 139 mg/dL); consumed more feed (P = 0.02); had heavier final live BW (P = 0.02); and greater fat thickness (P < 0.05). Glucose concentration did not affect feed efficiency or morbidity (P > 0.65). Apparent NE<sub>r</sub> for cane molasses and CSB were not different (P = 0.20). Concentrated separator byproduct is a suitable replacement for cane molasses. Cattle that had low glucose at arrival had improved finishing performance and fatter carcasses compared to heifers with high blood glucose at arrival.

Key Words: Concentrated separator byproduct, Cane molasses, Blood glucose

433 Effects of dietary crude protein level and degradability on performance and carcass characteristics of growing-finishing beef steers. J. F. Gleghorn<sup>4</sup>, N. A. Elam<sup>1</sup>, M. L. Galvez<sup>2</sup>, G. C. Duff<sup>2</sup>, and N. A. Cole<sup>1</sup>, <sup>1</sup>Texas Tech University, Lubbock, TX, <sup>2</sup>University of Arizona, Tucson, AZ, <sup>3</sup>USDA-ARS-CPRL, Bushland, TX.

Two experiments were conducted at two locations to determine the effects of dietary CP level and source on performance and carcass characteristics of beef steers. British × Continental steers were blocked by BW (357 ± 28 and 305 ± 25 kg initial BW; n=360 and 225; four and five pens/treatment in Exp. 1 and 2, respectively). Steami-flaked corn-based diets were arranged in a 2×3 factorial with three CP levels (11.5, 13, 14.5% of DM) and three sources of supplemental CP (N basis): 100% urea (U), 50:50 blend of urea and cottonseed meal (B), or 100% cottonseed meal (C). Steers in both experiments were initially implanted with Ralgro and reimplanted with Revalor-S on d 56. Performance and carcass data were pooled over location and analyzed with mixed model procedures using pen as the experimental unit. Crude protein level quadratically affected ADG (P < 0.05) and carcass-adjusted (to a common dress) ADG (P < 0.10). Increasing the level of supplemental CP increased carcass-adjusted ADG and gain:feed (P < 0.05) and carcass-adjusted gain:feed (P < 0.001). Dry matter intake was not affected by CP level or source (P > 0.10). Dry matter intake was not affected by CP level or source (P > 0.10). Hot carcass weight (HCW) and longissimus muscle area (LMA) were increased linearly with increasing urea level (P < 0.006), whereas increasing CP level quadratically affected HCW (P < 0.05), with a maximum value at 13% CP. Differences in back fat thickness and yield grade were negligible across treatments. Neither marbling score nor percentage of carcasses grading Choice was affected by CP level or source. Results indicate that increasing CP levels from 11.5 to 13% slightly increased ADG and carcass-adjusted ADG, whereas increasing the proportion of supplemental urea increased carcass-adjusted ADG, gain:feed, carcass-adjusted gain:feed, HCW, LMA, and dressing percent. A CP level above 13% seemed to be detrimental to ADG and HCW.

Key Words: Beef cattle, Crude protein, Urea

434 Processing Methods that Influence Characteristics of Steam-Flaked Corn. J. J. Sindt*, J. S. Drouillard, S. P. Montgomery, and E. R. Loe, Kansas State University, Manhattan.

We evaluated surfactant (SRF) concentration, tempering (TMP) moisture concentration, duration of steam (STM) conditioning, and flake density (DEN) as variables that potentially influence characteristics of steam-flaked corn. Samples of whole corn (n=12; 89% DM; 2 kg/sample) were weighed and placed into individual glass jars (3.785 L). Samples were then tempered in water (6, 10, or 14% added water to achieve 17, 21, and 25% moisture after TMP) containing 0 or 0.67 g/L of SRF and rotated continuously for 2 h at 20°C. Samples were then subjected to STM for either 20 or 40 min in a 12-chamber STM conditioner. After STM conditioning, samples were flaked to a common DEN. This procedure was replicated three times daily using three flake DEN (360, 335, and 310 g/L) and repeated for three consecutive days to complete a 2×3×3 factorial arrangement of treatments. Samples of corn were collected following TMP, STM, and flaking. As expected, TMP increased (linear, P<0.001) flaked-corn moisture content, however, moisture content was not altered by SRF (P=0.38), STM (P=0.17) or DEN (P=0.86). Adding the SRF during TMP reduced (P<0.05) the amount of moisture lost from corn between steaming and flaking. In vitro gas production was not affected by TMP (P=0.62), SRF (P=0.31), or STM (P=0.33), however, decreasing DEN increased (linear, P<0.01) the volume of gas produced. Flake durability was tested by tumbling the flakes for 10 min in a commercial durability tester and measuring the amount of flakes.
retained on a 9.5 mm screen. Increasing STM duration while increasing TMP moisture concentration increased the proportion of grain retained on a 9.5 mm screen (P < 0.05; STM duration x TMP moisture interaction). Additionally, decreasing DEN improved (linear, P < 0.05) flake durability. Fermentation characteristics are most influenced by DEN, and flake integrity can be improved by increasing TMP moisture and STM duration, or by reducing DEN.

Key Words: Steam-flaked corn, Grain processing, Tempering


Two experiments were conducted to evaluate full-fat corn germ (FFCG) as a fat source in finishing diets. In Exp. 1, crossedbred beef steers (n = 358; BW = 319 kg) were blocked by previous treatment and assigned randomly to each of four dietary treatments providing six pens per treatment. Treatments consisted of diets containing dry-rolled corn and 35% wet corn gluten feed (DM basis) and 0, 5, 10, or 15% FFCG. Diets were offered once daily for the entire 155-d finishing period. Increasing FFCG decreased (linear, P < 0.05) DMI and ADG and increased (linear, P < 0.05) flake dry matter digestibility, microbial protein (DMD) (linear, P < 0.02) of steers but increased gain efficiency (linear, P < 0.01). Additions of FFCG increased (linear, P < 0.04) kidney, pelvic, and heart fat, and USDA Yield Grade. In Exp2, crossbred beef heifers (n = 888; BW = 380 kg) were allotted randomly to pens and pens were blocked by date of implanting. Pens were assigned randomly to each of eight dietary treatments arranged in a 4 x 2 factorial providing six pens per treatment. Treatments consisted of diets formulated to provide no added fat (Control), 4% tallow, (Tallow), or 10% or 15% FFCG on a DM basis with or without 2000 IU of additional vitamin E. Diets were offered once daily for the entire 105-d finishing period. No fat x vitamin E interaction was detected (P > 0.20). Fat addition decreased (P < 0.01) DMI, marbling score and the number of carcasses grading USDA Choice. Tallow and 10% FFCG were not different (P > 0.06). Increasing FFCG decreased (quadratic, P < 0.03) ADG (1.29, 1.31, 1.20 kg) and gain efficiency (0.146, 0.154, 0.147 kg gain/kg DMI). Increasing FFCG decreased (linear, P < 0.05) DMI, marbling score, and the percentage of carcasses grading USDA Choice. None of the treatments included in the 0% WCS group to 20 nmol·mg protein−1·7 min−1 in the 15% WCS group. The i.f. saturated fatty acid percentages increased (P < 0.01) with increasing levels of WCS, and there was a tendency (P < 0.09) for a similar effect in subcutaneous adipose. The i.f. cis-9, trans-11 CLA percentage increased with increasing WCS in the steers fed the corn diet, whereas it remained unchanged or even decreased slightly in the steers fed the flaxseed or milo based diets (interaction, P < 0.02). Steers fed flaxseed had a greater (P < 0.01) s.c. adipose concentration of vaccenic acid (18:1trans-11) than the steers fed milo and tended (P < 0.07) to have greater amount of vaccenic acid than steers fed corn alone. Steers fed flaxseed also had greater (P < 0.01) s.c. and i.f. percentages of the α-linolenic acid (18:3n-3) than steers fed either of the other grain sources, and this effect accompanied a similar increase (P < 0.01) in total polyunsaturated fatty acid percentages. Steers fed flaxseed had a larger mean adipocyte volume in i.f. adipose tissue (P < 0.01), which tended to be larger in s.c. adipose tissue (P < 0.06). The increases in saturated fatty acids in s.c. adipose tissue appear to be a result of the decreased SCD activity in s.c. adipose tissue with increased inclusion of WCS. Increased dietary α-linolenic acid from flaxseed may have increased s.c. adipocyte volume by stimulating lipogenesis.

Key Words: Steers, Adipose metabolism, Linolenic acid

437 Finishing diets with elevated levels of α-linolenic acid increase adipose tissue α-linolenic acid, but do not alter stearyl-CoA desaturase activity. S. L. Archibeque*, D. K. Lunt1, R. K. Tune2, and S. B. Smith1, 1Texas A&M University, College Station, TX, 2Food Science Australia, Tingalpa D. C. Queensland, Australia.

Forty-five Angus steers (35 kg BW) were used in a 3 x 3 factorial, completely randomized block design evaluate the hypothesis that dietary α-linolenic acid (from corn, corn with flaxseed, or milo) and whole cottonseed (WCS) inclusion (0, 5, or 15% DM) would interact with partition of fatty acid and deposition of their lipid pool. Lipogenesis from acetate in s.c. adipose tissue was greater (P < 0.01) in steers fed flaxseed (5.42 nmol·h−1·100·106 cells−1) than in the corn (3.10 nmol·h−1·100·106 cells−1) or milo (1.92 nmol·h−1·100·106 cells−1) groups. Stearyl-CoA desaturase activity (SCD) in s.c. adipose tissue decreased (P < 0.04) from 53 nmol·mg protein−1·7 min−1 in the 0% WCS group to 20 nmol·mg protein−1·7 min−1 in the 15% WCS group. The i.f. saturated fatty acid percentages increased (P < 0.01) with increasing levels of WCS, and there was a tendency (P < 0.09) for a similar effect in subcutaneous adipose. The i.f. cis-9, trans-11 CLA percentage increased with increasing WCS in the steers fed the corn diet, whereas it remained unchanged or even decreased slightly in the steers fed the flaxseed or milo based diets (interaction, P < 0.02). Steers fed flaxseed had a greater (P < 0.01) s.c. adipose concentration of vaccenic acid (18:1trans-11) than the steers fed milo and tended (P < 0.07) to have greater amount of vaccenic acid than steers fed corn alone. Steers fed flaxseed also had greater (P < 0.01) s.c. and i.f. percentages of the α-linolenic acid (18:3n-3) than steers fed either of the other grain sources, and this effect accompanied a similar increase (P < 0.01) in total polyunsaturated fatty acid concentrations. Steers fed flaxseed had a larger mean adipocyte volume in i.f. adipose tissue (P < 0.01), which tended to be larger in s.c. adipose tissue (P < 0.06). The increases in saturated fatty acids in s.c. adipose tissue appear to be a result of the decreased SCD activity in s.c. adipose tissue with increased inclusion of WCS. Increased dietary α-linolenic acid from flaxseed may have increased s.c. adipocyte volume by stimulating lipogenesis.

Key Words: Steers, Adipose metabolism, Linolenic acid

438 Conjugated Linoleic Acid in tissues from beef cattle fed different lipid supplements. S. F. Porter1, T. R. Dhiman1, D. P. Comforth1, R. D. Wiedmeier1, K. C. Olson1, B. R. Bowman1, and N. D. Luchini2, 1Utah State University, Logan, UT, 2Bioproduts Inc., Fairlawn, OH.

The objective was to utilize fat supplements mixed with a high-grain ration to increase Conjugated Linoleic Acid (CLA) levels in beef cattle tissue and provide beef that is desirable to the consumer. Sixteen steers and 8 heifers were blocked according to body weight and assigned to 1 of 4 treatments. Animals were fed a TMR consisting of ground barley (78%), alfalfa hay, and corn silage plus 300 g/hd·d of either Megalac (ML) as control, fish oil (FO), partially rumen-protected trans fat (TF), or linseed oil (LO) as a fat supplement mixed into the TMR. Animals were fed at an average of 2.75% and then allowed to consume between 450 and 590 kg live body weight. At slaughter, muscle, adipose tissue, and edible fat samples were collected from the loin and round and analyzed for fatty acid profile. There was no tissue-by-treatment or site-by-treatment interaction (P > 0.05), so all samples were pooled and the overall treatment means were reported. Tissues from TF and LO cattle had higher average cis-9 trans-11 CLA levels than FO and ML treatments (P < 0.05). Cis-9 trans-11 CLA levels for ML, FO, TF, and LO were 0.24±, 0.26±, 0.45±, and 0.41±, % of total fatty acids, respectively. Trans-10 cis-12 CLA levels
were not different between treatments (P<0.05) and averaged 0.016% of total fatty acids. Color stability tests were performed tri-weekly on top loin steaks for 21 d. By day 7, FO steaks had a higher hue angle (indicating bronwness), which continued until day 20 (P<0.05). Neck muscle vitamin E levels in FO were lower than in LO and TF, but not different from ML (P<0.05). Vitamin E values for ML, FO, TF, and LO were 2.35±b, 1.58±, 3.29±, and 2.99±, g/kg of neck muscle, respectively. Off-flavor was stronger in FO (P<0.05) according to a trained taste panel. In the present study, supplementing trans fat and linseed oil increased cis-9 trans-11 CLA levels in beef tissue by 88% and 71% compared to control, respectively. The TF and LO treatments had 108% and 89% higher tissue vitamin E levels than FO, respectively. Feeding fish oil decreased color stability and introduced an off-flavor to the beef.

**Key Words:** Beef, Fat, Conjugated linoleic acid

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### Dairy Foods Symposium: Dairy foods research success stories

**439 Dairy foods research success stories.** W. Sandine, C. White, D. Hettinga, J. Hotchkiss, R. Thunell, M. Mangino, and D. Willrett, Oregon State University, Mississippi State University, Land O’ Lakes, Inc., Cornell University, DSM, Ohio State University.

This symposium results from the need to remind federal granting agencies and legislators of the economic and social benefits from agricultural research. While research funding from NSF and NIH has increased dramatically since 1990, that for agriculture has decreased, especially for agricultural experiment stations. Examples will be given. Research success stories benefiting this nation will be presented: A brief history of dairy foods research and its contribution to the American way of life; the dramatic impact of increased market milk shelf life for consumers and industry profits; the value of cheese starter culture media developments to industry and consumers; the defined strain starter culture program for Cheddar cheese plants; carbon dioxide and shelf life extension in cottage cheese for an expanded market; and successful whey research yields new products and eliminates an environmental pollutant. From these and other success stories the 38 member societies of CAST along with N-CFAR and other agencies are developing Fact Sheets to distribute to members of the U.S. congress and administrators to heighten their awareness of needed funding increases for agricultural research.

**Key Words:** Research, Funding, CAST

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### Beef Species: Beef cattle performance

**440 Influence of breed on performance and dry matter intake by feedlot bull calves in Brazil.** R. Almeida, D. P.D. Lanna, UFFR and PUCPR, PR, Brazil, 1LNCA-ESALQ/USP, SP, Brazil.

Performance and daily feed intake records from the largest bull test in Brazil were analyzed to determine differences attributable to breed. Postweaning performance of purebred calves was evaluated from seventeen pens, which held 145 Angus, 342 Brangus and 911 Nellore, for a total of 1,398 bulls tested in 2000, 2001 and 2002. Bulls calves arrived at 8 months of age and initial weight of 218 kg, and were fed for 28 days of adaptation and 112 days of test. A high forage diet (50% of DM as concentrate; 14% CP and 67% TDN) typical of Brazilian feedlots was used and monensin included at 27 ppm. Data were analyzed using GLM procedure of SAS. The first data set (performance data) included 1,398 individual records and the second set used 17 pens monitored daily for dry matter intake. Breed type affects steer growth at 8, 9 (P<0.01) and 11 (P<0.05) months, but not (P>0.05) at 13 months of age (end of feedlot period). Nellore bulls started on test with heavier weights but had the same final weight (13 months) as Angus and Brangus. Breed type also affected (P<0.01) average daily gain. Brangus and Angus had higher gains (1.34 ± 0.04 and 1.27 ± 0.03 kg/d) than Nellore bulls (1.19 ± 0.02 kg/d). Angus and Brangus consumed more feed (P<0.01) than Nellore calves. During the 112-day evaluation period intakes for Angus, Brangus and Nellore calves were: 7.23±, 6.06±, and 5.18± kg of dry matter/day, respectively. There were no differences (P>0.05) in feed efficiency among breeds. NRC (1984 and 1996) equations were used to predict DMI. The biases were -0.3, +0.6 and +10.0% for the NRC (1984) and -3.0, -2.1 and +7.2% for the NRC (1996), and for Angus, Brangus and Nellore, respectively. NRC equations overpredicted DMI for Bos indicus breeds. New DMI prediction equations for high roughage and purebred Zebu cattle need to be developed and validated.

**Key Words:** Beef cattle, Feed intake, Nellore

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**441 Evaluation of yearling bull sale prices at six regional locations.** D. Dean and A. Henning, Texas A&M University, College Station.

During the spring of 2001, a seedstock marketing cooperative conducted six sales in CO, IA, ID, MO, and SD. Breeders delivered bulls to locations approximately 150 d prior to sale date; bulls were fed to gain approximately 1.4 kg/d. The purpose of this study was to evaluate specific areas of selection used by commercial producers and their effect on sale prices of purebred purebreds. Data on Gelbvieh (GV, n = 675), Angus (AN, n = 65) and Red Angus (RA, n = 50) bulls were analyzed.

Specific traits available included sale price, age-adjusted ultrasound rib-eye area (ADJREA), age-adjusted ultrasound intramuscular fat percentage (ADJUMIF), age-adjusted ultrasound 12th and 13th rib backfat thickness (ADJUBFT), actual birth weight (BWT), actual weaning weight (WWT), average daily gain (ADG), ADG ratio, adjusted yearling weight (ADJYW), Frame score (FRAME), scrotal circumference (SC), birth weight EPD (BWTEPD), weaning weight EPD (WWTEPD), yearling weight EPD (YWEPD), milk production EPD (MILKEPD), total maternal EPD (TMEDP). AN and RA bulls were combined into one group and analyzed separately from GV bulls. RA EPDs were adjusted to the AN base according to 2001 across breed EPD adjustments. Sale price was analyzed by GLM procedures of SAS with independent variables of sire, with regressions on ADJREA, ADJUMIF, ADJUBFT, BWT, WW, ADG, ADG ratio, ADJYW, FRAME, SC, BWTEPD, WWTEPD, YWEPD, MILKEPD, and TMEDP. EPDs did not account for differences in sale price for GV bulls. Sire (P = 0.0005), BWT (P = 0.0288), WW (P = 0.055), ADG (P = 0.0386), ADGRATIO (P = 0.0159), SCROTAL (P = 0.0006) and ADJREA (P = 0.0001) affected prices paid by customers buying GV bulls with a slight trend for ADJBACKFat (P = 0.0628). Among GV bulls, sale price difference per unit change of the independent variables BWT, WW, ADG, ADG ratio, SC, ADJREA, and BACKFAT were $7.79, $1.09/kg, $256.88, $9.95, $41.71, $82.66, and $116.87, respectively. Among ANRA bulls, only ADJYWEPD affected (P = 0.05) sale prices, with a price per unit change of $4.24. EPDs were not influential in sale prices of these yearling bulls that had actual performance data reported in sale catalogs.

**Key Words:** Sale prices, Yearling bulls, Performance data

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**442 Evaluation of forage sources for finishing diets containing wet corn gluten feed.** C. R. Dahlen, A. DiCostanzo, R. T. Ethington, T. L. Durham, J. E. Larson, G. C. Lamb, Northwest Research and Outreach Center, University of Minnesota, Department of Animal Science, University of Minnesota, Kansas Feeds, Inc, ADM Corn Processing, North Central Research and Outreach Center, University of Minnesota.

Two hundred twenty-three Angus crossbred steers (308 kg) were used to evaluate effects of various forage sources in diets containing wet corn gluten feed. Steers were assigned by weight and origin to one of sixteen pens (14 or 15 steers/pen). Pens were randomly assigned to one of five dietary treatments. Dietary treatments consisted of diets balanced (1.39 Mcal NE2/kg DM; 12.5% CP) using high moisture and dry rolled corn (50/50 DM basis) with one of the following forage sources: corn silage (n = 3), wet corn gluten feed (n = 3), or wet corn gluten feed in combination with cow manure (n = 3), grass-legume hay (n = 3), or both (n = 4). Effects of yearling source on performance and carcass characteristics were determined using non-orthogonal contrasts. Steers fed diets containing...
wet corn gluten feed had similar (P > 0.05) performance and carcass characteristics as those fed the corn grain and corn silage diet. Steers fed the diet containing wet corn gluten feed without added forage gained faster (P = 0.05), required fewer (P < 0.05) kg DM/kg gain and were heavier at slaughter (live and carcass weights; P < 0.05) than steers fed diets containing wet corn gluten feed with additional forage. Steers fed the diet containing wet corn gluten feed and hay gained faster (P < 0.05), reached heavier final and carcass weights (P < 0.01), and greater dressing percentage (P < 0.01) than those fed the diet containing wet corn gluten feed and corn silage. Steers fed diets containing wet corn gluten feed in combination with either forage source had similar (P > 0.05) feedlot performance and carcass characteristics. Diets containing corn, wet corn gluten feed and corn silage either alone or with hay resulted in negative associative effects on estimated energy content of the diet (R² = 0.71; P < 0.01). The magnitude of this effect was greater (more negative) for the diet containing wet corn gluten feed in combination with corn silage. Combining wet corn gluten feed with corn silage, hay, or both led to associative effects that reduced feedlot performance.

Key Words: Steers, Corn gluten feed, Associative effects


There has been speculation as to whether short-fed finishing heifers require exogenous estrogen in addition to trenbolone acetate (TBA) when melengestrol acetate (MGA) is fed only in the final finishing ration. The objective of this study was to evaluate the effects of implants containing different levels of estradiol (E₂) and TBA compared to implants containing TBA alone on performance and carcass traits of short-fed finishing heifers. A total of 1,796 yearling heifers (352 kg) were used in a randomized complete block study. Treatments were: 1) REV-1H (80 mg of TBA and 8 mg of E₂), 2) REV-1H (140 mg of TBA and 14 mg E₂), 3) REV-200 (200 mg TBA and 20 mg E₂), and 4) FIN-H (200 mg TBA). All heifers were fed 4 mg of MGA per head daily, starting with the finishing ration (d 24-27) and were fed for a total of 121 days. Heifers implanted with REV-200 tended to gain faster (P<0.10), were more efficient (P<0.05) on a carcass-adjusted basis, and tended to have heavier hot carcass weights (P<0.10) than heifers in any other treatment group. Implanting with REV-200 tended to cause a reduction in percentage of Prime & Choice carcasses (P<0.10) and increased the percentage of Select carcasses (P<0.05) compared to FIN-H or REV-H. However, differences in quality grade corresponded to differences in Yield Grade. In this study, REV-200 tended to improve rate of gain and hot carcass weights and improved efficiency of gain and dressing percentage compared to other implant treatments. When single implant strategies are utilized in short-fed finishing heifers, and MGA is included only in the final finishing diet, implanting with higher levels of E₂/TBA may improve rate and efficiency of gain, carcass weight, and dressing percentage.

Key Words: Implats, Feedlot, Steers


Eight hundred and three, English × Exotic crossbred yearling steers (431 kg) were used in a randomized complete block study. The objective of the study was to evaluate the performance of heavy yearling steers given one of 3 different dosage implants. Treatments were: 1) Revalor-S (RS; 120 mg trenbolone acetate (TBA) and 24 mg estradiol (E₂) 2) Revalor-IS (IS; 80 mg TBA and 16 mg E₂), 3) Component-ES (ES; 20 mg estradiol benzoate and 200 mg progesterone). Steers were blocked by weight into 4 pen blocks per treatment with 67 head per pen. Steers were implanted at initial processing and fed for a total of 118 days. Steers implanted with RS and IS gained 7.7 and 5.0% faster (P<0.05) and had 4.0 and 3.4% (P<0.05) better dry matter feed conversion when compared to ES steers. Also, RS and IS increased (P<0.05) hot carcass weight 11.3 and 7.7 kg over ES implanted steers. Steers implanted with RS had increased (P<0.05) ribeye area when compared to IS and ES steers. Dressing percent was similar (P=0.99) across all treatments. There were no differences in percent Choice and Prime carcasses, which averaged 52, 56 and 57% for RS, IS and ES, respectively. In heavy, short-fed yearling steers, utilizing either a reduced-dose or full-dose combination E₂/TBA implant increased performance when compared to using an estrogen-based implant, with no adverse impact on quality grade. The data indicates that the use of Revalor-S and Revalor-IS can improve performance while maintaining a similar number of carcasses grading Choice and Prime when compared to Component-ES implanted steers.

Key Words: Implants, Feedlot, Steers


One thousand three hundred forty-four English × Continental crossbred steers (avg. 307 kg) were used in a randomized complete block study. The objective of the study was to evaluate the performance of feedlot steers given different dose implants either as single or re-implant programs. Treatments were: 1) Revalor-S (120 mg trenbolone acetate (TBA) & 24 mg estradiol (E₂) day 0 (RS), 2) Revalor-IS (80 mg TBA & 16 mg E₂) day 0 (IS), 3) Revalor-IS day 0 and Revalor-IS day 50 (IS-IS), and 4) Revalor-IS day 0 and Revalor-S day 50 (IS-RS). Component-ES (20 mg estradiol benzoate & 200 mg progesterone) steers were blocked by weight, and there were 4 pens per treatment with 67 steers per pen. Steers were fed for 186 days. Data were analyzed using GLM of SAS with pen as the experimental unit, and means were separated using LSD with a protected F-test (P<0.10). Steers implanted with IS-RS tended to have higher average daily gains and heavier final weights than any of the single implant treatments (P<0.10) on a live basis and higher average daily gain and better feed conversion vs. all other treatments on a carcass adjusted basis (P<0.10). Steers implanted with IS-RS also tended to have significantly heavier carcass weights than any of the single implant treatments (P<0.10). Percentage of carcasses grading Prime + Choice combined were 36, 34, 34, 43, and 41%, for IS-RS, IS-IS, RS, IS and ES, respectively and were not different (P=0.35) between treatments but steers implanted with ES and IS tended to have a higher percentage of carcasses (18 and 17.6%) which graded Prime + upper 2/3 Choice combined than IS-RS or RS, (11.5 and 12.3%; P<0.10), with IS-IS being intermediate (12.5%). However, differences in marbling and quality grade were explained by differences in empty body fatness, as there was a correlation between empty body fat and both marbling score (r=0.46; P=0.04) and percent Prime + Choice combined (r=0.57; P=0.09). These data indicate that daily gain, efficiency and carcass weight may be improved using Revalor-IS followed by Revalor-S compared to single implant programs in steers fed for 186 days, with minimum impact on quality grade, provided cattle are marketed at a similar body fatness endpoint.

Key Words: Implants, Feedlot, Steers
Response to selection by marker assisted BLUP with use of approximate gametic variance covariance matrices. L. R. Totir*, R. L. Fernando, and J. C. M. Dekkers, Iowa State University.

Under additive inheritance, Henderson’s mixed model equations (HMMME) provide an efficient approach to obtain genetic evaluations by marker assisted best linear unbiased prediction (MABLUP) given pedigree relationships, trait, and marker data. For large pedigrees with many missing markers, however, it is not feasible to calculate the exact gametic variance covariance matrix required to construct HMMME. The objective of this study is to investigate the consequences of using approximate gametic variance covariance matrices on response to selection by MABLUP. Two methods were used to generate approximate variance covariance matrices. The first method (Method A) completely discards the marker information for individuals with unknown linkage phase between two flanking markers. The second method (Method B) makes use of the marker information at only the most polymorphic marker locus for individuals with unknown linkage phase. Data sets were simulated with complete or incomplete marker data for flanking markers with 2, 4, 6, 8 or 12 alleles. Several missing marker data patterns were considered. The genetic variability explained by marker quantitative trait loci (MQTL) was modeled with one or two MQTL of equal effect. Response to selection by MABLUP using Method A or Method B were compared with that obtained by MABLUP using the exact genetic variance covariance matrix, which was estimated using 15,000 samples from the conditional distribution of genotypic values given the observed marker data. For the simulated conditions, the superiority of MABLUP over BLUP based only on pedigree relationships and trait data varied between 0.0% and 10.6% for Method A, between 1.1% and 16.2% for Method B, and between 4.1% and 18.5% for the exact method. The difference between response to selection obtained for the model with one MQTL and the model with two MQTL was small.

**Key Words:** Marker assisted selection, BLUP, Genetic variance covariance matrix

A simulation program using finite loci with infinite possibilities, FLIP, P. L. Spike*, R. L. Benson1, R. L. Fernando1, J. C. M. Dekkers1, P. J. Berger1, and B. R. Skaar1, Iowa State University.

A simulation program was developed in C++ for instructional use in animal breeding and genetics classes and for simulation research. The purpose of the program is to simulate animal performance for a species of choice with multiple traits and multiple breed populations. Animal performance is simulated by combining the effects of a finite number of loci in diploid organisms with random variation. The core of the program consists of “known” alleles assigned to loci on a variable number of pairs of homologous chromosomes and a single pair of sex chromosomes. Alleles can be genes or other unique DNA sequences that may serve as markers. The effects of the “known” gene combinations can be assigned such that both additive and non-additive effects can be defined for both allelic and non-allelic sets of gene pairs. The effects of “known” gene combinations can include the effects of imprinting. Optionally, the program can create additional “unknown” genes to increase the genetic variance-covariance resulting from the “known” genes to a desired level. These “unknown” genes are assumed to be inherited independently. In addition, more “unknown” genes can be added to increase the level of inbreeding depression expected from the “known” genes to a desired level of inbreeding depression. Finally, additional “unknown” genes can be created for use with multiple populations that will increase the levels of heterosis expected from the “known” genes to a desired level of heterosis. Genetic evaluation software will be used to produce genetic evaluations consistent with industry practices. Work continues on the development of a student interface to access animal performance, exchange genetic material among students and incorporate some economic evaluation of student progress.

**Key Words:** Genetic Simulation, Finite Locus


Genetic evaluation for secondary traits has increased considerably worldwide. Several secondary traits (e.g. fertility, health data) are now of crucial economical interest in different genetic improvement programs. Development of Monte Carlo methods for binary data made use of the threshold model (TM) as a standard tool to deal with such data. In the animal breeding field, given the theoretical and computational complexity of analysis of multiple binary traits, such analysis was done assuming a Gaussian distribution for the binary traits. In a Bayesian joint analysis of several binary responses using a TM, the major problem resides in the sampling of the residual (co)variance (RCV) matrix as results of the fixation of some of the diagonal elements of such matrix to overcome the identification problem. Hence, several alternative sampling techniques have been proposed based on the partition of the RCV matrix. Although these methods are theoretically sound, some computational and implementation problems can emerge, especially with large number of binary traits. The method we propose overcomes all the computational and implementation problems associated with the sampling of the RCV matrix. It consists in working with the non-identifiable TM. Once draws from the non-identifiable model are obtained, they are transformed to the identifiable scale using the square root of the diagonal elements of the non-identifiable residual variance matrix. Two simulations with 3 and 8 binary traits were conducted to test the proposed method. Based on five replicates, the bias was less than 3% and 2% for the genetic and RCV, respectively, in both cases. Such bias is well within the Monte Carlo error. Compared two actual methods (Metropolis-Hastings or matrix decomposition) used in analysis of multiple binary responses, the proposed method yielded more accurate results (less bias) and was extremely superior from computational point of view. The proposed method was applied to test-day mastitis data where mastitis status in each test-day was treated as different trait.

**Key Words:** Binary traits, Threshold model, Residual variances

Comparison of estimation methods for heterogeneous residual variances with random regression models. S. Tsuruta1, I. Misztal1, and T. Druet1, University of Georgia, Athens GA, 2 Station de Genetique Quantitative et Applique, INRA, Jouyen-Josas Cedex, France.

The objective of this study was to compare estimation methods of heterogeneous residual variances with random regression models. (Co)variance components were estimated with two data sets; milk yields (600 test day records for 354 cows in the first data set and 30,041 first records with 1 record per cow) in Holsteins. Up to third order Legendre polynomials for additive genetic effects were included in the models as random regressions on days in milk for milk yields and on year at first calving for final scores. Heterogeneous residual variances were estimated by logarithmic third order polynomials via AI-REML, intervals via Gibbs Sampler, or an extra error effect via REML. In the interval method, ten and five intervals for residual variances were assigned in the models for test day records and for final scores, respectively. Additive genetic variances were not different among heterogeneous residual variance estimation methods. Estimates of heritability and heterogeneous residual variances were similar for all methods except the interval method, in which the data size for each interval may not have been sufficient. Estimating heterogeneous residual variances with an error effect did not require program modifications and was easily applicable to multiple traits, but was computationally about five times more expensive. The extra error method and the logarithmic polynomial method may be better if variations of residual variances are small or regular. Also, the logarithmic method may have better estimating properties due to fewer parameters. When changes of residual variances are irregular, the interval method may be adequate. In practice, less expensive methods such as the interval method with sufficient data or the logarithmic polynomial method may be better choices for estimating heterogeneous residual variances with random regression models.

**Key Words:** Heterogeneous residual variances, Genetic parameters, Random regression models
Covariance functions estimated by fitting random regression models can contain artifacts (e.g., very high variances or correlations) due to small data sets, data structure or limitations of random regression models. These functions contain variances along trajectories and covariances between any two points for any given combination of traits. However, their high dimensionality makes it difficult to thoroughly check all these aspects. A library of functions was written in a matrix-algebra package to visualize time-dependent (co)variances and correlations among and within traits for different effects (additive direct and maternal, permanent...). Two sets of parameter estimates were analyzed. The first set, obtained using 4th order Legendre polynomials, is used in routine test-day evaluation of Canadian Holstein for 12 traits: milk, fat and protein yields and somatic cell scores in three parities. Covariance functions generally showed smooth patterns. Correlations decreased regularly with time within the same trait or among production traits. Correlations of yields with somatic cell score exhibited a more undulating shape. Values were generally small and negative, oscillating between 0.19 and -0.25, with high positive values seen only in the extremes of the trajectories. The second set, obtained using cubic Legendre polynomials, was an analysis of sequential weights of animals up to 2 years of age in Brazilian Nellore, fitting direct and maternal effects. Small peaks in the correlation patterns occurred relatively frequently. Correlations among maternal and direct additive effects dependent on the age oscillated between 0.35 and -0.65. Negative values were seen along most of the trajectory, and the value of 0.35 was observed in the correlation between direct additive effect at day 10 and maternal additive effect at day 570. Visual analysis of (co)variances and correlations allows to observe problems and can aid in constructing covariance functions without artifacts.

Key Words: Covariance functions, Random regression

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**452 Entrepreneurial characteristics of dairy farming differences between Dutch and Pennsylvania farmers. R.H.M. Bergevoet* and L. A. Holden, 1 Wageningen University, 2Penn State University.**

The objective was to investigate the impact of different farming environments between European Union (EU) versus the northeastern US, on dairy farmers’ goals, values, and strategies for success. Dutch farmers in the Netherlands and Pennsylvania completed a common questionnaire assessing their goals, objectives, assessment of their business environment, and perception of success. Netherlands questionnaires (n=256) were completed by mail and Pennsylvania questionnaires were completed in person (n=73). The Mann-Whitney test was used to evaluate differences between groups of farmers. Results indicated that the main reasons for becoming involved in farming for both groups were more freedom, owning a business, and the potential for high income; however the degree of importance of these factors differed (P<.05) by group. Both groups placed a higher value on non-economic goals compared to economic goals, but with differing degrees of importance (P<.05). Both groups cited the image of their product and the development of the Internet as opportunities and legislation and local planning as threats, but they value consumer’s concerns about the environment, animal welfare and food safety differently (P<.05). Netherlands farmers considered consumer concerns as opportunities while Pennsylvania farmers viewed them as threats (P<.01). Both groups valued farming in an “environment friendly” way, and neither group saw “going organic” as a serious option. Netherlands farmers especially evaluated their success on the criteria: ability to expand, net farm income and cost of production per hundredweight of milk. Pennsylvania farmers placed the most emphasis on net farm income. With different economic systems between the EU and northeastern US, there were common goals, values and business strategies shared by dairy farmers.

Key Words: Goals and objectives, Farmer characteristics, Assessment of environment

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**453 Whole farm planning for the production of grass-finished beef. T. M. Johnson*, R. E. Morrow, C. A. Wells, M. L. Thomas, and J. K. Apple, 1National Center for Appropriate Technology, Fayetteville, AR, 2University of Arkansas, Fayetteville.**

Beef calves in the US are predominately produced on small farms then transported to feedlots prior to harvest. Some beef producers with adequate resources have been attempting to improve sustainability and capture more value by selling retail beef products; however, challenges exist that must be overcome to make the production of retail beef possible on the farmstead. In Northwest Arkansas, 11 farms participated in a SARE project to evaluate the potential of producing and direct marketing grass-finished beef. In this pilot study, 50 crossbred calves from 11 producers were moved to a common site and rotationally grazed on wheat, cereal rye and annual rye pastures, from December 3, 2001 until June 25, 2002. No grain was fed. Calf initial weight was 307 ± 10.5 kg. Thirty-four calves were harvested from May 6 to June 25 in four groups when body condition score reached 6 when palpated by hand. Number of days grazed was 175 ± 3.9 d. Harvest weight was 456 ± 11.9 kg with an ADG of 0.86 ± 0.029 kg. The following carcass characteristics were observed: 54.4 ± 0.28% dressing percent, 249 ± 7.4 kg hot carcass weight, 2.01 ± 0.099 yield grade, with 85% of the carcasses grading select, 12% standard and 3% choice. Carcasses were dry-aged an average of 21-d and the retail yield was 145 ± 4.3 kg. Carcasses were processed into 25 retail cuts, with emphasis on boneless product. Products have been marketed through word of mouth, newspaper advertising, radio features, presentations to civic organizations, and a display booth during a local community fair. Sales during the first six months resulted in 36% of the product being sold. Data from this project has been presented at 11 meetings or workshops for beef producers and will be used in beef marketing publications targeting small to medium-sized producers. As a result, nine of these producers have formed a limited liability corporation, hired a professional marketing firm, and are pursuing additional marketing opportunities for grass-finished beef.

Key Words: Grass-finished Beef, Marketing, Sustainability

The livestock industry has been working for several years to develop data collection and reporting models. The need for completion and implementation of traceability from birth to slaughter and eventually consumption has been elevated with the passage of the latest farm bill and specification of the Country of Origin Labeling. To be successful, individual data collection requires additional input costs associated with the labor, equipment, and software necessary to record, and store the individual animal data at each of the production segments. Data systems must be reliable, efficient, easy to use and include identification beginning at an early age and allow for data collection throughout the animal's life cycle. Realization of value requires the ability to coordinate and share data across all industry segments. A collaborative industry-Utah State University effort evaluated and demonstrated a Windows based desktop/PDA Palm based software application for collecting cattle registration records, health observations, diagnoses, and treatments for new calves in the university cow herd. A second Windows based desktop software application was evaluated to collect processing information at arrival in the University feedlot. An internet-based portal application was utilized to provide a secured environment for warehousing relevant business data for reporting, analysis, and information exchange. The data collected was made available locally and was uploaded to off-site data storage for disaster data protection and consolidated data reports. The use of a large database in conjunction with the internet allowed for reports to be generated at the production facility as often as management demanded. This model will also allow facilitation of audit or verification systems and electronic record delivery systems necessary for Country of Origin Labeling.

Key Words: Beef cattle, Identification, Data collection


Steers enrolled in the Texas A&M Ranch to Rail Program from 1992 until 2001 were compared for feedyard performance and profitability by percent Bos indicus (B) influence. Steers were categorized as either 0, 25, 37.5, 50 and 100% B, resp. There were few significant differences between % B except that 100 B had lighter CW and smaller REA. As % B increased CW, REA and QG decreased and FAT, KPH, YG and WBS increased but not significantly. These results show few differences in carcass merit and tenderness between 0 and 50% Bos indicus steers.

Key Words: Carcass merit, Tenderness, Bos indicus

457 CalfTrack: A system of dairy calf workforce management, training, and evaluation and health evaluation. A. J. Heinrichs*, C. M. Jones1, L. R. VanRoeke1, and M. A. Fowler2. 1The Pennsylvania State University, 2Land O'Lakes Animal Milk Products, Co.

Getting calves off to a good start is the first step in producing healthy, well grown replacement animals that are ready to enter the milking herd at 22 to 24 months of age. To meet this goal, employees must provide consistent, quality care for calves, particularly during the preweaning period. Several years of extension programming in the calf management area have culminated in the development of a comprehensive program entitled Calf Track. The Calf Track, Calf Management Training System is farm administered and employee oriented, and most materials are available in both English and Spanish. Calf Track is a complete training, education, and development program designed to ensure that employees consistently meet the biological, managerial, personnel, and resource requirements of the calf. The program includes an orientation video; chore plans, which are instruction sheets that sequentially teach new or experienced employees the standardized procedures required to perform a calf care task; a trainers guide containing detailed technical information for the herdsman; and a health scoring system. The chore plans cover a range of topics, including calving assistance, colostrum feeding, use of an esophageal feeder, mixing and feeding milk replacer, evaluating calf environments, normal appearance and behavior, and routine health treatments. The scoring system teaches animal monitoring and observation techniques; provides an action-oriented method of evaluating calf health, administering treatment, and recording health history; and offers a simple system of employee evaluation. The complete Calf Track Calf Management Training System is designed to help employees master daily calf-raising chores with confidence, independence, and a sense of accomplishment, while raising healthy dairy calves that can become productive and profitable herd replacements. This is an educational and training program that helps farm employees understand how to do their job and why it is important. In addition, the program outlines standard procedures for common calf care tasks and provides managers with an employee evaluation system.

Key Words: Calf management, Calf health, Calf nutrition
**459 Molecular epidemiology of beta-lactam resistant Gram-negative bacteria in dairy cattle, A. A. Sawant* and B. M. Jayarao, Pennsylvania State University, University Park, PA.**

Beta-lactam antibiotics are widely used for therapeutic purposes in dairy cattle. A survey on use of beta-lactam antibiotics revealed that ceftiofur (76%), and ampicillin (48.5%) were the most frequently used beta-lactams, however the use of pencillin and cephalxin were restricted mostly for dry cow therapy. Resistance to ceftiofur and ampicillin was observed in 3% and 60% of dairy farms and 1% and 32% of cows, respectively. It was observed that dairy farms that used ampicillin were 6-fold more likely to have lactating cows shedding ampicillin resistant gram-negative bacteria (AMP-GNB) in feces. A total of 98 of 313 (31.3%) lactating cows on 20 of 33 (60.6%) farms were shedding AMP-GNB. The AMP-GNB accounted for 0.01 to 96.5% of the total GNB in the feces. The diverse AMP-GNB comprised of *E. coli* (n=74), *C. koseri* (n=14), *E. aerogenes* (n=4), *K. oxytoca* (n=3), *M. morganii* (n=1), *P. alcaligenes* (n=1), and *Pseudomonas* spp. (n=6). The 74 *E. coli* isolates showed 12 resistance patterns. Resistance to oxytetracycline (86%), spectinomycin (22%), Florfenicol (20%), neomycin (11%), and cephalxin (8.1%) was observed. A total of 7 isolates of *E. coli* encoded for shiga toxin (stx) genes, of which 1, 4 and 2 isolates encoded for Stx1, Stx2 and Stx1 and 2, respectively. A total of 69 AmpR *E. coli* isolates belonged to 44 pulsed-field gel electrophoresis subtypes (PFGE). It was observed that PFGE subtypes were unique to each farm, however 2 subtypes were seen in more than one farm. The TEM gene that encodes for betalactamase was observed in 94% of *E. coli* isolates. A total of 6 *E. coli* isolates were resistant to one or more of the four extended spectrum beta-lactamas (ceftioxane, cefepodixime, cepazidime, cefotaxime), as per NCCLS recommended guidelines for potential extended beta-lactam resistance. It can be inferred that resistance to extended beta-lactams is perhaps an emerging problem in dairy cattle.

**Key Words:** Beta-lactam resistance, *E. coli*, Dairy cattle

**460 Prevalence, distribution, and characterization of oxytetracycline resistant *Escherichia coli* in lactating dairy cattle. A. A. Sawant * and B. M. Jayarao, Pennsylvania State University, University Park, PA.**

A study was conducted to gather relevant information on the epidemiology (descriptive and molecular) of oxytetracycline-resistant Gram-negative bacteria (OXY-GNB) in dairy cattle. The findings of our study showed that 97 of 313 (31%) lactating cows on 21 of 33 (63.6%) dairy farms shed OXY-GNB in feces. The OXY-GNB from 23 farms accounted for 0.01 to 100% of the total gram-negative fecal flora. A total of 113 isolates resistant to oxytetracycline from 90 cows on 23 farms were identified as *E. coli*. It was observed that 105 of 113 (92.9%) and 8 (7.1%) isolates encoded for Tet B and Tet A genes, respectively. None of the 113 isolates encoded for shiga-toxin I and II genes. Farms that fed milk replacers containing oxytetracycline were 12-fold more likely to have lactating cattle shed OXY-GNB in their feces as compared to farms that did not use milk replacers. The 113 isolates of *E. coli* belonged to 9 resistance patterns. Resistance to florfenicol (14.2%) was most frequently observed followed by ampicillin (7.1%), spectinomycin (4.4%), and ceftiofur (2.7%). A total of 60 AmpR isolates were stooled for PFGE subtypes. It was inferred that the PFGE subtypes were unique to each farm, however 4 unique types were seen in one farm. Genetic analysis of the Tet B suggested that the gene was not located on a plasmid or an integron. Preliminary results suggest that the Tet B is more likely to be a part of a transposon located on the chromosome. Based on the findings of this study thus far, it can be inferred that prevalence of OXY-GNB is associated with use of milk replacers on dairy farms. Further OXY-GNB from dairy cattle, are likely to be highly diverse and multidrug resistant.

**Key Words:** Milk replacer, *E. coli*, Dairy cattle

**461 The commensal bacterial populations of swine feces and stored swine manure: Reservoir of bacterial resistance? T. R. Whitehead1*, M. A. Cotta2, G. Whittle3, N. Shoemaker2, and A. A. Salyers1, 1 National Center for Agricultural Utilization Research, Peoria, IL, 2University of Illinois, Urbana, IL.**

In order to facilitate improved growth and reduce infection, a number of antimicrobial compounds are commonly added at subtherapeutic levels to the feed of domestic animals. These normal residents may serve as reservoirs of antibiotic resistance genes. The finding of a high number of identified and unidentified AR eubacterial species in swine feces and manure has come under intense scrutiny of late, as a number of recent reports have suggested that increased microbial resistance to the antibiotics may have an impact on human health. Most investigations have centered on antibiotic resistance in known pathogens and aerobic bacteria. However, the great majority of the bacteria present in the commensal microflora found in the feces and stored manure of domestic animals, including swine, are anaerobic bacteria. These normal residents may serve as natural reservoirs of antibiotic resistance genes. We have initiated an investigation of antibiotic resistant (AR) anaerobic bacteria present in both pig feces and manure storage pits. Samples were collected from a local swine facility where tylosin was used at subtherapeutic levels. AR anaerobic bacteria were enumerated on complex media with and without tetracycline (Tc), erythromycin (Em), or tylosin (Ty) at 10 μg/ml. AR bacteria were found in all samples, and the level of resistance ranged from 4% resistant to 32% resistant. Several Em/Ty resistant strains were also Te resistant. Results of PCR and DNA sequencing analyses of pure cultures and total DNA from both ecosystems demonstrated the presence of various classes of erm and tet resistance genes, including the first reported identification of ermT in the United States. In addition, new classes of erythromycin (erm(35)) and tetracycline (tet(36)) resistance genes have been recently identified in the isolates. The tet(36) gene has been identified in Gram-positive and Gram-negative isolates, suggesting that the gene is being transferred between microorganisms. The finding of a high number of identified and unidentified AR eubacteria and gene classes in swine feces and manure storage pits suggests that these ecosystems may serve as reservoirs of antibiotic resistance genes. The influence of feeding antibiotics on the levels of AR resistance in these populations has yet to be ascertained.

**Key Words:** Antibiotic, Resistance, Swine
462 Late gestation and advanced lactation at cessation of milking do not delay mammary epithelial apoptosis in dairy cattle. E. L. Annen*, A. V. Capuco2, P. C. Gentry3, L. H. Baumgard1, and R. J. Collier4, 1University of Arizona, Tuscon, 2USDA-ARS, Bovine Functional Genomics Lab, BARC, Beltsville, MD. Advanced pregnancy and concurrent lactation until cessation of milking are thought to slow mammary involution in dairy animals. Our objective was to characterize the temporal pattern of apoptosis in the bovine mammary gland following milk stasis. Serial mammary biopsies were performed on 11 Holstein cows during late lactation and the dry period. Cows were dried-off 60d before expected calving. Mammary biopsies were taken at -5, 0, 1, 2, 3, 5, 6, 7, 8, 10, 14, and 21 relative to cessation of milking. Tissues were fixed in neutral buffered formalin, and paraffin sections were subjected to TUNEL assay for immunohistochemical detection of apoptotic cells. The incidence of mammary epithelial cells undergoing apoptosis was lowest in lactating tissue, peaked (P < 0.0001) 2d following cessation of milking and then declined through d8. At d2, the incidence of apoptosis was 4 to 8-fold greater than that in lactating tissue. By d8, the number of apoptotic mammary epithelial cells did not differ (P > 0.05) from pre-stasis values. Rodents and ewes typically initiate apoptosis by 2d post-stasis and reach peak apoptosis at approximately 4d. Because these species are not typically in advanced gestation and lactation when milk removal ceases, we hypothesized that onset of apoptosis would be slower and incidence of apoptosis reduced in cows as compared to sheep and rodents. Our data indicate that onset of epithelial apoptosis in cows is rapid but transient and alveolar integrity is maintained throughout the 21d post dry-off. Further, a second wave of apoptosis involving intralobular stromal elements appears to initiate at d4 and peak at d5 (P < 0.05). The balance between apoptosis and cell proliferation during this time frame is currently under investigation. Data are consistent with rapid initiation of tissue remodeling of both epithelium and stroma during the dry period of dairy cows.

Key Words: Mammary apoptosis, Involution

463 Microarray analysis of bovine mammary gene expression following abrupt cessation of lactation. S. R. Davis*1, A. J. Molenaar1, K. Stelwagen2, T. T. Wheeler1, C. J. McMahon1, D. B. Baird1, H. V. Henderson1, V. C. Fan1, L. Good1, K. Odin1, K. Singh1, D. L. Hyndman2, and T. Wilson3, 1AgResearch Hamilton, 2Dunedin, 3Lincoln, New Zealand. This work identified early changes in gene expression triggered by mammary engorgement that lead to apoptosis. Alveolar tissue was obtained from 36 non-pregnant cows in mid-lactation slaughtered at 6, 12, 18, 24, 36 and 72h (n=6/group) after last milking. mRNA was extracted from 6 and 36h tissue using TRIZOL®. cDNA prepared and labeled with Cy3 and Cy5 dyes using an Ambion kit. Samples were hybridized to bovine ESTs arrayed on glass slides. Each slide had 23954 ESTs arrayed (including limited replication) representing 16550 ESTs with known SwissProt hits and 6772 with no known hit, selected from mammary and immune bovine libraries. Microarray slides (n=24) were analysed in a “daisy arrayed on glass slides. Each slide had 23954 ESTs arrayed (including limited replication) representing 16550 ESTs with known SwissProt hits and 6772 with no known hit, selected from mammary and immune bovine libraries. Microarray slides (n=24) were analysed in a “daisy

Key Words: Mammary, Involution

464 Evidence of cisternal recoil after milk letdown in the udder of dairy cows. G. Caja1, M. A. Ayadi1, and C. H. Knight2, 1Universitat Autonoma de Barcelona, Spain, 2Hannah Research Institute, UK. A delay between activation of the milk letdown reflex and milk evacuation from the udder can negatively affect milk yield. Linzell (1955) was the first to demonstrate back-flux of milk from ducts into alveoli of mice after milk letdown, and here we investigate the possibility that the elastic nature of the udder cistern results in an equivalent phenomenon in dairy cows. Two groups of Holstein cows in early (n=5; 80 DIM, 31 kg/d) and late lactation (n=4; 301 DIM, 17.5 kg/d) were used. Udder cistern size was measured by real time ultrasonography. Left and right front udder quarters were scanned in duplicate at 0, 3, 15, 30 and 60 min after an i.v. oxytocin (OT) injection. For the first udder scan cows were injected i.v. with an OT receptor blocking agent (Atosiban; 10 µg/kg BW) to prevent spontaneous milk letdown. Cistern measures were repeated for 8 and 16 h milking intervals. Values of cistern area (1.1 to 33.6 cm²) differed according to stage of lactation (P < 0.01), time after OT injection (P < 0.001 and milking interval (P < 0.01). Average cistern area increased dramatically (93%) at 3 min after OT injection at which time the cistern reached its maximum distension (16.8 vs 8.7 cm²; P < 0.001), and decreased slowly thereafter (14.6, 13.5 and 12.8 cm² at 15, 30 and 60 min, respectively). The decrease in cistern size was significant at 15 min and later time points (P < 0.05) but not at earlier time points. The 0 and 3 min data provide clear evidence of milk letdown. The decrease in cistern size thereafter provides the first report, to our knowledge, documenting the return of milk to the ductal and alveolar compartments of the cow udder following the end of milk letdown. We term this cisternal recoil. The process will result in a mixing of milk that has been stored for some time with freshly synthesized milk. Given the presence in milk of putative inhibitory bioactive factors, this could have consequences for further secretory activity.

Key Words: Residual milk, Cisternal milk, Udder physiology

465 Kinetics of glucose transport and metabolism in lactating bovine mammary glands measured in vivo with a paired nutrient/indicator dilution technique. F. Qiao*, C. Xiao, D. R. Trout, and J. P. Cant, University of Guelph, Ontario, Canada. Twenty-four paired glucose and extracellular indicator (p-aminohippuric acid) venous dilution curves across intact bovine mammary glands were obtained from bolus injections into the external iliac artery to measure kinetics of glucose transport and metabolism. A compartmental capillary compartmental model was used to interpret the curves. Four different capillary submodels, describing hypothetical mechanisms of glucose transport and metabolism, were expressed in ordinary differential equations and fitted to the observed curves by an iterative approach to least-squares. Submodel I, assuming first-order unidirectional uptake and metabolism of glucose, was unable to fit the peak and tail of glucose dilution curves (r² < 0.96). Submodel II, considering transport as a first-order bidirectional process, yielded good fits (r² = 1.00), but errors of estimation of the transport parameter were high (428 times the estimate, on average). Transport rate constants were 5 to 50 times greater than metabolism rate constants and, when expressed as clearance values, 5 times greater than blood flow rates. Submodel III assumed instantaneous mixing between extra- and intra-cellular glucose distribution spaces and first-order kinetics of metabolism. This submodel yielded r² = 0.99 and low errors of parameter estimation (<32% of estimate). The metabolism rate parameter k = 0.406 ± 0.083 min⁻¹ was not different from that calculated from background arterial and venous glucose concentrations (k = 0.404 ± 0.119 min⁻¹). Assuming Michaelis-Menten kinetics of glucose metabolism in Submodel IV did not improve goodness-of-fit and parameters were less identifiable. It was concluded that glucose is rapidly translocated into an intracellular space that is 34% of intracellular volume, that once glucose enters the cytosol proper where metabolism occurs, there is negligible efflux out of the cell, and that glucose sequestration follows first-order kinetics between 0 and 5 mM extracellular glucose.

Key Words: Glucose transport, Mammary glands, Indicator dilution
The objective of this research was to explore the synergy between sexed embryo production and to assess costs and benefits of these technologies on commercial farms. Genetically superior culled cows were used as donors, and oocytes were collected via colposcopy or at the time of slaughter. Oocytes were aspirated from the ovaries, fertilized 20-24 hours later, and matured to the blastocyst stage. Embryos were transferred into recipient cows. The objective was to study the potential of sexed embryos for use in dairy cattle breeding programs.

Key Words: Heifers, Mammary, Calves

Physiology: Gamete physiology


The objective of this research was to explore the synergy between sexed embryos and in vitro embryo production and to assess costs and benefits of these technologies on commercial farms. Genetically superior culled cows were used as donors, and oocytes were collected via colposcopy or at the time of slaughter. Oocytes were aspirated from the ovaries, fertilized 20-24 hours later, and matured to the blastocyst stage. Embryos were transferred into recipient cows. The objective was to study the potential of sexed embryos for use in dairy cattle breeding programs.

Key Words: In vitro production, Sexed semen
on Day 4 using twice daily i.m. injections of FSH (Follitropin®) for 4 days (40, 30, 20, 10 mg). PGF2α (40 mg) was injected i.m. on Day 6 p.m. and Day 7 a.m. (20 mg). The CIDR® was removed on Day 7 p.m. Heifers were artificially inseminated (AI) one time, 70–72 h following PGF2α. Ova/embryos were collected nonsurgically 7 days after AI. Heifers not responding to superstimulation were not flushed and omitted from the analysis. Percentage data were transformed to the arc sine for ANOVA. Least squares means are presented in the table. Fewer ova were fertilized with sexed treatments relative to non-sexed and as sexed dosage was reduced to 2 x 10⁶ sperm (P < 0.05). Assuming an embryonic sex ratio of 9:1 with sexed sperm and 1:1 ratio with non-sexed sperm, more embryos of the desired sexed can be obtained with 20 x 10⁶ total sex-selected sperm following timed AI in superovulated heifers.

### Table

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<thead>
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a,b,c Means without common superscripts differ (P < 0.05).

### Key Words:
Sex, Sperm, Superovulation

### 471 Fertility and distribution of estrus among cows following prostaglandin induced embryonic/fetal mortality.
T. W. Geary*, USDA-ARS, Fort Keogh LARRL, Miles City, MT

Late embryonic mortality occurs in approximately 10% of beef cattle. The objective of this study was to evaluate the distribution and fertility of estrus following early pregnancy loss in beef cattle. Pregnant cows (n = 124) and non-pregnant cows (control; n = 173) were divided across 2 yr to receive PGF (25 mg, i.m.) at d 25 (PG25; n = 40), 30 (PG30; n = 43), or 35 (PG35; n = 41) of gestation or during the mid-luteal phase of their estrous cycle (controls). Control cows were further divided into three approximately equal groups to receive PGF on the same dates as PG25, PG30, and PG35 cows. All cows were placed with fertile bulls immediately after PGF and were observed for estrus twice daily for 45 d (PG25 and 60 control cows), 40 (PG30 and 56 control cows), or 35 d (PG35 and 56 control cows). Pregnancy was confirmed among PG25, PG30, and PG35 cows by ultrasonography and detection of a fetal heartbeat at the time of PGF (d 0). Synchronization rate (5-10 days) was greater (P < 0.05) in yr 2 (87%) than yr 1 (77%), and greater (P < 0.05) for PG35 (98%) and PG30 (91%) cows than control (78%) or PG25 (72%) cows. The interval from PGF to estrus was 4.0 ± 0.2, 4.6 ± 0.4, 4.1 ± 0.4, and 3.3 ± 0.4 d for control, PG25, PG30, and PG35 cows, respectively (P > 0.10). Synchronized pregnancy rates were higher (P < 0.05) for PG35 (66%) and PG35 (68%) cows than for PG25 (40%) cows. Synchronized pregnancy rates of control cows (54%) were not different (P ≥ 0.10) than previously pregnant cows. Breeding season pregnancy rates (yr 1) were lower (P < 0.05) for control cows (84%) than for PG35 (100%) cows, but not different (P > 0.10) than pregnancy rates of PG25 (95%) or PG30 (95%) cows. In summary, cows that received PGF early during gestation exhibited an estrus of normal fertility within 5 d. Cows that experience early pregnancy losses during a breeding season likely exhibit a fertile estrus soon afterwards to prevent low overall breeding season pregnancy rates from being realized in beef cow herds.

### Key Words:
Embryonic mortality, Synchronization, Fertility

### 472 Insulin like growth factor-I (IGF-I), IGF binding proteins (IGFBP), and steroids in dominant follicles of postpartum beef cows.

The effect of interval before the first postpartum estrus and ovulation on IGF-I, IGFBP, and steroids in dominant follicles (DF) was evaluated in Angus × Hereford cows. Growth of DF (> 9 mm) was monitored daily by ultrasonography and fluid from DF was collected in vivo at either 22 to 28 d or 42 to 48 d postpartum. Follicular fluid (FF) was also aspirated from DF of contemporary proestrus cows. Estrous behavior was monitored continuously with HeatWatch, and progesterone in plasma collected twice weekly was used to access luteal activity. Time of follicular aspiration was classified as short (< 35 d) or long (> 35 d) interval before the first estrus and ovulation, or proestrus. Amounts of IGFBP and steroids in FF were not influenced by day postpartum. However, the amounts of IGFBP-3 and -4b (20-kDa) in FF were greater (P < 0.05) in DF aspired < 35 d before the first estrus, or at proestrus, than in DF aspired > 35 d before estrus. Concentrations of progesterone in FF were less (P < 0.01) in DF > 35 d (30 ± 6 ng/mL) than in DF < 35 d (81 ± 15 ng/mL) before estrus and in proestrus follicles (91 ± 10 ng/mL). Concentrations of androstenedione in FF were greater (P < 0.01) in proestrus follicles (14 ± 10 ng/mL) than in DF aspired > 35 d (4 ± 5 ng/mL) and < 35 d (10 ± 2 ng/mL) before the first postpartum estrus, and tended (P = 0.08) to be greater in DF < 35 d than in DF > 35 d before estrus. Proestrus follicles had greater (P < 0.01) estradiol (538 ± 148 ng/mL) than DF > 35 d (72 ± 39 ng/mL) or < 35 d (95 ± 32 ng/mL) before estrus. Concentrations of IGF-I in FF and plasma were not influenced by reproductive stage. In conclusion, estradiol production by DF of postpartum anestrous cows may be limited by decreased androstenedione production, and alterations in IGFBP in FF during the postpartum interval may influence follicular maturation.

### Key Words:
Beef cow, IGF-I, Insulin like growth factor binding proteins

### 473 Effect of dietary fat prepartum on first ovulation and reproductive performance in lactating dairy cows.

The objective of this study was to test the effects of prepartum and postpartum (PP) dietary supplements on the interval to first ovulation and reproductive performance. Multiparous Holstein cows (n = 81) were fed isoenergetic diets (2.9 or 4.6% fat; supplemental fat was prilled long chain fatty acids, Energy Booster) for 3 weeks preceding calving and control cows received no supplemental diets (0.22 kg/d of soluble sugars + 0.29 kg/d of Ca propionate) during the first 4 weeks PP. Daily energy balance (EB) was determined from calving to day 30 PP. Ovarian follicular development was monitored by ultrasonography and blood samples were analyzed for estradiol, progesterone, insulin, IGF-I, NEFA, and IGFBP’s (ligand-blot). Beginning after day 55 PP, cows were injected with prostaglandin F2α (PGF) every Friday and were inseminated following estrus. Cows remained on the PGF schedule until estrus was detected or day 100 PP. Thereafter, cows were inseminated at every observed estrus prior to 220 days PP and PGF was used when cows were palpated non-pregnant after insemination. There was no effect of prepartum fat supplementation or PP glucogenic supplementation on any metabolic or hormonal parameter nor on follicular dynamics (39% vs. 35%). By survival analysis earlier first PP ovulation was associated (P < 0.05) with less negative EB, less BCS loss, lower NEFA prepartum and PP, IGFBP-3, but not plasma IGF-I levels, tended (P < 0.08) to be more abundant in cows with ovulatory first dominant follicle. Both ovulation prior to 50 days of lactation (P < 0.05) and prepartum supplemental fat (P < 0.03) were associated with a higher pregnancy rate during lactation. Cows fed supplemental fat prepartum had a higher pregnancy rate (86% versus 58% in controls (median PP days to pregnancy = 110 and 141, respectively). Effects of PP supplementation on first ovulation or pregnancy rate were non-significant. In conclusion, prepartum supplemental dietary fat and earlier first PP ovulation significantly increased pregnancy rate during lactation.

### Key Words:
Prepartum fat, Pregnancy rate, Cows

### 474 Ovarian follicular populations before weaning in sows are dependent on GnRH-induced LH release.
C. J. Bracken*, B. L. McCormack, T. C. Cantley, R. P. Radcliff, and M. C. Lucy, University of Missouri.

The factors affecting follicular growth and the variation in weaning to estrus and weaning to ovulation intervals in sows are poorly understood. The objective was to determine if follicular populations before weaning in sows are dependent on GnRH-induced LH release. The posterior vena cava anterior to the ovarian vein was cannulated in 8 sows at 10.6 ± 0.7 d after farrowing. Blood samples were collected three daily (1500, 2000, and 2300 h) beginning on the day of cannulation and continuing until ovulation. Serum FSH and estradiol concentrations were measured by radioimmunoassay. Sows were randomly assigned to receive either 2 mL of GnRH (1µg/mL, n=4) or 2 mL saline (n=4) every 0.5 hour for 48 hours beginning 96 h before weaning and ending 48 h before weaning (weaning = 17.4 ± 0.6 d after farrowing). Average follicular diameter was determined once daily by transrectal ultrasonography. Follicular diameter (P < 0.001) and serum estradiol concentrations (P < 0.05) significantly increased pregnancy rate during lactation.
were greater during infusion in GnRH-infused sows compared to saline-infused sows. Serum FSH decreased in sows infused with GnRH (P < 0.001). After GnRH infusion follicular diameter and serum estradiol decreased in GnRH-infused sows and FSH concentrations rebounded above saline control. We conclude that follicular populations before weaning in sows are dependent on GnRH-induced LH release but cannot be sustained in the absence of LH support prior to weaning.

### Production, Management, & the Environment

**475 Interrelationship between various measurements of temperament in Brahman cows and their Brahman calves.** K. O. Curley*, D. A. Neuendorff, A. W. Lewis, and R. D. Randel, Texas A&M University Agricultural Experiment Station, Overton, TX.

Animal temperament has been inversely associated with carcass quality and feedlot performance traits. Temperament can be assessed through both subjective and objective methodologies. The objectives of this study were 1) to compare temperament evaluations of exit velocity from a squeeze chute, chute score, pen score and temperament ratings obtained from longitudinal knowledge of the dam’s reaction to handling; and 2) identify any correlations between calf and dam temperaments. A group of Brahman females (n= 47, 4-13 yrs old) and their spring-born Brahman-sired calves was utilized. Cow temperament rating (T) was identified as (1= calm, 2= normal, and 3= wild). Three other assessments were obtained while working the cattle through a manual squeeze chute at weaning. Chute scores (CS) were determined from behavioral responses to restraint on the scale (1=quiet to 5=wild). Exit velocity (EV) was measured (m/sec) as the animals exited the chute and traversed a fixed distance (1.83m). A set of infrared sensors acted as remote triggers for the start and stop of the timing device. Pen scores (PS) (1=quiet to 5=wild) were ascertained from calf behavior while the animals were in small groups (n<10) after exiting the squeeze chute. Pearson correlation coefficients (r) and ANOVA were utilized for statistical comparisons. Cow T influenced (P<0.01) cow EV (r=0.20, 2=1.45 .14, and 3=2.2818 m/sec) and cow CS (1=1.13.18, 2=1.22.12, and 3=2.06.16). Cow T influenced (P<0.05) calf EV (r=1.60.33, 2=1.72.32, and 3=2.65.30 m/sec), calf CS (1=1.53.20, 2=1.64.13, and 3=2.44.18) and calf PS (1=1.86.29, 2=2.29.19, and 3=2.86.26). Cow T was correlated with cow EV r=.61 (P<0.01) and cow CS r=.47 (P<0.01). T was not measured in the calves due to a lack of observations necessary to make this rating. Cow T was correlated to calf EV r=.33 (P<0.02), CS r=.46 (P<0.01) and PS r=.33 (P<0.02). Calf EV was correlated with calf EV r=.31 (P<0.03) and calf CS r=.38 (P<0.01). Temperament of a calf can be associated with dam temperament.

**Key Words:** Temperament, Chute score, Pen score

**476 Interrelationship between various measurements of temperament in Brahman cows and their Hereford-sired calves.** K. O. Curley*, D. A. Neuendorff, A. W. Lewis, and R. D. Randel, Texas A&M University Agricultural Experiment Station, Overton, TX.

Animal temperament has been inversely associated with carcass quality and feedlot performance traits. Temperament can be assessed through both subjective and objective methodologies. The objectives of this study were 1) to compare temperament evaluations of exit velocity from a squeeze chute, chute score, pen score and temperament ratings obtained from longitudinal knowledge of the dam’s reaction to handling; and 2) identify any correlations between calf and dam temperaments. A group of Brahman females (n=55, 3-13 yrs old) and their spring-born Hereford-sired calves was utilized. Cow temperament rating (T) was identified as (1= calm, 2= normal, and 3= wild). Three other assessments were obtained while working the cattle through a manual squeeze chute at weaning. Chute scores (CS) were determined from behavioral responses to restraint on the scale (1=quiet to 5=wild). Exit velocity (EV) was measured as the animals exited the chute and traversed a fixed distance (1.83m). Pen scores (PS) (1=quiet to 5=wild) were ascertained from calf behavior while the animals were in small groups (n<10) after exiting the squeeze chute. Pearson correlation coefficients (r) and ANOVA were utilized for statistical comparisons. Cow T influenced (P<0.01) cow EV (1=0.90.20, 2=1.45 .14, and 3=2.2818 m/sec) and cow CS (1=1.13.18, 2=1.22.12, and 3=2.06.16). Cow T influenced (P<0.05) calf EV (1=1.60.33, 2=1.72.32, and 3=2.65.30 m/sec), calf CS (1=1.53.20, 2=1.64.13, and 3=2.44.18) and calf PS (1=1.86.29, 2=2.29.19, and 3=2.86.26). Cow T was correlated with cow EV r=.61 (P<0.01) and cow CS r=.47 (P<0.01). T was not measured in the calves due to a lack of observations necessary to make this rating. Cow T was correlated to calf EV r=.33 (P<0.02), CS r=.46 (P<0.01) and PS r=.33 (P<0.02). Calf EV was correlated with calf EV r=.31 (P<0.03) and calf CS r=.38 (P<0.01). Temperament of a calf can be associated with dam temperament.

**Key Words:** Temperament, Chute score, Pen score

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<th>FSH ng/mL</th>
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*Means ± SEM

**Key Words:** GnRH, Follicle, Lactating sows

**477 Breed type and gender effects on chute exit velocity and chute temperament score in beef calves.** J. F. Baker*, R. D. Randel*, and C. R. Long2, 1 University of Georgia, Tifton, GA/USA, 2Texas Agricultural Exp. Station, Overton, TX/USA.

Time to travel a short distance after release from a squeeze chute and subjective chute temperament score (1 = calm, quiet - 5 = attempt to escape, highly agitated) have both been correlated with feedlot and meat quality traits. Objectives of this study were: evaluate effects of breed type and gender on exit velocity (EV, m/s) and chute temperament score (CS), and measure relationships between EV and CS two times near weaning. Brford (BO, n = 62), and Brangus (BN, n = 92) calves were weighed on a platform scale and CS was assigned. Calves were then released to a squeeze chute and restrained with head caught. After a blood sample was obtained the calf was released and time recorded to travel 1.83 m. Measurement one (T1) occurred when half of the calves within breed type and gender were weaned. Measurement two (T2) was fifty d later when the remainder were weaned. Least squares means were obtained from PROC MIXED with main effects breed type and gender with weaning group included for T2. Breed type was a significant source of variation in EV and CS but gender and the two-factor interaction were not significant for T1. Brford (1.86 ± 0.10 m/s) were slower than BN (2.23 ± 0.08 m/s). Breed type and gender were significant but weaning time was not significant at T2 for EV. Brford were still slower than BN (1.45 ± 0.10 m/s and 1.92 ± 0.08 m/s, respectively). Heifers were faster than steers (1.91 ± 0.09 and 1.45 ± 0.09 m/s, respectively). The correlation coefficient (r) between the two EVs was 0.54 (P < 0.01). The r between EV and CS were 0.29 (P < 0.01) for T1 and 0.31 (P < 0.01) for T2. In conclusion significant differences exist between breed types for EV and CS. Although the correlation coefficients between velocity and score were significantly different from zero the magnitudes were only moderate in magnitude. The exit velocity may be preferred due to the subjective nature of the score and the limited ability to distinguish subtle differences between animals.

**Key Words:** Temperament, Beef cattle, Weaning
Breed of sire and gender effects on chute exit velocity and chute temperament score in beef calves. R. C. Vann,1,2 R. D. Randel,1,2 MAFES/Brown Loam Experiment Station-Raymond,1 Texas Agricultural Experiment Station-Overton.2

The objectives of this study were to evaluate effects of breed of sire, age of dam and gender on exit velocity (EV, m/s), chute temperament score (CS; 1=calm, no movement to 5=jumping and rearing, highly agitated) and pen temperament score (PS; 1=non-aggressive, not excited by humans to 5=aggressive, runs into fences and at humans if approached) and measure relationships between EV, CS and PS at two times near weaning. Crossbred calves (n=195) were assigned a PS, then calves were weighed on a platform scale and CS was assigned. Calves were then released to a squeeze chute and restrained. After a blood sample was obtained the calf was released and time recorded to travel 1.83 m. Measurement one (T1) occurred 21 d after weaning and the second measurement (T2) 90 days later. Least square means were obtained from PROC MIXED with main effects of sire breed, gender and age of dam. Breed of sire (Angus or Brangus) was not a significant source of variation for EV, CS or PS. Gender was a significant source of variation for EV and PS at T1 and was different for EV at T2 (P < 0.06). Heifers had a greater EV at T1 and T2 (1.75 ± 0.10 and 2.48 ± 0.14 m/s, respectively) compared to steers (1.56 ± 0.10 and 2.22 ± 0.15 m/s, respectively). The correlation coefficient (r) between EV at T1 and T2 was 0.489 (P < 0.001). The r between EV and CS was 0.26 (P < 0.002) at T2. The r between EV and PS were 0.489 (P < 0.001) at T1 and 0.487 (P < 0.001) at T2. In conclusion, breed of sire was not a significant source of variation in chute exit velocity however, differences existed between steers and heifers. Although the correlation coefficients between velocity and temperament score were significantly different from zero the magnitudes were only moderate. In this case, pen score had a better correlation with velocity than chute score. The exit velocity may be measured: body weight and body condition score, age at puberty, post-partum 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 fat 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 fat has resulted in varied and inconsistent results on reproductive function. Elucidating mechanisms of action of how supplemental fat can influence reproductive function has been a difficult process. The complexity of the reproductive system and make-up of fat 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: Cattle, Tympnic temperature, Stress

478 Thermoregulation and weight change in Hereford and Senepol steers as affected by forage type and estrous therapy. R. Browning, Jr.*, S. H. Kebe, M. Byars, E. Lane, and C. Johnson, Tennessee State University, Nashville.

Hereford (n = 30; H) and Senepol (n = 26; S) 3-year-old steers were fed endophytic tall fescue (T) or orchardgrass (O) hay and seed for 8 wk during July and August to assess breed, diet, and estrous effects on thermal and weight status. Half of the steers in each breed-diet group received either estradiol implant (E) and half were not implanted (N). Implant × breed × diet interaction and implant as a main effect did not influence (P > 0.2) respiration rates, shade use, or skin temperature. Breeds × diet affected weight gain (P = 0.01) as the percentage of steers gaining weight (P = 0.03). Weight was gained by 100 ± 13% of SOE, HOE, HOE, and HON steers (ADG = 846, 572, 413, and 321 ± 156 g/d, respectively), 86% of STN (230 g/d), 68% of STE (269 g/d), 50% of HTN (132 ± 43 g/d) steers. The remaining steers lost weight. The percentage of HTN steers gaining weight was lower (P = 0.05) than all other groups, HTE differed (P = 0.05) from all groups except STE, and percentages did not differ among STE, STN, HON, HOE, SOE, and HOE steers. Means separation test ranked and grouped (alpha = 0.05) treatments from high to low ADG: [SOE, SON, ] [SON, HOE, HOE, STN, ] [STN, HTE, HTN]. As main effects, weight gain was greater (p = 0.03) for E vs. N (375 vs. 169 ± 85 g/d), greater (p < 0.01) for S vs. H (505 vs. 39 ± 85 g/d), and greater (p < 0.01) for O vs. T steers (357 vs. −23 ± 101 g/d). Forage, breed, and hormone therapy affected weight change in older steers during summer. Thermal status of steers may explain some of the variances in weight gain.

Key Words: Senepol, Tall fescue, Weight gain

481 Fat supplementation and reproduction in beef females. R. N. Funston*, University of Nebraska, Lincoln.

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. Polynaturated fatty acids such as those in fishmeal also bypass the rumen but have been documented to affect reproductive processes. Fats have been fed before and after calving, during the breeding season, and during heifer development. Response to fat has been investigated through measuring: body weight and condition score, age at puberty, post-partum interval, first service conception rates, pregnancy rates, calving
Two trials were conducted to determine effects of forage type and degradable intake protein (DIP) source on microbial crude protein (MCP) efficiency in nursing calves and gestating cows. In Trial 1, sixteen cow/calf pairs were assigned randomly to graze upland native range or subirrigated meadow to determine the effects of forage type on calf forage intake, milk consumption, and MCP efficiency from May through September. Calf forage intake and milk consumption were estimated by total fecal collections and weigh-suckle-weight, respectively. Allantoin and creatinine were used as markers of MCP flow and urinary excretion, respectively. Fluid milk intake decreased linearly (P < 0.01) from May to September for calves grazing both forage types. This was accompanied by increases in forage OM intake for each month (P < 0.05), and a quadratic increase in MCP flow (P < 0.05). There were no changes over time in MCP efficiency which averaged 190g/kg digestible OM. In Trial 2, twenty four gestating cows grazing dormant native range were assigned randomly to one of three treatments to determine the effects of supplemental DIP source on MCP efficiency. Treatments were: 1) non-protein nitrogen (urea); 2) true protein (corn gluten feed); and 3) no supplementation. Forage intake was estimated from fecal output determined with intra-ruminal slow releasing chromium devices. Allantoin and creatinine were used as markers of MCP flow and urinary excretion, respectively. While statistical significance was found, differences in forage intake were likely related to forage availability rather than treatment effects because the control diet was not deficient in DIP (10.5g digestible OM intake). There were no differences in MCP efficiencies among treatments which averaged 85g/kg digestible OM. The MCP efficiencies measured in Trial 2 closely match those predicted by NRC, suggesting allantoin is an accurate marker of MCP flow. MCP efficiencies for calves grazing forage appear to be higher than 130g/kg digestible OM assumed by NRC.

**Key Words:** Microbial Crude Protein, Cows, Calves

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Urinary creatinine has been used as an output marker to predict output of metabolites in urine such as allantoin. Therefore, the use of creatinine as a reference material in nutrient balance studies depends upon a uniform and constant excretion of creatinine. A series of total urine collections were conducted to evaluate the effect of age, pregnancy, and diet on creatinine excretion in heifers and cows. For each collection, urine was collected over a 5-d period and composited by animal within treatment and diet group. Urine samples were analyzed for creatinine and creatinine simultaneously. All animals were fed in individual stalls. Creatinine excretion, 11 heifers (BW = 441 ± 49 kg) were fed a forage diet supplemented with dried distillers grains (DDG). There was no difference in creatinine excretion across all ages (mean = 0.026 g/kg BW; P=0.34). Fifteen cows (BW = 572 ± 59 kg) fed a forage diet supplemented with DDG were sampled to determine the effect of pregnancy on creatinine excretion. Pregnancy did not change daily creatinine excretion (P=0.46). To determine if diet alters creatinine excretion, 11 heifers (BW = 441 ± 49 kg) were sampled for 2 urine collection periods. In period 1, heifers were fed a forage diet supplemented with DDG. In period 2, heifers were fed a finishing diet (90% concentrate:10% forage). Creatinine excretion was suppressed in heifers on the finishing diet (P<0.05) with forage fed heifers excreting 0.002 g/kg BW more creatinine in their urine. Age and pregnancy do not influence changes in creatinine excretion; however, diet may affect creatinine excretion in growing heifers.

**Key Words:** Creatinine, Age, Pregnancy

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Inadequate supply of metabolizable methionine or other limiting amino acids may limit protein accretion in gestating beef cows. Five ruminally cannulated gestating beef cows (490 ± 27 kg) were used in a 5 × 5 Latin square to evaluate the effects of post ruminal DL-methionine (Met) supplementation on N retention, serum metabolites, and plasma amino acid concentrations during late gestation. Cows were allowed ad libitum access to water, mineralized salt, and experimental diet comprised of 67% wheat straw (1.9% CP and 78.7% NDF, OM basis) and 33% alfalfa (17.0% CP and 43.2% NDF, OM basis). Daily experimental diet was individually fed and refusal weights recorded for N intake determination. Treatments consisted of no urea (NU), urea (U), urea + 5 g/d Met (5MU), urea + 10 g/d Met (10MU), and urea + 15 g/d Met (15MU). Urea was administered into the rumen via rumen cannula once a day at 0600 h in two gelatin capsules to achieve a diet of 6.8% CP as fed. Methionine was infused into the abomasum twice a day at 0600 h and 1800 h. Cows were adapted to the diet 30 d prior to the initiation of the experiment. Experimental periods were 14 d; 4 d to allow clearance of previous treatment effects, 4 d for adaptation to treatments, and 6 d for total fecal and urinary collection. Serum and plasma samples were collected every 4 h for 24 h on day 13 of each period for analysis of serum urea nitrogen, glucose, non-esterified fatty acids, and plasma amino acids. Nitrogen retention was improved (P < 0.05) with urea and incremental amounts of methionine (32.3, 41.6, 48.1, 48.7, and 51.6 ± 3.4 g/d for NU, U, 5MU, 10MU, and 15MU, respectively). No differences (P > 0.05) were identified for serum urea nitrogen, glucose, or non-esterified fatty acids. A quadratic response was determined (P < 0.05) for plasma Met (36.9, 30.1, 55.9, 96.6, and 196.3 ± 20.5 µM for NU, U, 10MU, 15MU, respectively). Responses observed in N retention and plasma Met indicates that methionine is a limiting amino acid in low quality forage diets for gestating beef cows.

**Key Words:** Cattle, Methionine, Supplementation

Fescue toxicosis is a poorly defined, widespread phenomenon affecting ruminant and nonruminant grazing livestock species. Fescue toxicosis results in estimated losses to the beef industry of nearly 800 million dollars annually due to lowered conception rates and depressed body weight gains. The aim of this study was to evaluate luteal and follicular function and weight gains in nonpregnant heifers consuming endophyte-infected (EI) tall fescue. Thirty crossbred heifers (Angus x Holstein or Hereford x Holstein) 18 to 24 months of age and weighing 390 ± 15.5 kg were divided equally amongst three treatment groups; endophyte-free (EF) fescue diet, EI fescue diet or endophyte-infected diet and treated with the dopamine (DA) antagonist, domperidone injected s.c. at 0.44mg/kg BW (EID). Heifers were weighed weekly and data analyzed using ANOVA with LSD post hoc testing. After 28 days on the experimental treatments, heifers fed EI diets had reduced weight gains (20.5 ± 4.0) when compared to heifers fed EF (35.5 ± 6.6) or EID (35.5 ± 3.7; p<0.05). The heifers’ ovarian structures were monitored via transrectal ultrasound to determine follicle size and day of ovulation. Blood plasma samples were collected daily and analyzed for progesterone (P4) concentration by RIA. Data were analyzed using PROC MIXED with repeated measures followed by least square means post hoc testing. Heifers ingesting EI diets had shorter duration interovulatory intervals (EF = 22.5 ± 0.6 d, EI = 20.7 ± 0.37 d), and lower mid-cycle P4 concentrations than heifers in the EF or EID treatments (p<0.05). These results suggest that domperidone supplementation of heifers eating EI fescue may ameliorate certain symptoms of fescue toxicosis.

**Key Words:** Fescue, Domperidone, Interovulatory interval

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Ruminant Nutrition: Feed intake

486 Recently identified signals for feed intake regulation. J. L. Miner*, University of Nebraska.

Both gastrointestinal distension and presence of nutrients in the digestive tract exert satiating effects. This has been recognized for many decades. However, our understanding of the specific mechanisms by which these stimuli are communicated and translated remains incomplete. Investigation of feed intake regulation in ruminants has historically been aided by descriptions of this biology in rodent models. Thus the role in intake regulation of absorbed chemicals, gut hormones, the vagus nerve, and specific brain nuclei has been confirmed (or modified) in ruminant species. However, much has remained unknown. For example, despite recognition that the brain peptide, NPY, is an extremely potent stimulant of feeding, and concurrent inhibitor of gonadotropes, we have not understood how undernutrition promoted its activity. The recent characterization of leptin in mice, however, has led to the demonstration in sheep that this protein secreted from adipocytes is capable of signaling energy status to the brain, and that at least some of its effects on intake and reproductive hormone secretion are mediated via NPY. Other mechanisms of intake regulation in rodent have recently been described. Agouti-related protein and melanocytotropic-concentrating hormone seem key to hypothalamic intake-stimulating mechanisms. Cocaine-amphetamine-related transcript (CART) peptide and malonyl CoA appear to be part of hypothalamic satiety mechanisms. We may also expect that recently described gut peptides that appear to function in determining feed intake in rodents, perform similar functions in ruminants. For example, glucagon-like peptide-1 and ghrelin are inhibitory and stimulatory, respectively, in rodents. In summary, application of modern molecular biology techniques has lead to discovery of several regulatory molecules, some of which have only been characterized in model species. At least one of these, leptin, has significantly contributed to models of how nutritional status is communicated for modulation of feed intake and reproduction in ruminant animals.

Key Words: Cattle, Feed intake, Endocrine

487 Ghrelin, a growth hormone secretagogue, is expressed by bovine rumen. P. C. Gentry*, J. P. Willey, and R. J. Collier, University of Arizona.

The growth hormone secretagogue ghrelin is an important regulator of energy metabolism, nutrient partitioning and feeding behavior. Although it has been detected in a variety of tissues, the stomach is the primary source of ghrelin, while receptors are located in the pituitary and hypothalamus. Ghrelin levels peak prior to a meal and subside dramatically immediately after. In addition to stimulatory growth hormone secretion, exogenous ghrelin reduces fat utilization, induces adiposity and provokes food intake in humans and mice. Thus, ghrelin is an important endocrine link between the gastrointestinal tract and brain. To date, the role of ghrelin in ruminants remains unexamined. Our objective was to determine if ghrelin is expressed in ruminant and ruminant calves and to assess distribution of ghrelin mRNA expression throughout the gastrointestinal tract. Expression of ghrelin was assessed by semi-quantitative RT-PCR in Holstein bull calves at 4 (n=6) and 12 (n=5) wk of age. Calves were fed colostrum at birth and for at least three subsequent feedings, followed by a commercial milk replacer. Calves were fed twice daily at 7 AM and 6 PM. Beginning on d 12, calves were offered a corn-based calf starter feed, free choice. Calves were euthanized at 7 AM on the day of slaughter and were not fed. Primers spanning nucleotides 40-488 of the ghrelin coding region were used to amplify ghrelin from total cellular RNA from rumen, reticulum, omasum, abomasum, duodenum, jejunum, ileum and abdominal adipose tissue. Ghrelin was detected in rumen and abomasum but not in other tissues. When corrected for differences in RNA input by normalizing to the housekeeping gene G3PDH, ruminal expression was greater in 12 wk calves than in 4 wk calves, corresponding to the increase in rumen function occurring during this period. Further studies characterizing ghrelin expression in cattle under differing dietary and growth conditions are in currently in progress, as are experiments to determine cellular sites of ghrelin expression.

Key Words: Ghrelin, Energy metabolism, Ruminant


Data from three experiments were used to evaluate the DMI predictions of version 5.0 of the Cornell Net Carbohydrate and Protein System (CNCPs) in tropical conditions in 3 production settings in Honduras. Experiment 1 was conducted with 12 lactating Holstein cows in individual stalls at a research farm. The cows received known amounts of supplements and fresh, chopped Panicum maximum cv Tobiátã grass and intake was measured daily. Intake of grazing cattle was evaluated in Experiments 2 and 3 using the alkane technique over 8-d periods. Experiments 2 (commercial farm) and 3 (research farm) included 12 and 13 crossbred dual-purpose cows rotationally grazing Cyanodon dactylon cv Alicia and Panicum maximum cv Tobiátã grass, respectively, with appropriate supplementation. Model predictions were evaluated by regressing the observed (obs) values (Y variable) on the predicted (pred) values (X variable). Mean bias and mean square prediction error (MSPE) were calculated. Differences between obs and pred values were evaluated using a 2-tailed t-test. Model-predicted DMI (18.2 kg/d) was close to the observed values (18.0 kg/d), with a mean bias of -0.19 kg DM/d, suggesting that the CNCPs accurately predicted intake of confined lactating animals in tropical conditions. The intake predictions by the CNCPs for the grazing dual-purpose lactating cows were not as accurate. The CNCPs model underpredicted DMI in experiment 2 (10.7 kg/d obs versus 12.8 kg/d pred), with a mean bias of -2.04 kg DM/d, and DMI was overpredicted in experiment 3 (12.5 kg/d obs versus 12.2 kg/d pred), with a mean bias of 0.45 kg DM/d. For the three experiments, the slope of the regression between observed and predicted DMI did not differ from unity, but the intercept differed (P < 0.05) from zero, indicating a prediction bias. Accurate intake data from grazing animals is difficult to obtain and errors in the estimation of herbage intake using the alkane method may have contributed to the bias in the predictions by the CNCPs model.

Key Words: CNCPs, Dry matter intake, Tropical pasture

Sheep: Sheep production and management

489 Out-of-season breeding in hair sheep using Mechlorethyl Acetate (MGA). N. C. Whitley1, D. J. Jackson1, and S. Schoenian2, *University of Maryland Eastern Shore, 2Maryland Cooperative Extension, WMREC.

Thirty-two Katahdin and crossbred Katahdin ewes were group-fed one of two diets, a commercial diet containing MGA (n=16; MGA) or a commercial diet with no MGA (n=16; CON) for a period of 10 d after being removed from rams for 21 days prior to the start of treatment. The MGA group was fed to provide approximately .25 mg/ewe of MGA/kg of feed. While the control group was fed the control diet. Following the treatment period, ewes were grouped for mating (=d0) with two rams wearing marking harnesses for 14 days. Ewes were checked twice daily for estrus and numbers mated was recorded to determine days to first mating and percentage mated. Blood samples were collected for serum estrone sulfate (ES) radioimmunoassay at approximately 52.1±5 and 112.2±5 days after mating for pregnancy detection. Days to first mating tended (p<.08) to be lower for MGA-treated ewes compared to CON ewes, averaging 2.3±.6 and 4.3±.9, respectively. The percentage of ewes mated was higher (p<.01) for MGA-treated ewes (100±8.8%) compared to CON ewes (37.5±8.5%). Pregnancy rates could not be determined based on serum ES concentrations in this study and concentrations were not influenced by treatment, averaging 7.4±1.1 ng/ml for days 52 and 112, respectively. Lambing rate per ewe exposed and per ewe mated were both higher (p<.01) for MGA-
treated ewes (75.010.9 for both) compared to CON ewes (6.3±0.05% and 16.7±17.8%, respectively). Number of lambs born per ewe mated was also greater (p<0.03) for ewes treated with MGA (1.4±0.23 lambs compared to CON ewes (3.3±0.38 lambs), but number of lambs born per ewe lambing (1.8±0.15 lambs) and total litter birth weight (7.0±0.36 kg) was not influenced by treatment. Day 112 serum Es concentrations for ewes lambing tended to be positively correlated with total litter birth weight (r²=0.30, p<0.07), but not with number of lambs born (r²=0.21, p<0.14). Overall, progesterone priming in combination with the ram effect in hair sheared pregnancy, increased fertility and fecundity of ewes bred during summer.

Key Words: MGA, Hair sheep, Ram effect

490 Effect of breed type on shear force, sensory analyses and fatty acid content of lamb. S. P. Greiner*1, S. K. Duckett2, and D. R. Nutter1. 1 Virginia Polytechnic Institute and State University, Blacksburg, 2 University of Georgia, Athens.

Eighty eight lambs from two locations (L1, L2) were evaluated to assess breed differences in longissimus muscle tenderness, sensory attributes, and fatty acid content. At L1, Dorper (DP) and Dorset (DO) crossbreds (out of -DO, -Rambouillet, -Finnsheep ewes) were produced in 2000 and 2001, along with straightbred Katahdin (KT) and Baraboo Blackbelly x St. Croix (HB) wethers in 2003. At L2, DP and Suffolk (SU)-sired lambs (out of SU ewes) were produced in 2001. Lambs were weaned at 90 d of age, grazed, and then fed a high-concentrate diet prior to slaughter at 8 mo of age. Racks from carcasses were aged at 4°C for 10 d and frozen at -20°C for subsequent Warner-Bratzler shear force (WBS), sensory, and fatty acid (FA) analyses. Chops were rated by a trained sensory panel for tenderness (T), juiciness (J), lamb flavor (LF), and off-flavor (OF) using a 8-point scale (1 = extremely tough, dry, and bland; 8 = extremely tender, juicy, and intense). FA content of intramuscular lipid was determined by GLC. A model that fit location and breed type was used to evaluate DP vs non-DP (ND; DO) and SU) breed types. No breed by location interactions were observed. WBS values were 0.62 kg lower (P<0.01) for DP than ND (2.38 vs 3.00 SEM = 0.15). Similarly, panelists rated DP more T (P<0.01) than ND (5.51 vs 5.02 SEM = 0.08). J, LF, and OF were similar (P>0.32) for DP and ND. Concentrations of stearic, palmitic, and lauric acids were higher (P<0.05) in DP-sired lambs, whereas the percentage of linoleic acid was lower (P<0.05). DP tissues had higher (P<0.05) percentages of total saturated FA, along with lower (P<0.05) percentages of monounsaturated and polyunsaturated FA than ND. At L1 in 2001, WBS values were higher (P<0.05) for DO than DP and KT. WBS values were similar (P>0.05) for DP, KT, and HH lambs. HH lambs received higher (P<0.05) and more desirable T scores than DO and KT lambs. However, no differences were detected between breed types for J, LF, or OF. Longissimus tenderness was improved with Dorper genetics.

Key Words: Lamb, Sensory evaluation, Fatty acid


Low protein and limit-fed diets decrease excretion of N and P and help decrease environmental pollution. Twelve wether lambs (42kg BW) grouped into three blocks and kept in metabolic crates, were fed the experimental diets to determine the effects of low protein and limit-fed corn-based diets on DM digestibility and N and P metabolism. Treatment were; i) ad libitum intake, corn-SBM control, ii) limit-fed (2.5% of BW), low N and P corn diet, iii) ad libitum intake, low N and P soy hull-corn silage diet, and iv) limit-fed (2.5% of BW), low N and P soy hull-corn silage diet. The trial consisted of a 19 d period, 14 d for adaptation and 5 d for total collection of feces and urine. N intake by lambs was about 38% lower (P<0.05) than that of lambs fed the control diet. Lambs fed the soy hull-corn silage based diets consumed 45% less (P<0.05) than those fed the corn-based diets. Fecal output (g/d) by lambs fed soy hull-corn silage-based diets was nearly two times greater (P<0.05) than that of lambs fed corn-based diets. Fecal N output followed a similar trend, but fecal P output was not affected (P>0.05) by diet. DM (P<0.001) and N (<P<.01) digestibility was lower for ad libitum or limit-fed soy hull-corn silage diets than for the control or limit-fed (low N and P) corn diet. N and P retention (g/d) was also lower (P<0.05) for the limit-fed corn diet and ad libitum or limit-fed soy hull-corn silage diet. N retention was negative for the limit-fed low N and P soy hull-corn silage diet. Similar trend was observed for N retention as% of N intake. N retention as % of N digested was negative (P<0.05) for the limit-fed low N and P soy hull-corn silage diet, whereas, no difference was found between control, limit-fed corn and limit-fed soy hull-corn silage diets. Higher fiber, lower digestibility diets increase N excretion and decrease N retention (regardless of intake level), compared with corn-based diets.

Key Words: Low protein diets, Limit feeding, N and P metabolism

Animal Behavior & Well Being Symposium: Alternative housing for livestock


Dairy Housing has changed markedly over the last 30 years. Most new dairy facilities in the United States are either free stall confinement housing, or dry lot housing in areas with minimal rainfall. Many older facilities were designed to provide worker comfort and labor efficiency. Buildings in warm and cold weather climates were designed to minimize worker exposure while restricting ventilation. The impact of facility design on animal performance was rarely measured. More recently, researchers have measured the impact of facilities on the cow’s ability to handle stressful environmental conditions such as heat, cold, and overcrowding. In particular, heat abatement has been a critical design component in most regions of the United States. Handling waste has become a major issue, with scrape or flush systems predominant. The dietary industry has moved away from workers comfort to comfort, realizing that comfortable cows are healthier, more productive and profitable. Dairy design goals are to ease manure handling and maximize cow comfort, labor efficiency, and productivity while minimizing investment. Future trends will focus on improving cow comfort and productivity, with an increasing emphasis on heat abatement.

Key Words: Dairy housing, Free stall, Heat abatement

619 Housing the sow without crates - challenges and solutions. J. N. Marchant-Forde*, USDA-ARS.

Confining sows in crates throughout gestation, farrowing and lactation is commonplace in North America. In Europe, crating the sow throughout gestation will be prohibited from 2013 and the farrowing crate continues to be scrutinized by a powerful animal welfare lobby. In North America, major retailing chains are already introducing welfare guidelines and the issue of sow housing is an area that is attracting a great deal of attention, not least because of recent legislation enacted in Florida. However, loose housing of the gestating and farrowing sow does present real challenges that need to be addressed in order to safeguard pig well-being and ultimately, productivity. The major challenge of group housing the gestating sow is that of inter-sow aggression. Sows will fight especially when mixed and when having to compete for access to resources. Therefore, the ways in which sows are introduced to each other and how they are fed are major factors in determining the success or failure of a system, both in well-being and productivity terms. For loose-housed farrowing sows, the major challenge is that of safeguarding the well-being of her piglets, in terms of pre-weaning mortality and ensuring even growth. Over the last decade, aspects of sow housing have undergone a great amount of research. Although the majority of this work has been carried out outside of North America, many of the research results are likely to be directly applicable to the swine industry here. This paper will highlight work done to date with a focus on the development of practical solutions, derived from both system design and system management techniques, that allow the skilled and motivated stockperson to work what are called
alternative housing systems. At the end of the day, it is the stockperson who will ensure the success or failure of any sow housing system and the well-being of sows within that system. However, the tools do exist to safeguard pig well-being and productivity when removing them from confinement systems and, importantly, perhaps address some of the negative public perceptions about the swine industry.

Key Words: Sows, Alternative housing, Well-being


International trade in agriculture has developed enormously since the 2nd World War, and with it demands for liberalisation of the trade have grown. In 1994 the pressure for liberalisation resulted in agriculture being included in the General Agreement on Tariff and Trade (GATT). Despite this attempt to arrive at globally applied rules on agricultural trade, many countries still operate “systems,” which in various ways are designed to protect national agriculture industries. Since 1995 the GATT rules have been enforced by the World Trade Organization (WTO), and the EU and the US have so far initiated the majority of disputes over application of the rules. This tension between the US and EU over agriculture trade has relevance to the debate over animal welfare and its incorporation in international trade rules.

Key Words: Welfare, Trade policy, European

Forages & Pastures Symposium: Forage strategies for arid climates

493 Supplementing grazing beef cattle: If, when, with what, and especially how often? J. E. Huston*, Texas Agricultural Experiment Station, Texas A&M University System.

The literature was reviewed on the needs for and responses to supplementation by beef cattle grazing range forages. Only cases of adequate quantity of forage were considered. Rangelands vary in climatic conditions and plant species composition thereby causing differences in diet quality among occupied areas and during seasonal periods within those areas. Also, nutrient requirements of the cow unit vary with genetic potential and stage of production. An extensive dataset collected in western Texas (average annual rainfall ± approximately 500 mm) over a 17-year period was used to illustrate responses to supplemental feeding and various feeding practices. Unsupplemented, mature beef cows lost 18.4% of their fall weight (including reproductive tissues) before the beginning of the breeding season (April 1) and conceived at a rate of 81%. Cows fed the equivalent of one-half of their daily protein requirements in a concentrated supplement lost 12.9% of fall weight and had a 91% conception rate, a satisfactory reproductive rate in a mixed-age herd. Various preparations and supplementary nutrients were tested against this standard response. Several experiments were tested to compare the relative responses from feeding identical weekly amounts of supplemental feeds but broken into daily, three times per wk, and weekly portions. Generally, feeding interval did not affect mean responses in reduced body weight and condition score under the conditions of these studies and with the supplements offered. Those fed weekly (approximately 6.5 kg at a single weekly feeding) showed less variability in supplement and forage consumed and in changes in body weight. These data and inferences drawn are summarized in “The Eleven Commandments of Supplemental Feeding of Beef Cattle.”

Key Words: Beef-cattle, Supplemental-feeding, Feeding-interval

494 Complementary forages and grazing systems for beef cattle production on arid rangelands in the Western US. T. DelCurto*, D. W. Bohnert, C. S. Schauer, and G. D. Pulisher, Eastern Oregon Agricultural Research Center, Oregon State University, Union and Burns.

Western beef cattle producers are faced with numerous challenges relative to forage resources and nutritional opportunities. Specifically, much of the western US is characterized by high elevation rangelands that typically have short growing seasons and limited, highly-variable, precipitation. As a result, forage availability and quality are often low throughout most of the grazing period and limit optimal beef cattle production. Numerous opportunities exist, however, to improve the nutritional plane of beef cattle grazing arid rangelands. The introduction of complementary forages can lengthen the period of adequate nutrition. Forage species including alfalfa, forage kochia, crested wheatgrass, and winterfat have all been shown to offer unique nutritional advantages. Likewise, forage species that tolerate winter grazing and snow can provide economic advantages to western producers by decreasing the reliance on feeding harvested hay to cattle during the winter period. Grazing systems that utilize topographical characteristics of rangelands to enhance the nutrition of cattle production are also potential opportunities. For example, using pastures with southern exposures early and northerly aspects late can effectively increase the nutritional plane of grazing cattle. In addition, the use of rangelands that have diverse forb and shrub components late in the grazing period will improve the nutritional plane of the cattle. Care must be taken, however, to develop grazing systems that maintain or enhance the biological diversity of the forage base and long-term sustainability of the rangeland resource. In summary, nutritional opportunities do exist to improve the nutritional plane of cattle grazing western rangelands. Specific strategies need to be tailored to the resources available to beef cattle producers and will necessarily differ from location to location.

Key Words: Complementary forages, Grazing systems, Western range-


Application of existing and novel management techniques can alter traditional livestock grazing patterns and significantly improve the sustainability of arid rangelands. Livestock often congregate and heavily graze riparian areas and other sensitive rangeland while abundant forage remains in other areas. Increasing the uniformity of grazing can help protect fisheries, wildlife habitat and other vegetative and watershed resources. For years, managers have improved grazing distribution in extensive arid pastures by developing new water sources. In addition, strategic supplement placement can be used to lure cattle to graze areas that typically receive little use. Placement of low moisture molasses blocks in steeper areas that were far from water increased forage use by 14% at distances up to 600 m from supplement in foothill rangeland. Recent research has examined the potential of breed and individual animal selection to improve grazing distribution patterns. Cattle breeds developed in mountainous terrain utilize rugged rangeland more (P < 0.05) uniformly than breeds developed in more gentle terrain. In pastures that were grazed by cattle identified as “hill climbers” (previously observed on rugged terrain), more residual vegetation (P < 0.05) was left on gentle slopes and areas closer to water than in pastures grazed...
by cattle identified as “bottom dwellers” (previously observed on gentle terrain near water). Cattle may use rugged rangeland more uniformly after weaning and during periods when temperatures are more moderate (spring, early summer, and fall). Herding shows great promise for protecting sensitive rangeland. Preliminary data show that residual riparian forage in pastures where livestock were herded was up to two times higher than in a control pasture. The integration of herding and strategic supplement placement appears to be more effective than herding alone. Many concerns associated with the sustainability of grazing on arid rangelands can be resolved by manipulating livestock grazing behavior through management.

Key Words: Grazing, Distribution, Behavior

**496 Whole ranch management systems to optimize forage use and meet multiple use goals.** L. R. Roath*, Colorado State University.

Optimal forage use must account for the needs of the land and of the grazing animals, simultaneously! The challenge in designing systems to meet these criteria is to: 1) account for food choices of an array of grazing animals in time and space; 2) recognize what that means to relative food availability and relative depletion rates; 3) determine what the standing quantity of quality is and how many animals of what types it can supported (i.e. stocking rate); 4) determine the influence of the grazing use on the forage resource and feedback mechanisms; and 5) find and monitor reliable indicators of both plant and animal performance that will provide information on a time scale that will allow managers to adjust management choices to create sustainable management systems. This is a daunting job!

Prototype conceptual and applied models are being developed at Colorado State University to take some of the mystery out of this enormous task. The question of distribution of forage use and removal has been addressed scientifically by Dr. Larry Rittenhouse and Dr. Tom Hobbs. Progress is being made to use this conceptual information in predicting landscape use patterns and then making predictions of relative stocking rates for multiple grazing animal species. This work has allowed assessment of landscape level stocking rates and is now being tested for reliability. Preliminary indications are that the application of these models provides much additional information for the decision process about appropriate stocking rates but does not supplant the need for monitoring protocol for plants, plant communities, individual animals and populations. Monitoring tools like fecundity rates, animal weight, body condition for wild and domestic grazing animals and the Grazing Response Index, community dynamics, grazing pattern and rate of forage depletion for plants will be discussed, as well as, discussing the influences weather and growth dynamics of forage quality and availability. How managers might use these approaches to affect decisions on their operations will be suggested.

**Goat Species Symposium: Assisted reproduction in goats**

**497 Update on estrus synchronization in a minor species.** N. C. Whitley*, University of Maryland Eastern Shore, Princess Anne, MD.

Estrus synchronization allows for parturition at the most suitable time to take advantage of niche markets, feed supplies, labor and/or rising price trends. In the past, the synchronization of estrus in goats has focused primarily on dairy goats to allow for optimal timing of milk production. However, recent interest in meat goat production has resulted in attempts to use dairy goat, sheep and cattle synchronization regimes in meat goat management systems. Methods of synchronization have included techniques as simple as alteration of light patterns or manipulation of social inputs (i.e. the buck effect) and those as complex as varying timed hormonal treatments combined with light alteration and the buck effect. The synchronization of estrus using timed hormonal treatments seems to be more convenient in many meat goat production situations. Examples of hormones used include melatonin, progestagens (administered orally, as an injection or by using intra-vaginal releasing devices), gonadotropins/GNRH (or agonists) and/or prostaglandins alone or in combination. As is seen with sheep and cattle, breed and/or breed type, stage of production and environmental impacts can influence synchronization success in goats. The introduction of breeds developed in other countries for rapid growth, such as the Boer goat, and increased consumer and producer interest have added to the impetus for developing cost efficient and/or highly effective estrus synchronization regimes. New research is being conducted and various synchronization methods are being attempted in goats, a minor species, and the objective of this paper is to review these efforts.

Key Words: Estrus Synchronization, Meat Goats, Hormone

**498 Current status of cryopreserving goat semen.** P. H. Purdy*, 1 USDA-ARS National Animal Germplasm Program, Fort Collins, CO.

The success of goat sperm cryopreservation may be evaluated by multiple cellular characteristics. Classically, sperm cell motility, viability, acrosomal membrane integrity as well as other in vitro assays have been used to assess the success of cryopreservation and fertilizing potential. Ideally, multiple evaluations would be performed to evaluate how successful a freezing protocol is or how successfully a particular semen sample freezes. Successful cryopreservation of mammalian sperm is a relative concept, particularly when compared with sperm from other species. Dairy bulls have been selected for the ability to “freeze well” for generations and consequently these bulls have repeatedly high percentages of motile, viable sperm cells post-thaw that are capable of fertilizing oocytes. On the other hand, buck, ram, boar and stallion sperm is less consistent in these and other attributes post-thaw and potentially less fertile. The purpose of this review is to assess the current status of cryopreserving goat sperm and will include a review of literature that describes post-thaw motility, viability, acrosomal integrity, in vitro fertilization and other sperm cell attributes. In addition, the review will also compare the post-thaw sperm cell attributes of goats with that of other species to identify areas of research with consistent satisfactory results and those areas that could be enhanced to match the other species.

Key Words: Goat, Sperm, Cryopreservation


This study examined the effects of nutritional priming (NP) and multiple superovulation regimes on oocyte production in superovulated dairy goats using 389 non-lactating does, 1-10 years old, during the non-breeding season (December to May). The does were body condition scored (BCS scale: 1-5) and then randomly assigned to 2 equal groups. All does were fed hay ad lib; but the experimental group received an additional 0.5 kg/head/day of concentrated feed (DM crude protein = 19%) 2-3 weeks prior to oocyte collection. The donors were synchronized with progesterone vaginal implants (300 mg) on Day 0 and PGF2α (5 mg IM) on Day 7. The superovulation regime consisted of FSH twice daily (64mg/day IM) on Days 12-15. The implants were removed on Day 14 or 15 and GnRH was given (5mg IM) on Day 16. Estrus was detected by vasectomized bucks on Days 15 & 16. The reproductive response was assessed by exposing the uterus through a midline incision and by retrograde flushing of both oviducts to collect oocytes. The ova collected in donors with BCS 2, 3, 4 were 10.6±1.4, 10.1±0.5, 6.2±2.7 for NP does, and 8.7±1.0, 9.7±0.6, 12.6±3.7 for nonNP does, respectively. Two tendencies emerged that could not be verified statistically because of the variability of oocyte collection. First, nutritional priming appears to reduce oocyte production in overconditioned does. Sec- ond, compared to underconditioned does in the nonNP control group, experimental does with lower BCS tended to be more reproducitively responsive to nutritional priming. Additionally, historical data for does with repeat superovulatory regimes were analyzed. Ova collected from donors in their first superovulation regime (12±0.5) were significantly greater than ova from donors in their fourth regime (40.9). Thus, when devising a protocol to maximize oocyte production, nutritional priming should be considered for underconditioned does but not for overweight...
animals. Furthermore, multiple superovulation regimes will decrease the number of ova collected.

**Key Words:** Superovulation, Nutrition, Goat

### 500 Effect of breed and progesterone priming on pregnancy rates in anestrus meat goats in response to the buck effect. L. Nutt*, S. Woldesenbet, and G. Newton, Prairie View A&M University, Prairie View, TX 77446.

Our goal was to test the effects of male introduction, with and without progesterone (P4) priming on pregnancy rates in three breeds of meat goats. Female Boer (B, n=35), Spanish (S, n=46) and Myotonic (M, n=57) goats were selected during seasonal anestrus (May/June). Half of the does of each breed were vaginally implanted with a P4 controlled internal drug release (CIDR-G) device on May 7. After 12 days each doe received 1 ml (5 mg) of prostaglandin F2-alpha (Lutalyse). After 14 days all does were sorted by breed into one acre breeding traps. A buck received 1 ml (5 mg) of prostaglandin F2-alpha (Lutalyse) and received a corn-soybean meal supplement at 1.5% BW (n=14), or fitted with P4 (n=8) or MPA treatment groups and either group-fed once daily a MGA/corn/soybean meal supplement at 1.5% BW (n=14), or fitted with P4 (n=8) or MPA

(n=8) sponges for 8 d. All animals received ad lib chopped hay, and sponge-treated animals received a corn/soybean meal supplement. At the end of treatment, all animals were injected (im) with 2.5 ml of PG-600 (200 IU eCG/100 IU hCG) and placed with a fertile, libido-tested male of the appropriate species fitted with a marking harness. Estrus was observed at 4-h intervals for 96 h. The incidence and rate of estrus was determined after 4 d via laparoscopy, and pregnancy and fetal numbers were determined via transrectal ultrasound after 28 d. Data were analyzed using GLM and chi-squares procedures of SAS. MGA and sponge protocols did not significantly differ in estrus response (50% and 80%, respectively) and time to estrus (57.7 and 52.1 h, respectively), but pregnancy rate (7 and 15%, respectively) and ovulation rate (0.4 and 1.5, respectively) were lower (P<0.05) in MGA-treated animals. There were no differences in response between sheep and goats, and no differences between the two sponge types. Results suggest that MGA feeding can be used to induce estrus, but that efficacy was lower than was observed for vaginal sponge treatments.

**Key Words:** Melengestrol Acetate, Goats, Hair Sheep

### 502 Effect of fat supplementation of goats in different body condition and under increased photoperiod upon ovulatory activity and preovulatory endocrine profiles. C. A. Meza H.*,1,2, M. E. Hernandez L.1, J. G. Chavez-Perchez2, H. Salinas3, J. Urrutia M.4, and M. Mellado4, 1Universidad Autonoma Chapingo-UURUZA, 2Radiodiagnostico y Ultrasonografia, 3INIFAP, 4UAAAN.

The effect of fat supplementation level (FSL) and body condition (BC) upon ovulatory activity (OA) and the preovulatory serum profile of GH, LH and insulin (INS) in goats subjected to natural increases in photoperiod (March and April), was evaluated. The study was carried out in northern Mexico (25 NL, at 1,117 m). Goats, 14 months old, were classified as low body condition (LBC, n=10, 26.8±1.2 kg, BC5=3.0) or high BC (HBC, n=11, 33.8±2.2 kg, BC5=3.8), and received either no by-pass fat (NF) or Ca fatty acid salt (WF, 120 g d l-1), equivalent to 0.768 Mcal NE, during a 42-d experimental period. Goats received a basal diet of alfalfa hay (2.0% BW, 14.6% CP), water, shade, and mineral salts. Once synchronized (two PGF2a injections, 11 d apart), blood samples were collected during the late follicular phase of the second estrus at 15-min intervals for 6 h to quantify pulsatility (PULSE) and area under the curve (AUC) of GH and LH, as well as serum INS levels. The number of follicles (TF), corpus luteum (CL) and total ovarian activity (TOA) was scanned during the late luteal phase after blood sampling. No differences occurred (P>0.05) for either FSL or BC with respect to TF (2.90±3.5) and CL (2.50±2.8). Average serum concentrations for LH, GH, and INS, were 3.460±55, 7.490±96 and 1.640±05 ng/ml, respectively. While GH-AUC (2791.2366), GH-PULSE (3.50±2.52), and LH-PULSE (3.70±7.7) did not differ (P>0.05) between BC and FSL, supplemented goats depicted the largest TOA (5.0 vs 6.00±2, P=0.04) with concomitant increases (P=0.07) in LH-AUC and INS. Fat-by pass supplementation of yearling goats with only 56% of adult weight during the anestrus season positively affected their metabolic status and the hypothalamic-hypophyseal-ovarian axis response.

**Key Words:** Goats, Energy, Ovarian activity

### Production, Management, & the Environment Symposium: Impact of animal feeding operations on the environment

#### 503 Overview of nitrogen in the environment. J. N. Galloway*, University of Virginia.

Nitrogen is essential for life but useable N is in short supply; thus ecosystem productivity is often limited by N availability. Historically, biological nitrogen fixation (BNF) was the primary process that converted unusable molecular diatomic nitrogen to useable reactive N (N2). However, in the current world, human activities (Haber-Bosch process, cultivation-induced BNF and fossil fuel combustion) are now more important than natural BNF in creating N. In addition, since denitrification is not keeping pace with enhanced N creation, N is accumulating in the atmosphere, hydrosphere and biosphere. There are a large number of consequences on ecosystems and people that occur as enhanced N moves along its biogeochemical pathway. Referred to as the Nitrogen Cascade, the same nitrogen atom can cause sequential effects in the atmosphere, in terrestrial ecosystems, in freshwater systems, in marine systems, and on human health. This presentation will review the cycling of N in the natural environment, in contrast with the current environment, and will include projections for nitrogen cycling in the future. The Nitrogen Cascade will be used to illustrate the impacts of N on environmental systems. The presentation will address a challenge facing society–namely, while the consequences of N accumulation are severe, the introduction of N into agricultural systems is necessary to sustain food production. The challenge facing society is how to optimize nitrogen management in food (and energy) production while maintaining environmental quality.

**Key Words:** Nitrogen, Cascade, Fertilizer
504 Management to reduce nitrogen losses in animal production. C. Alan Rotz*1, 1USDA / ARS.

Reduction of N losses in animal production requires whole-farm management. Reduced loss from one component of the farm is easily negated in another component if all components are not properly managed. Animal excretion of N can be reduced by improving the balance of protein fed to that required by individual animals or animal groups or by improving production efficiency. Management to improve milk or meat production reduces the protein per animal, thus improving N utilization. Large losses of N occur on farms due to ammonia and nitrous oxide emissions to the atmosphere and nitrate leaching to ground water. Animal housing design and manure collection procedures influence the volatile loss in the housing structure. More frequent flushing or scraping of floors provides some reduction in loss, and experimental methods for separating feces and urine promise much greater reductions. Manure storage units are used to reduce application losses and improve the timing of nutrient application with crop needs. Maintaining a surface crust in storage tanks reduces volatile loss, and the use of covers or enclosed tanks can greatly reduce storage loss. Irrigation and surface spreading of manure without rapid incorporation often assures the loss of all remaining ammonia N. Rapid incorporation, band spreading, and shallow injection methods reduce this application loss, and deep injection into the soil essentially eliminates this loss. For grazing animals, the use of rotational grazing and half-day grazing practices can improve the distribution and utilization of manure nutrients. Reducing volatile losses between the animal and the soil can lead to greater leaching and denitrification losses if this additional N is not used appropriately. Use of a crop rotation that efficiently recycles these nutrients and applying these nutrients near the time they are needed by the crop reduces the potential for further loss. Maintaining the proper number of animals per unit of land available for manure application is always critical for efficient recycling of nutrients with minimum loss to the environment.

Key Words: Nitrogen loss, Management, Farm system

505 Quantitative assessment of phosphorus transport to surface and groundwaters. J. L. Havlin*, North Carolina State University, Raleigh, NC.

National water quality survey data illustrate that increased eutrophication of fresh waters is related to increased P and N delivered from both non-point and point sources. As a result of increasing information and concerns regarding P delivery and water quality, the USDA-NRCS revised its nutrient management policy in May 1999 to reflect the potential contribution of P to water quality degradation. The policy requires each state to revise the Nutrient Management (590) standard in its Field Office Technical Guide. The revised standard must include an assessment of potential P loss from agricultural fields. As soil test P levels increase, through applications of animal waste and other P sources, the potential P delivery to surface and groundwater greatly increases. There are many interacting factors that influence P delivered from an agricultural field to surface or groundwater. These include the quantity and type of P applied, timing and method of application, soil type (soil chemical, physical, and biological properties), extent of soil erosion and sediment delivery, runoff and leaching potential, proximity to the water body, and other factors. We have developed a P Loss Assessment Tool (PLAT) that provides a means to assess the relative risk of P delivery to surface and groundwater. The PLAT is a P index method that was developed using the most current and relevant scientific data supporting P transport to surface and groundwaters. To quantify P delivered to surface and groundwater, PLAT includes four components or submodels: sediment bound or particulate P in surface runoff water, soluble P in surface water runoff, soluble P on leaching water, and P source contributions. The model also enables the user to evaluate how adoption of best management practices impact or reduce P loss. The quantitative estimates from each component are added to obtain an estimate of total P loss. These values are then assigned to categories of very high, high, medium, and low P loss. The presentation will discuss P loss pathways, technical components of PLAT, and an impact assessment of fields in North Carolina receiving animal waste.

Key Words: Water quality, Phosphorus

506 Animal management to reduce phosphorus losses to the environment. K. F. Knowlton*, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Water quality in the United States is threatened by contamination with nutrients, primarily nitrogen and phosphorus. Animal manure can be a valuable resource for farmers, providing nutrients, improving soil structure, and increasing vegetative cover to reduce erosion potential. At the same time, application of manure nutrients in excess of crop requirements can result in environmental contamination. Environmental concerns with phosphorus are primarily associated with pollution of surface water (streams, lakes, rivers). This pollution may be caused by runoff of phosphorus when application to land is in excess of crop requirements. Increased specialization and concentration of livestock and crop production has led to the net export of nutrients from major crop producing areas to the rest of the country, thus increasing the potential P delivery to surface and groundwater. To quantify P delivered to surface and groundwater, PLAT includes four components or submodels: sediment or particulate P in surface runoff water, soluble P on leaching water, and P source contributions. The model provides a means to assess the relative risk of P delivery to surface and groundwater. The PLAT is a P index method that was developed using the most current and relevant scientific data supporting P transport to surface and groundwater. To quantify P delivered to surface and groundwater, PLAT includes four components or submodels: sediment bound or particulate P in surface runoff water, soluble P in surface water runoff, soluble P on leaching water, and P source contributions. The model also enables the user to evaluate how adoption of best management practices impact or reduce P loss. The quantitative estimates from each component are added to obtain an estimate of total P loss. These values are then assigned to categories of very high, high, medium, and low P loss. The presentation will discuss P loss pathways, technical components of PLAT, and an impact assessment of fields in North Carolina receiving animal waste.

Key Words: Nutrients, Pathogens, Surface runoff

507 Water quality and the grazing animal. R. K. Hubbard*1, G. L. Newton2, and G. M. Hill2, 1USDA-ARS, Tifton, GA, 2University of Georgia, Tifton, GA.

Grazing animals and pasture production impact water quality both through urine and feces droppings by the animal itself and through fertility practices associated with production of high quality pasture. The two nutrients of primary concern relating to animal production are nitrogen (N) and phosphorus (P). Nitrogen is of concern because high concentrations in drinking water in the nitrate form cause methemoglobinemia (blue baby disease) while other forms of N (primarily nitrite) are considered to be potentially carcinogenic. Phosphorus in the orthophosphate form is of concern because it causes eutrophication of surface water bodies. The impact of grazing animals on soil and water quality is best evaluated at the watershed scale. Such evaluation must include both direct input of animal wastes from the grazing animal and also applications of inorganic fertilizers to produce quality pastures. Watershed scale studies have primarily used the approach of nutrient loadings per land area and nutrient removals as livestock harvests. A number of studies have measured nutrient loadings in surface runoff from grazed land and compared loads with other land uses. Concentrations in discharge have been regressed against standard grazing animal units per land area. Watersheds with concentrated livestock populations have been shown to discharge 5 to 10 times more nutrients than watersheds with other land uses. Another major concern with animal production including grazing animals is pathogens, which may move from the wastes into surface water bodies. Major surface water quality problems associated with pathogens have been associated with grazing animals, particularly when they are not fenced out from the streams and farm ponds. This paper presents an overview of water quality findings and concerns relating to grazing animals.

Key Words: Nutrients, Pathogens, Surface runoff

508 Governmental policies and measures regulating agricultural nitrogen and phosphorus in the European Union. O. Oenema*, Wageningen University and Research Center, Wageningen, The Netherlands.

This paper discusses governmental policies and environmental regulations that influence nitrogen and phosphorus in animal manure and fertilizers in the European Union (EU-15). It starts with an introduction of changes in governmental policies during the last century. Second, it summarizes the basics of environmental policies and measures,
then summarizes the main characteristics of agriculture in the EU-15. Thirdly, it provides an overview of the common agricultural policy CAP in the EU and of environmental regulations and directives. Finally, it discusses implementation of the EU Nitrate Directive in the Netherlands and Denmark. Systematic interference of governments with European agriculture started in the 19th century. Marked effects of policies on agriculture followed after the foundation of the EU with its CAP. Environmental issues in agriculture were addressed following the reform of the CAP in 1992 and following the implementation of various environmental regulations and directives from the 1980’s and 1990’s onwards. The EU Nitrate Directive has as yet the strongest influence on N and P in agriculture, especially through its objectives to designate areas vulnerable to nitrate leaching, to establish action programs and to establish a code of good agricultural practice. These measures must ensure that, for each farm, the amount of N applied via livestock manure shall not exceed 170 kg per ha per year. The Nitrate Directive was agreed to by all member states in 1991, but there are variations between member states in the interpretation, implementation and enforcement of the Nitrate Directive. Differences in the progress of implementation appear in part to be related to differences in the structure of agriculture, as shown by a comparison between Denmark and The Netherlands.

Key Words: Nitrogen, Nitrate, Europe

**Breeding & Genetics: Dairy cattle breeding for nonproduction traits**

**509** Selection for mastitis in Norwegian dairy cattle. A. Karlsen*1, B. Heringstad2, E. Sehested1, and M. Svendsen1, 1GENO Breeding and A.I. Association, 2Department of Animal Science, Agricultural University of Norway.

Clinical mastitis (CM) is the most frequent and costly disease in dairy production. Mastitis has been recorded through the health card system as an integrated part of the Norwegian Dairy Herd Recording System (NDHRS) since 1978, and includes recording of all veterinary treatments on individual cows. In 2002, 96% of the cows belonged to herds in the NDHRS. In Norway, antibiotics can only be prescribed by veterinarians, and it is compulsory to record diagnosis and treatment on the cow’s health card. Information is then transferred to the NDHRS on routine basis. Mastitis has been included in the total merit index of Norwegian Dairy Cattle (NRF) since 1978, and the relative weight in the total merit index is currently 22%. In 2002, progeny testing for mastitis was based on an average of 210 daughters. Since 1990 there has been a favourable genetic trend for mastitis resistance. In 2002 the phenotypic average of CM (from 15 days prior to calving to120 days after first calving) was 11.5%. Results from a Norwegian selection experiment, including one group of cows selected for high protein yield (HPY) and one group selected for low clinical mastitis (LCM), clearly demonstrates the effect of direct and indirect selection on CM. After 3 cow-generations the genetic difference between LCM and HPY cows was 8.6 % CM. The genetic trend for the LCM cows, equivalent to a reduction of 0.9 % CM per year, shows that considerable selection response can be achieved for mastitis if sufficient selection pressure is put on the trait. If mastitis is ignored in the breeding program, selection for increased milk production will result in an unfavourable correlated response in CM. Results from the selection experiment indicate that an increase of 0.23 % CM per year may be expected as a correlated response. Genetic trends for the NRF population show that the trend in herd-year-season, and one 5-year period, was a genetic improvement for health, fertility, and milk production simultaneously, despite unfavourable genetic correlations and low heritabilities for some of the traits.

Key Words: Mastitis resistance, Selection, Norwegian dairy cattle

**510** Associations of lactoferrin concentrations in milk with indicators of mastitis in dairy cows. A. A. Martin*, M. A. Faust, L. J. Rowe, and E. J. Lonergan, Iowa State University, Ames 50011.

Objectives were to determine levels of lactoferrin in milk and associations of lactoferrin with mastitis indicators. Milk samples were collected for some of the traits. Samples were read in a microtiter plate at a wavelength of 450 nm. Lactoferrin was conjugated with horseradish peroxidase. The substrate, 3,3',5,5'-tetramethylbenzidine, was used to detect the bound detection antibodies. Samples were read in a microtiter plate at a wavelength of 450 nm. Detailed mastitis treatment records for 2002 were acquired and used to determine incidence of mastitis, number of days treated, and mastitis severity for individual cows. Projected mature equivalent fat corrected milk (FCM) and lactation average somatic cell count (SCC) were obtained from Dairy Herd Improvement records. Means for mastitis incidence, days treated, and lactation average SCC were .94, 19.3, and 3.2, respectively. Several chronic cows skewed results for days treated consequently this variable was transformed using the natural log function. Mean lactoferrin was .336 mg/ml (SD = 222 mg/ml). Highest FCM was associated with lowest concentration of lactoferrin in milk. Lactoferrin levels were lowest for youngest cows (P < .01). Stage of lactation was not important for lactoferrin concentration when cows with 10 or fewer days in milk were eliminated from the analysis. Correlations of mastitis indicators with lactoferrin and SCC measures were similar and indicated that highest days treated was associated with highest lactoferrin and highest SCC (P < .05). Correlation of lactoferrin and lactation average SCC was .36. In this small data set, heritability for lactoferrin was considerably higher than estimates for SCC related measures. Lactoferrin may be useful for genetic selection to control increases in mastitis that accompany selection for high yields.

Key Words: Lactoferrin, Mastitis, Somatic cell score

**511** Measure of the impact of somatic cell count on longevity of Holstein and Jersey cows using survival analysis. D. Z. Caraviello*, K. A. Weigel, G. Shook, and P. Ruegg, University of Wisconsin - Madison.

Survival analysis through a Weibull proportional hazards model was applied to evaluate the effect of somatic cell count (SCC) on survival of 1,892,919 Holstein and 250,835 Jersey cows with first calving from 1990 to 2000 in the United States. Herds were divided in 5 levels for Holsteins (2 replicates per level) and 3 levels for Jerseys by average somatic cell count. Survival was defined as days from first calving until culling or censoring corrected for 305-d mature equivalent milk production. Our model included time-dependent effects of herd-year-season, parity-stage of lactation and within-herd-year quintiles for mature equivalent milk production, as well as the time-independent effect of age at first calving. Different rho and gamma parameters for the Weibull distribution were estimated for each of the herd levels. SCC was divided into 15 classes and its impact on functional survival, after accounting for all other factors listed above, was evaluated. Survival analysis methodology allowed a nonlinear relationship between SCC and longevity. Average censoring and average time decreased as average SCC level of the herd increased. Results showed differences between levels of herds in the risk of culling; cows in the high SCC class had 3.4, 2.7, and 2.3 for Holsteins and 4.0, 2.9 and 2.2 for Jerseys times higher risk of being culled than cows in the average SCC class in herds with low, medium and high average SCC, respectively. This suggests stricter culling for SCC in herds with low average SCC. Cows in the lowest class for SCC also showed higher risk of culling than cows in the average SCC class, particularly in herds with high average SCC.

Key Words: Survival analysis, Somatic cell count, Longevity

**512** Effect of synchronization protocols on genetic parameters of reproductive traits in dairy cattle. R. C. Goodling*1, G. E. Shook*1, K. A. Weigel1, N. R. Zwald2, and R. D. Welper2, 1University of Wisconsin-Madison, 2Alta Genetics, Inc.

Genetic evaluation for female reproduction is one strategy for improving performance. Many producers utilize synchronization of ovulation or estrus to manage reproduction. Our objective was to examine the effects of synchronization protocols on parameter estimates of days to first breeding (DFB). Data were collected from producers participating in an AI progeny testing program, and utilizing DC305 herd management software to record reproductive treatments and events. Analysis was performed on 13,134 records from 42 herds. Data were split into

three subsets: all first breedings (ALL), non-synchronized first breedings (NSYN), and synchronized first breedings (SYN). DFB was truncated to range from 25 to 300 d, with overall mean 73.9 d and SD of 26.9 d. NSYN data consisted of 7760 records with mean 73.0 d and SD 31.1 d. SYN data consisted of 5374 records with mean 75.2 d and SD 19.3 d. Only the earliest parity for each cow was included. Both animal and sire models were used to estimate genetic parameters. Fixed effects for both models were herd-year-season, parity, and calving age. Random effects were animal or sire. SYN was included as a fixed effect in the models of ALL. Variances were calculated using the REMLF90 program of Misztal. Heritabilities may be higher in SYN than in NSYN, ranging from 0.024 to 0.080 (Table 1). Variances were substantially lower in SYN records (Table 1). The SYN and NSYN data should be analyzed as different traits, or may be combined with an adjustment for heterogeneous variances.

<table>
<thead>
<tr>
<th>Sire</th>
<th>Animal model</th>
<th>Animal model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residual Heritability</td>
<td>Residual Heritability</td>
</tr>
<tr>
<td>ALL</td>
<td>0.031</td>
<td>0.037</td>
</tr>
<tr>
<td>NSYN</td>
<td>0.037</td>
<td>0.051</td>
</tr>
<tr>
<td>SYN</td>
<td>0.040</td>
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</tbody>
</table>

Key Words: Days to first breeding, Heritability, Synchronization

513 The effect of using body condition score and dairy character as indicators for genetic resistance to diseases in Danish Holstein, J. Lassen1, M. Hansen1, M. K. Sorensen2, G. P. Aamand2, L. G. Christensen2, and P. Madsen2

1 Danish Institute of Agricultural Sciences, Denmark., 2 The Danish Agricultural Advisory Centre, Denmark., 3 The Royal Veterinary and Agricultural University, Denmark.

The aim of this study was to investigate the genetic relationship between body condition score (BCS), dairy character (DC), mastitis and other diseases than mastitis in first parity Danish Holsteins in order to explore the possibilities for using BCS and DC for indirect selection for disease resistance. The data set included 30,470 records on conformation scores and 366,286 on diseases. Mastitis was defined in the period from #100 to #200 and indirect (BCS and DC) information sources with different possibilities for using BCS and DC for indirect selection for disease resistance. The accuracy of an index for disease resistance with direct and residual var. var. ability — var. var. ability

<table>
<thead>
<tr>
<th>Trait</th>
<th>BCS</th>
<th>DC</th>
<th>OD100</th>
<th>MS550</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCS</td>
<td>0.25 (0.027)</td>
<td>-0.37 (0.01)</td>
<td>-0.05 (0.002)</td>
<td>0.008 (0.007)</td>
</tr>
<tr>
<td>DC</td>
<td>-0.60 (0.06)</td>
<td>0.22 (0.025)</td>
<td>0.03 (0.007)</td>
<td>0.010 (0.007)</td>
</tr>
<tr>
<td>OD100</td>
<td>-0.21 (0.10)</td>
<td>0.14 (0.09)</td>
<td>0.022 (0.004)</td>
<td>0.011 (0.007)</td>
</tr>
<tr>
<td>MS550</td>
<td>-0.15 (0.09)</td>
<td>0.22 (0.09)</td>
<td>0.31 (0.07)</td>
<td>0.036 (0.004)</td>
</tr>
</tbody>
</table>

Heritabilities (diagonal), Heritability (below diagonal) and residual (above diagonal) correlations.

Key Words: Body condition score, Dairy character, Disease resistance

514 Comparison of First-Parity Holstein, Holstein-Jersey crossbred, and Holstein-Normande crossbred cows for dystocia and stillbirths, B. J. Heins1, M. K. Sorensen1, G. P. Aamand2, L. G. Christensen2, and P. Madsen2

1 Danish Institute of Agricultural Sciences, Denmark., 2 The Danish Agricultural Advisory Centre, Denmark.

First-parity Holstein, Holstein-Jersey crossbred, and Holstein-Normande crossbred cows calving from June 2001 to December 2002 were compared for dystocia and stillbirths from six California herds. Dystocia scores ranging from 1 (no assistance) to 5 (hard pull) and stillbirths (1 for alive and 0 for dead) were recorded for 1268 Holstein cows, 243 Holstein-Jersey cows, and 66 Holstein-Normande cows. Cows were bred to Brown Swiss, Holstein, Jersey, Montbeliard, Normande, and Scandinavian Red sires. Investigated were effects of calf sex, breed composition of cow, age at calving, breed of service sire, sire of calf within breed composition, and herd. For dystocia, sex of calf, and herd were significantly different (P<0.01). The least squares mean for calf sex was 1.71 for males and 1.35 for females. Breed composition of dam did not differ significantly, however, there was a tendency for less calving complications for the crossbred cows compared to Holsteins. Mean scores were 1.59 (H) 1.46 (HxJ), and 1.54 (HxN). Brown Swiss sired calves (1.64) differed significantly (P<0.05) from Jersey sires (1.32), and Brown Swiss sires differed (P<0.02) from Holstein (1.67) sires. For stillbirths, calf sex, age at calving age were significantly different (P<0.01). Male calves (14%) had higher stillbirths than females (3%). Holstein sires had the highest rate of stillbirths (15%), and rates for the other breeds of sires were 8% for Brown Swiss, 8% for Jersey, 12% for Montbeliard, 4% for Normande, and 6% for Scandinavian Red sires. Holstein sires differed significantly from Normande (P<0.05) and Scandinavian (P<0.01) sires. Montbeliard significantly different (P<0.05) from Scandinavian Red sires. Although not significantly different, Holstein cows had 12% stillbirths, Holstein-Jersey cows had 9% stillbirths, and Holstein-Normande cows had 6% stillbirths.

Key Words: Crossbreeding, Dystocia, Stillbirths


First services from AI were recorded on 270 Holstein cows and on 181 Holstein heifers. One half of cows and heifers were mated to Holstein AI sires and the other half were bred to Jersey AI sires. Cows and heifers were randomly assigned to either a Holstein or Jersey service sire, except coefficients of inbreeding were not allowed to surpass 6.25% for mating of Holstein sires to Holstein females. First service conception rates did not differ by breed of service sire for lactating cows. For virgin heifers, Holstein sires had significantly higher first service conception rates than Jersey sires (P<0.01). From September 2001 to January 2003, 135 Holstein and 152 Holstein-Jersey crossbred calves were born at the University of Minnesota research at the St. Paul, campus, and at the West Central Research and Outreach Center, Morris. Dystocia was scored with a range of 1 (no assistance) to 5 (hard pull). Mean dystocia score was 1.65. Independent variables for analysis were herd, parity (1st versus 2nd and later), sex of calf, and breed of sire. Differences between Holstein and Jersey sires were significant for dystocia score, calf weight, and retained placenta. C. D. Dechow1, G. W. Rogers1, T. J. Lawlor2, L. Klei3, and P. M. VanRaden3

1 Department of Animal Science, University of Tennessee, 2 Holstein Association USA Inc., 3 Animal Improvement Programs Laboratory USA Inc.

The objectives of this study were to estimate genetic correlations among body condition score (BCS), dairy form (DF), days open (DO), ME milk, ME fat and ME protein production. Body condition score and DF obtained from the Holstein Association USA Inc. were merged with DO and production data from the Animal Improvement Programs Laboratory at USDA. Edits applied to the data included: a valid BCS observation, a minimum of 20 daughters per sire, a minimum of 10 cows per sire, and 250. The final data set included 166,222 records. Fixed effects were age within lactation group, 5th order polynomials of DIM and HYS for DO. Random effects were age within lactation group, 5th order polynomials of DIM and HYS for production traits and lactation number and HYS for DO. Only one record per cow was used and DO greater than 250 were excluded. In all analyses were performed with AS-REML. Heritability estimates ranged from 0.04 for DO to 0.30 for ME protein. The genetic correlation estimate between BCS and DO was 0.51.
-0.33. The genetic correlation estimate between DF and DO was 0.51. The genetic correlation estimate between BCS and DO was -0.10 when DF was included as a covariable and the genetic correlation estimate between DF and DO was 0.49 when BCS was included as a covariable. Genetic correlation estimates among BCS and production traits ranged from -0.20 to -0.30, whereas genetic correlation estimates among DF and production traits ranged from 0.41 to 0.52. These genetic correlations can be used to help develop appropriate weights for an index that includes days open evaluations. Using dairy form evaluations as an indicator trait would increase the accuracy of days open evaluations for newly proven bulls.

**Key Words:** Body condition score, Dairy form, Days open

### 517 Seasonality of days open in US Holsteins. S. Oseni and I. Misztal, University of Georgia, Athens, GA, USA.

The objectives of this study were to establish a pattern for the seasonality of Days Open (DO) by state and region within the US and to present statistics on regional trends for DO. Data included 6,871,265 records from 1998 to 2001. Fixed effects in the model included region, herd, year and month of calving (MOC), parity, milk-class, region * MOC, herd * MOC, year of Calving * MOC and parity * MOC. Results showed that DO were longest for March/April and shortest for September/October calvings for all regions, years and parities. Regional mean DO were 156 (Southeast), 145 (Midwest), 142 (Northeast), 143 (Northwest) and 140 (Southwest). Mean DO by state ranged from 135 (AZ) to 161 (FL). States with DO > 150 included: KY, OK, TX, and most parts of the Southeast. Monthly variations by state ranged from 7 (OK) to 64 (AR, MS). States with monthly variations > 40 d were AZ, MO, AR, OK, TX, GA, SC, NC, MS, AR, TN, AL and LA. Regularity of calving was computed as the ratio of calvings in months with the least and most calvings. Regularity varied from 0.16 (LA) to 0.88 (MA). It was below 0.4 for AZ, TX, OK and all of Southeast. Exceptions in the general patterns were PL, where regularity was higher and variations of DO were lower than in adjacent states, and in CA, where, despite hot weather, regularity was high and variations were low. Studies on the effect of heat stress on days open in the Southeast are limited by the small number of cows compared to other regions and by low fraction of cows bred during the peak of heat stress. Therefore, such studies could use data from all regions associated with hot weather including lower Midwest and parts of Southwest.

**Key Words:** Days open, Seasonality, Month of calving

### 518 A new genetic evaluation for calving ease in the Italian Holstein. F. Canavesi*, S. Biffani, and A. B. Samorè, ANAFI.

The first genetic evaluation for calving ease was published around 1992. Data collected by milk recording agencies define calving difficulty based on a small number of cows compared to other regions and by low fraction of cows bred during the peak of heat stress. Therefore, such studies could use data from all regions associated with hot weather including lower Midwest and parts of Southwest.

**Key Words:** Days open, Seasonality, Month of calving

### 519 Characteristics of genetic evaluations for daughter fertility in relation to other fitness traits. H. D. Norman*, J. R. Wright, P. M. VanRaden, and M. T. Kuhn, Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.

Considerable attention is being focused on cow fertility because of the initiation of genetic evaluations for daughter pregnancy rate (DPR) in February 2003. In order for a new trait to be accepted, the industry needs to understand its characteristics. Properties of DPR evaluations were compared with those of evaluations for other fitness traits introduced during the last decade. For cows born during 1988, 1993, and 1998, predicted transmitting abilities (PTA) for DPR averaged 0.9, 0.5, and 0.4%, respectively, which reflected a negative genetic trend. Cow PTA for somatic cell score (SCS) also had a small unfavorable trend, but cow PTA for productive life (PL) has been improving. Mean reliability (REL) for cow PTA DPR is nearly as high as REL of PTA for PL and SCS even though based on a lower heritability (0.04 for DPR compared with 0.085 for PL and 0.10 for SCS), partly because of additional observations on fertility in later lactations or because of its lower repeatability. For 1988, 1993, and 1998 birth years, cow REL DPR was 32, 32, and 30%, respectively, compared with REL PL of 31, 32, and 31% and REL SCS of 32, 35, and 34%. For artificial-insemination (AI) bulls born during 1984 through 1988 (n = 6037), 1989 through 1993 (n = 7247), and 1994 through 1998 (n = 5425), PTA DPR averaged 0.1, 0.0, and −0.2%, respectively. Similar to cow PTA, bull PTA SCS showed a small unfavorable trend (3.11, 3.11, and 3.13), whereas PTA PL have been improving (~0.47, 0.61, and 0.14 mo). Mean bull REL DPR were 67, 67, and 59%, respectively; mean REL PL were 67, 67, 61%, and mean REL SCS were 68, 73, and 69%. Effects of birth year and AI sampling organization on bull PTA DPR was examined. Birth year accounted for 2.6% of variance in DPR; AI sampling organization accounted for additional 0.3%. Those same effects accounted for 5.8% and 0.1%, respectively, of PL variation and for 1.1 and 0.4% of SCS variation. For bulls in active AI service, no differences were found between AI sampling organizations for DPR, although an effect was found for PL and SCS. Based on REL alone, reservations about using PTA DPR in selection programs because of its limited accuracy appear to be unwarranted.

**Key Words:** Daughter pregnancy rate, Productive life, Somatic cell score

### 520 Definition of traits and comparison of models for genetic evaluation of cow fertility. P. M. VanRaden* and M. E. Tooker, Animal Improvement Programs Laboratory, Animal Research Service, USDA, Beltsville, MD.

Cow fertility and longevity traits often have distributions similar to coin tosses that are repeated if tails are observed. Methods to evaluate repeated binomial observations were compared by simulation. Dependent variables included 21-d pregnancy rate, length of time to achieve pregnancy, and log of length of time. Pregnancy rate and average number of 21-d opportunities required to achieve pregnancy are reciprocals, but the product-moment (linear) correlation of true transmitting abilities was −0.987 rather than −1.00 because of curvature. An evaluation of pregnancy rate in which lactations received more weight if the cow required more cycles to become pregnant was preferred slightly to an unweighted evaluation but was not more accurate than evaluation of days open. Of the several models of analysis compared in simulation, none had an accuracy advantage of >1% over the others. With actual days-open data, heritability decreased from 4.1 to 3.0% when the upper limit on days-open data, heritability decreased from 4.1 to 3.0% when the upper limit on days open was increased from 150 to 305 d, probably because heritability of days to first breeding is higher (6.6%). The economic benefits of very early pregnancy are not as great as the costs of delayed pregnancy. Thus, breeding dates up to 250 d (rather than 150 d) are used routinely so that the more severe fertility problems are identified. As compared with days open or calving interval, pregnancy rate can be computed sooner, cows that do not become pregnant are included more easily, and larger rather than smaller values are desirable. Pregnancy rate can be obtained from days open using a nonlinear formula, pregnancy rate = 21/(days open – voluntary waiting period + 11), or by a linear approximation, pregnancy rate = 0.25/(323 – days open), obtained from the derivative of the nonlinear formula evaluated at the mean. Voluntary waiting period is the initial phase of lactation during which no inseminations occur (assumed to be 60 d) and the factor of +11 adjusts to the middle day of the 21-d cycle. With either formula, 154 days open...
converts to a pregnancy rate of 20% and 133 days open to a pregnancy rate of 25%.

**Key Words:** Genetic evaluation, Cow fertility, Pregnancy rate

### 521 Quality of data included in genetic evaluations for daughter pregnancy rate. P. M. VanRaden, M. E. Tooker*, A. H. Sanders, and G. R. Wiggans, Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.

National genetic evaluations of daughter pregnancy rate are based on data from 40 million lactation records of 16 million cows that calved since 1960. Up to five lactations are included per cow. Date pregnant is determined from several data sources. The most accurate information is last insemination date verified by birth date of next calf within 15 d of expected birth date. For lactations with no reported inseminations, date pregnant is obtained by subtracting mean gestation length (280 d for Holsteins) from next calving date. For lactations without next calving date, date pregnant is assumed to be the last insemination date unless the cow was subsequently examined and verified not pregnant, or was still milking in the same lactation more than 29 d after the last insemination. Last reported breeding date is used if the next lactation is initiated by abortion. A final data source is an owner report that the cow was sold because of infertility. Such cows are assumed to be nonpregnant and the last insemination date is disregarded. Records for pregnancy rate are considered to be complete at 250 d in milk (DIM), and pregnancy status after 250 DIM is not used. Date pregnant is set equal to 50 DIM for cows that become pregnant before 50 DIM. Some early pregnancy dates calculated from next calving date are inaccurate because of short gestations or unreported abortions. Therefore, lower and upper limits of 50 and 250 DIM, respectively, were applied after adjusting days open for season effects; 5 and 14% of records were affected. For Holstein calvings during 1998 and 1999, 57% had breeding date verified by calving date; 6% had next calf born with no previously reported breeding date; 5% had breeding date inconsistent with birth date of next calf; and 5% had the cow reported as sold for reproductive reasons. Although 19% of reported final breeding dates could not be verified because the cow was sold for reasons other than fertility, comparisons with birth date indicate that most farms report accurate breeding dates.

**Key Words:** Genetic evaluation, Fertility, Pregnancy rate

### 522 Use of early lactation days open records for genetic evaluation of cow fertility. M. T. Kuhn* and P. M. VanRaden, Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.

National genetic evaluation for female fertility was implemented in February 2003. The evaluations are reported as daughter pregnancy rate. Pregnancy rate is calculated from days open (DO) as (233 – DO)/4. Currently, records must have a minimum of 250 days in milk (DIM) to be included for pregnancy evaluation. Furthermore, DO is set to 250 for records that go beyond that upper limit. This research examined the possibility of using DO records prior to 250 DIM by predicting unknown records. The prediction model included the fixed effects of lactation and calving ease and linear regressions on age at calving, average of first three test day milk yields, previous DO, previous number of services, and days to first breeding. Quadratic effects of age and milk yield were also included. To assess the utility of the predictions, 10 DO groups were formed by defining the first group as 70 days or less and subsequent groups in 20 day increments. The final group was defined as ≥250-d. Each record was included in each group. Within group, y-hat was defined as actual DO if actual DO was ≤ the upper limit for that group. Biases, standard deviation of prediction errors, and phenotypic correlations between y-hat and actual DO were calculated for each group. Genetic correlations were estimated for the groups with 90, 130, and 170 day upper limits. Biases ranged from 30 d (70-d group) to 0 d and was close to 0 starting with the 110-d group. Standard deviation of prediction errors ranged from 49 d to 14 d. Phenotypic correlations increased from .41 (70-d) to .98 (250-d). Estimates of genetic correlations were 1 in all 3 groups examined. These results suggest that DO records can be utilized prior to the current 250-d requirement. Projected records require a weight less than one in genetic evaluation. Weights can be determined from correlations between actual and predicted records. Pregnancy confirmation code, now being collected, will also contribute to determination of weights.

**Key Words:** Genetic evaluation, Cow fertility, Prediction

### Food Safety: On farm food safety: Assessment of costs, tools and management

#### 523 Economic assessment of food safety in the dairy chain. N. Valeeva*, M. Meuwissen, and R. Huirne, Wageningen University, Wageningen, the Netherlands.

As a result of the increased demand for food safety, a number of quality assurance regulations have been introduced all over the world. However, little is known about the costs and efficiency of implementing such regulations, especially with regard to the entire chain. The objective of this research was to develop a mathematical programming model to identify regulations for increasing the level of food safety in the dairy production chain in a cost-effective manner. The model included compound feed production and its transport, the dairy farm itself, transport of raw milk, processing, delivery of (pasteurized) milk, and the retailer and catering sectors. The model focused on two main groups of hazards: microbial (Salmonella, *E. coli, M. paratuber culosis* and *S. aureus*) and chemical (antibiotics and dioxin). In collecting input data for the model, special attention was given to the costs of the various measures and the effectiveness of these measures in increasing the food safety level. Costs included implementation and maintenance of these measures (including interest and depreciation costs). Effectiveness was measured by adaptive conjoint analysis as the relative contribution of each measure to the food safety level. An electronic questionnaire was completed by 67 experts from industry, research, extension and farming who evaluated the measures in four steps. Linear regression analysis was then performed to determine the relative contribution (i.e. so-called utility level) of each measure. Respondents were consistent (R-squared > 0.8) with respect to their individual responses. Relative contributions and cost estimates were used in the mathematical model to determine the optimal set of measures for various food safety levels. Results showed that the dairy farm (42%) and dairy processing (24%) stages are most important for reducing microbial hazards. In contrast, the compound feed (43%) and dairy farm (39%) stages are most important for reducing chemical hazards. Overall, an increase in the higher levels of food safety was associated with a steep non-linear increase in costs.

**Key Words:** Food safety, Dairy chain, Economics


Quaternary ammonium compounds (QAC) are widely used as disinfectants in dairy, meat-packaging, and food processing industry. QACs have been shown to be more effective against gram-positive than gram-negative bacteria. In a dairy setting, gram-negative organisms are the major microflora in the environment. There is very little information on the MIC₉₀ values of gram-negative bacteria of dairy origin to QACs. A study was conducted to assess the susceptibility of gram-negative bacteria isolated from feces of lactating cattle to QACs. Gram-negative bacteria including *Escherichia coli* (n=186), *Citrobacter koseri* (n=14), *Enterobacter aerogenes* (n=3), Klebsiella oxytoxa (n=3), and *Pseudomonas* spp. (n=6) were examined for their susceptibility to cetrimide (CTAB), benzalkonium chloride (BKC), and benzalkoniumhexadecyl ammonium chloride (BDAC). The MIC₉₀ modal values for *E. coli* were 60µg/ml for BKC (range 30 - 90µg/ml) and 60µg/ml for CTAB (range 50-700µg/ml), and 400µg/ml for BDAC (range 100 - >800). *Pseudomonas* spp. showed high MIC₉₀ values for BKC (≥80µg/ml), CTAB (≥700µg/ml), and BDAC (≥700µg/ml). *Citrobacter koseri*, *E. aerogenes*, and *K. oxytoxa* showed MIC₉₀ ≥30µg/ml for BKC, ≥300µg/ml for CTAB, and ≥600µg/ml for BDAC, respectively. The prevalence of the gene in *E. coli* was detected in 80 of 186 (43%) of the *E. coli* isolates. The *qacE* gene was also detected in other species except *E. aerogenes*. Results of the study suggested that: (1)


The antimicrobial effect of long-chain fatty acids in culture medium is known to reduce some pathogenic microorganisms by inhibiting membrane transport systems. Feeding flaxseed to finishing cattle increases the alpha-linolenic acid (18:3n-3) composition of adipose and muscle tissues. We conducted an experiment to determine if feeding flaxseed to enrich carcass tissues with alpha-linolenic acid could be used to inhibit growth of pathogenic organisms in ground beef. Individually fed steers (n=70; 338 kg initial BW) were fed steam-flaked corn-based diets containing (DM basis) 0, 5, 10, or 15% ground flaxseed with or without the addition of 220 IU/kg DM of vitamin E for 120 d. Three 10-g composites of 80% lean ground beef were obtained from each carcass and separately inoculated (3.0 log colony forming units/gram of meat) with a five-stain mixture of *Escherichia coli* O157:H7, *Listeria monocytogenes*, or *Salmonella* spp. Each pathogen was enumerated on d 0, 3, and 10. No interactions were detected among flax and vitamin E treatments (P>0.75). The addition of flaxseed to finishing diets did not affect the antimicrobial activity in ground beef against *E. coli* O157:H7 (P=0.14), *L. monocytogenes* (P=0.24), or *Salmonella* spp. (P=0.63).

In addition, vitamin E did not affect antimicrobial activity in ground beef against *E. coli* O157:H7 (P=0.36), *L. monocytogenes* (P=0.44), or *Salmonella* spp. (P=0.30). Fatty acid enriched ground beef from cattle fed flaxseed does not elicit antimicrobial activity against *E. coli* O157:H7, *L. monocytogenes*, and *Salmonella* spp.

Key Words: Alpha-linolenic acid, Antimicrobial, Ground beef

526 Effects of diet and monensin on ruminal persistence and fecal shedding of *Escherichia coli* O157:H7 in cattle. M. J. VanBaale*, J. M. Sargeant1, D. P. Gnad2, B. M. DeBeer1, K. F. Lechtenberg2, and T. G. Nagaraja1, 1Kansas State University, Manhattan, KS, 2Midwest Veterinary Services, Oakland, NE.

Twelve ruminally-cannulated cattle, adapted to high-forage (85% forage; HF) or high-grain diet (85% grain; HG) with or without monensin (1.32 mg/kg of diet), were used in a 2 x 2 factorial design, to investigate the effects of diet and monensin on level and duration of ruminal persistence and fecal shedding of *E. coli* O157:H7. Cattle were ruminally inoculated with a strain of *E. coli* O157:H7 (10^10 CFU/animal) adapted to nalidixic acid (Nal⁷). Ruminal and fecal samples were collected for 11 wk, and then cattle were euthanized, necropsied, and contents from different gut locations were collected. Samples were cultured for enumeration or detection of Nal⁷ *E. coli* O157:H7. Fecal and ruminal pH were recorded immediately after collection and an aliquot of ruminal sample was acidified and frozen for VFA analysis. Cattle fed the HF diet shed higher (P<0.05) concentrations of Nal⁷ *E. coli* O157:H7 in the feces and for a longer duration compared to cattle fed the HG diet. In HF fed cattle, the duration of shedding decreased for monensin compared to no monensin group. Generally, ruminal persistence of Nal⁷ *E. coli* O157:H7 was not affected by diet or monensin. Fecal pH was higher (P<0.05) in cattle fed HF diet compared to cattle fed HG diet. Monensin had no effect on fecal pH in cattle fed either of the two diets. Cattle fed HF diet had higher ruminal pH (P<0.05) and lower VFA concentrations than the cattle fed the HG diet. At necropsy, Nal⁷ *E. coli* O157:H7 was detected in hind gut (rumen and cecum) contents more often than from any other gut location, including the rumen. Our study suggests that cattle on a HF diet shed higher concentrations and for a longer duration than cattle on a HG diet. Monensin supplementation decreased the duration of shedding with HF diet, and the hind gut, not the rumen, appears to be the site of persistence of *E. coli* O157:H7 in cattle.

Key Words: *Escherichia coli* O157, Monensin, Cattle

527 Bacterial effect of 2-nitropropanoic acid against selected foodborne pathogens in vitro. Y. S. Jung*, R. C. Anderson, T. R. Callaway, T. S. Edington, K. J. Genovese, R. B. Harvey, T. L. Poole, and D. I. Nisbet, USDA-ARS, Food and Feed Safety Research Unit, College Station, TX.

The bacterial effect of 2-nitropropanoic acid (2NPOH), a nitroalkane, on several pathogenic bacteria including *Salmonella enterica* serovar Typhimurium, *Escherichia coli* O157:H7, *Listeria innocua*, and *Enterococcus faecalis* was determined in vitro. The test compound was added to tryptic soy broth (TSB) medium in amounts to give 0, 2.5, 5, and 10 mM final concentration. Specific growth rates (1/h) were calculated by measuring optical density (A600).

The growth of gram negative (Typhimurium and *E. coli* O157:H7 and positive (*L. innocua* and *E. faecalis*) was largely inhibited at ≥ 2.5 mM 2NPOH and was completely inhibited at 10 mM 2NPOH. To determine if pH affected the bacterial activity of 2NPOH, approximately 10^5 to 10^6 CFU per ml of Typhimurium were inoculated into TSB medium containing 0, 2.5, and 10 mM 2NPOH and adjusted to pH 5.6, 7.2, and 8.0. After 24 h incubation at 37°C, cell numbers were reduced approximately 3 log (from 10^5 to 10^2 CFU/ml) at 2.5 mM 2NPOH at pH 5.6 but not at pH 7.2 or 8.0. However, Typhimurium was completely inactivated (>5 log reductions) at 10 mM 2NPOH regardless of pH. To evaluate the bacterial effect of 2NPOH against Typhimurium in buffered rumen and fecal fluid (pH 6.8), a novobiocin and nalidixic acid resistant Typhimurium strain was inoculated into these mixtures supplemented with 0, 2.5, 10 mM 2NPOH and incubated at 37°C under CO₂. The populations were monitored at different times (0, 3, 6, and 24 h). After 24 h, mean ± SD populations (log CFU/ml) of Typhimurium were reduced significantly (P<0.05) in both ruminal and fecal fluid containing 2NPOH at 10 mM concentration compared to controls (0.55 ± 0.64 vs 2.65 ± 0.06 and 0.1 ± 0.00 vs 2.80 ± 0.28, respectively).

The results obtained in this study indicate that 2NPOH has bactericidal activity against *Salmonella*, *E. coli* O157:H7, *L. innocua*, and *E. faecalis*, and potentially could be developed as an antimicrobial supplement.

Key Words: 2-Nitropropanoic, Bactericidal, Foodborne pathogens

528 Origanox as a natural ingredient to inhibit the growth of foodborne pathogens. S. A. Ibrahim*, North Carolina A&T State University, Greensboro, NC.

The Pathogen Reduction Program of the U.S. Department of Agriculture Food Safety and Inspection Service recommends that natural antimicrobial treatments such as herb extracts be included to reduce or inactivate food borne pathogens. Origanox (OX) is a common herb extract that has been used as a functional ingredient in foods, but has not been extensively examined as a possible antimicrobial agent. The objective of this study was to evaluate the effect of OX on the survival and growth of *Escherichia coli* O157:H7, *Salmonella typhimurium* (ATCC 14208) and *Salmonella agona* (H 6115 and F 5567). *E. coli* O157:H7 and *Salmonella* grown separately in Tryptic soy broth (TSB) at 37°C for 24 h, were inoculated (final inoculum level of 2 log/ml) into TSB containing OX with different concentrations of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0%. Samples were then incubated at 37°C for eight h. Samples were withdrawn every two h during the incubation period and surface plated on EMB agar and XLD agar for conducting enumeration counts of *E. coli* and *Salmonella*, respectively. Results showed that the addition of 0.2% OX significantly inhibited the growth of pathogenic bacteria when compared to control samples. During the eight h storage period, populations of bacteria increased by 7.0 log CFU/ml in control samples while bacterial populations in samples with the addition of 0.1% OX increased by 2.2 log CFU/ml. When appropriate dilution of microbial suspension was surface plated on Tryptic soy agar supplemented with 0.1% OX, at least 2-log reduction in the microbial population was observed. These results indicated the potential applicability of OX as antimicrobial agent for increasing the biosafety of many consumable food products.

Key Words: Origanox, *Escherichia coli* O157:H7, *Salmonella typhimurium*
529 Experimental chlorate product treatment reduces *Salmonella* populations in swine during lairage. T. R. Callaway1, R. C. Anderson1, T. S. Edington1, K. J. Genovese1, C. H. Sedding1, Y.-C. Juang2, K. M. Bird1,3, T. L. Poole1, R. E. Harms1, and D. J. Niisbet1. USDA-ARS, Food and Feed Safety Research Unit, College Station, TX, 2 Iowa State University, Ames, IA.

Each year more than 1.3 million human cases of salmonellosis are reported in the United States. Swine can be a reservoir of *Salmonella* that can be transmitted to human consumers of pork products. *Salmonella* have the ability to respire anaerobically by reducing nitrate to nitrite via the intracellular enzyme nitrate reductase (NR). However, NR does not differentiate between nitrate and its valence state analog chlorate, which can be converted within the bacterium to cytotoxic chlorite. When added to pure and mixed cultures of bacteria, chlorate killed both *E. coli* and *Salmonella* within 24 h. Preliminary in vivo studies indicated that chlorate supplementation reduced *E. coli* O157:H7, wild-type *E. coli* and *Salmonella* in cattle, sheep and swine, respectively. Therefore, an experimental chlorate-containing product (ECP) has been developed for use in food animals. The current study was undertaken to evaluate the experimental chlorate-containing product (ECP) has been developed for use in food animals. The current study was undertaken to evaluate the effectiveness of ECP during the short-term lairage period immediately prior to harvest. Pig manure (10 kg) was inoculated with 10 million E. coli and Salmonella and was spread throughout pens housing pigs (n=10) to simulate the introduction of swine to dirty lairage facilities. After 2 h, pigs were given ad libitum feed (controls) or feed supplemented with ECP for 4 h. Animals were humanely sacrificed and tonsils, ileocecal lymph nodes, cecal and rectal contents were collected. Fewer pigs treated with ECP had *Salmonella*-positive tonsils, but not unexpectedly due to the continuous exposure to *Salmonella*-contaminated feces this difference was not significant (P>0.05). No differences were noted in lymph node or intestinal content *Salmonella* status, likely due to the very short duration of ECP treatment. However, in a follow-up study using pigs (n=10) naturally colonized with *Salmonella*, ECP treatment (P<0.05) reduced natural cecal *Salmonella* colonization. Thus, these results indicate that ECP could be a viable pre-harvest intervention strategy to reduce *Salmonella* concentrations in swine, however further research is needed to optimize the effectiveness of ECP during lairage and transport to the slaughter facility.

Key Words: *Salmonella*, Swine, Lairage

530 Vermont Cattle Health Improvement Project. C. A. Rossiter-Burhans1, J. W. Barlow2, and T. E. Johnson3. Poulin Grain Inc., Newport, VT, 2 University of Vermont, Burlington, VT, 3 Vermont State Department of Agriculture, Montpelier, VT.

Concerns about Johnne’s disease (JD) prevalence, economics, food safety, and public health risks have prompted industry, state and federal level initiatives recently. Vermont (VT) Department of Agriculture initiated a pilot Vermont Cattle Health Improvement Project (VTCHIP), in 2001 to develop a cooperative (state and industry) cattle health program requiring active participation by veterinarians and producers. Objectives included enhancing farm viability by promoting improved preventive herd health and disease control practices. VTCHIP broadly addressed herd health issues but focused on JD education, requiring comprehensive review of farm goals, herd health parameters, and management bottlenecks. Enrolled veterinarians (n=55) and producers (n=145) engaged in a systematic review process concluding with written management strategies addressing identified health concerns. A VTCHIP workbook guided a 4-step assessment process for: 1. farm goals and health parameters 2. estimating JD herd prevalence 3. farm management risk factors relative to the spread of JD, and 4. specific management plans to prevent or control JD and address other identified health concerns. VTCHIP funding supported the herd veterinarian’s involvement in executing risk assessments and farm plans ($350/farm) and initial herd diagnostic testing ($300/farm). Funding was a one-time State appropriation supplemented by a USDA and a private grant. Future goals for VTCHIP include 1. securing support for an ongoing program 2. adopting the voluntary JD herd status program whereby VT herds can establish a national low-risk status and create a value added market for low risk animals, 3. expanding industry and state cooperation, and 4. addressing other economically significant health issues using the VTCCHIP framework. Advantages of the VTCCHIP approach include 1. cooperative implementation through herd veterinarians, 2. management focus, 3. systematic format, and 4. flexible application to multiple herd health issues. Advantages, successes, and challenges of the initiative will be presented.

Key Words: Johnne’s disease, Herd health


Porcine milk contains hormones and growth factors that are thought to be responsible for the rapid postnatal intestinal growth and development of piglets. Work in our lab has shown that the addition of recombinant human IGF-I to sow milk replacer at 0.1 to 1.0 mg/L increased intestinal villus growth, lactase (LPH) activity and LPH mRNA expression in piglets. Further, stable isoform tracer studies suggest that IGF-I regulates LPH activity by suppressing proteolytic degradation of LPH and its precursor (proLPHh). Others have shown that oral IGF-I at 10 mg/L increased mucosal growth and sodium-dependent nutrient transport compared to piglets fed formula alone. However, the impact of IGF-I over-expression in sow milk on piglet intestinal development was unknown. To answer this question, transgenic sows that over-express IGF-I in milk under the direction of the regulatory elements of the bovine a-LA gene construct. IGF-I content was induced on d 113 of gestation and piglets were removed prior to ingestion of colostrum. Within 4 h, 10 piglets were randomly distributed to each sow, such that each litter contained piglets from all other sows within that replicate. On days 3, 7, 14, and 21 postpartum, one CON litter and one IGF-I litter were euthanized following a 12h fast. Serum IGF-I and IGF-I binding proteins were measured. Intestinal weight, length, protein and DNA content, disaccharidase activity and villus morphology were assessed. Piglets suckling CON sows were heavier than IGF-I only on d 7 (p<0.02). Intestinal weight and length were similar between treatment groups. Jejunal mucosal weight was greater than CON on d21. When data from all time points were combined, IGF and disaccharidase activity than piglets suckling non-transgenic sows. (Funded by the USDA CSREES under project NRICGP 00-35206).

Key Words: Transgenic, IGF-I, Lactase


Our lab and others have shown that piglets fed formula containing IGF-I have increased villus growth, lactase activity, and nutrient transport, however, the impact of IGF-I over-expression in sow milk on piglet intestinal development was unknown. To answer this question, transgenic sows that over-express IGF-I in a mammary- and lactation-specific manner were created (IGF). IGF-I in colostrum of IGF transgenic swine (1.0 mg/L) is 5-fold higher than non-transgenic (CON) sows and milk IGF-I content (0.6 mg/L) is 60-fold higher than CON. Herein, the impact of ingestion of elevated milk IGF-I throughout lactation on piglet intestine was assessed. Piglets (n=160) were studied in 2 replicates. Farrowing was induced on d 113 of gestation and piglets were removed prior to ingestion of colostrum. Within 4 h, 10 piglets were randomly distributed to each sow, such that each litter contained piglets from all other sows within that replicate. On days 3, 7, 14, and 21 postpartum, one CON litter and one IGF-I litter were euthanized following a 12h fast. Serum IGF-I and IGF-I binding proteins were measured. Intestinal weight, length, protein and DNA content, disaccharidase activity and villus morphology were assessed. Piglets suckling CON sows were heavier than IGF-I only on d 7 (p<0.02). Intestinal weight and length were similar between treatment groups. Jejunal mucosal weight was greater at d3 in IGF-I piglets than CON (p<0.01) and ileal mucosal weight was increased with IGF-I at d 7, and 21 vs. CON (p<0.01). Jejunal and ileal lactase and sucrase activities were greater (P<0.05) in IGF-I piglets than CON on d21. When data from all time points were combined, IGF and disaccharidase activity than piglets suckling non-transgenic sows. (Funded by the USDA CSREES under project NRICGP 00-35206).

Key Words: Transgenic, IGF-I, Lactase

Growth & Development: Intestinal development - colostrum symposium


Concerns about Johne’s disease (JD) prevalence, economics, food safety, and public health risks have prompted industry, state and federal level initiatives recently. Vermont (VT) Department of Agriculture initiated a pilot Vermont Cattle Health Improvement Project (VTCHIP), in 2001 to develop a cooperative (state and industry) cattle health program requiring active participation by veterinarians and producers. Objectives included enhancing farm viability by promoting improved preventive herd health and disease control practices. VTCHIP broadly addressed herd health issues but focused on JD education, requiring comprehensive review of farm goals, herd health parameters, and management bottlenecks. Enrolled veterinarians (n=55) and producers (n=145) engaged in a systematic review process concluding with written management strategies addressing identified health concerns. A VTCHIP workbook guided a 4-step assessment process for: 1. farm goals and health parameters 2. estimating JD herd prevalence 3. farm management risk factors relative to the spread of JD, and 4. specific management plans to prevent or control JD and address other identified health concerns. VTCHIP funding supported the herd veterinarian’s involvement in executing risk assessments and farm plans ($350/farm) and initial herd diagnostic testing ($300/farm). Funding was a one-time State appropriation supplemented by a USDA and a private grant. Future goals for VTCHIP include 1. securing support for an ongoing program 2. adopting the voluntary JD herd status program whereby VT herds can establish a national low-risk status and create a value added market for low risk animals, 3. expanding industry and state cooperation, and 4. addressing other economically significant health issues using the VTCHIP framework. Advantages of the VTCCHIP approach include 1. cooperative implementation through herd veterinarians, 2. management focus, 3. systematic format, and 4. flexible application to multiple herd health issues. Advantages, successes, and challenges of the initiative will be presented.
piglets had greater jejunal lactase and sucrase activity (P<0.0001) as well as increased ileal sucrase activity (P<0.0001) than CON. In summary, piglets suckling IGF had greater intestinal mucosal weight and disaccharidase activity than piglets suckling CON sowes, however, body weight was not affected. (Funded by NRRCIP 00-35206).

Key Words: IGF-I, Disaccharidase, Intestine

533 Intestinal development in neonatal calves: Effects of glucocorticoids and dependence on colostrum feeding. S. N. Sauter1, P. Guilloteau2, J. W. Blum1, and H. M. Hammon1,1, 1University of Berne, Berne, Switzerland, 2INRA, Rennes, France.

The neonatal development of the gastrointestinal tract around parturition in precocious mammals is greatly affected by endocrine factors like glucocorticoids as well as by nutritional factors. We have tested the hypothesis that glucocorticoids and colostrum (C) supply affect intestinal morphology, cell proliferation, digestive enzyme activities, and xylose absorption in neonatal calves. Calves (n=7 per group) of GrFD− and GrFD+ were fed a milk-based formula (F), whereas calves of GrC−D and GrC+D were fed C. Dexamethasone (DEXA; 30 µg/kg body weight x d) was injected to calves of GrFD+ and GrC+. Calves were fed F or C for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. IGF-I, Disaccharidase, Intestine 3.4.14.5) were measured. C feeding increased (P<0.05) villus sizes in small intestine, enhanced (P<0.05) xylose absorption capacity and increased (P<0.05) peptidease activities in ileum. DEXA-treatment increased (P<0.01) villus size in duodenum, but reduced (P<0.01) villus size and reduced (P<0.001) sizes of Peyer’s patches in ileum. Mainly in F-fed calves DEXA increased (P<0.05) cell proliferation of crypt cells in ileum, decreased (P<0.05) amino peptidase N in jejunum, but increased (P<0.05) amino peptidase A activities in ileum. C feeding enhanced intestinal villus size, xylose absorption, and enzyme activities, whereas DEXA differently affected villus size, cell proliferation and enzyme activities dependent on intestinal segments and differences in feeding.

Key Words: Neonatal calf, Gut development, Dexamethasone

534 Effects of bioactive components of colostrum and milk on neonatal health, growth and intestinal development. T. A. McFadden*, University of Vermont.

Colostrum and milk contain a wide variety of bioactive components that influence health and growth of the calf. Many of these components are highly enriched in colostrum and have well established effects on development, whereas the role of others remains to be defined. The objective of this paper is to review the mechanisms involved in mammary secretion of these factors and their subsequent effects on neonatal growth and development of the calf, with emphasis on factors concentrated in colostrum. Bioactive components of colostrum and milk include immunoglobulins, hormones, growth factors, cytokines, vitamins, minerals, other secretory proteins, and cellular components. The most widely recognized role of colostrum is to provide passive transfer of maternal immunoglobulins, primarily IgG1, to the calf, thereby reducing risk of calf disease. However, inadequate consumption of colostrum also results in low levels of beta-carotene and Vitamin A and alterations in plasma metabolites in the calf. Moreover, colostrum stimulates intestinal cell proliferation, perhaps through actions of its component growth factors. Cellular components of colostrum appear to enhance development of local immunity and active immunization of the neonatal intestine. Other proteinaceous factors, including cytokines, growth and dermal growth factor and immunoglobulins, are not only absorbed intact, but have been shown to be transported into the cerebrospinal fluid where they may play a role in neural development. Additional proteins, such as colostral trypsin inhibitor, may act to prevent proteolysis of bioactive immunoglobulins, cytokines and hormones, thereby protecting their functional activity. Clearly, the bioactive components of colostrum and milk interact to promote neonatal development. Thus, better understanding of these components and their functions may lead to new methods to manipulate their concentrations in mammary secretions and thereby improve calf health and growth.

Key Words: neonatal calf, somatotropic axis, dexamethasone

535 Effects of dexamethasone on the somatotropic axis in neonatal calves and dependence on colostrum intake. S. N. Sauter1, E. Ontsouka1, M. Pfaffi2, J. W. Blum1, and H. M. Hammon1,1, 1University of Berne, Berne, Switzerland, 2Technical University of Munich, Freising, Germany.

Glucocorticoids and colostrum (C) feeding influence postnatal maturation of the somatotropic axis. We have tested the hypothesis that the somatotropic axis in neonatal calves is modulated by a high glucocorticoid status and by C feeding. Calves (n=7 per group) of GrFD− and GrFD+ were fed a milk-based formula (F), whereas calves of GrC−D and GrC+D received C. Dexamethasone (DEXA; 30 µg/kg body weight x d) was injected to calves of GrFD+ and GrC+. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. On d 1, 2, 4, and 5 plasma concentrations of growth hormone (GH), insulin-like growth factor (IGF)-I and IGF binding proteins (IGFBP)-2 and -3 were measured, and on d 5, mRNA concentrations of IGF-I, IGFBP-2 and -3, IGF type 1, IGF type 2, and insulin receptors (IGF1R, IGF2R, and IR, respectively) and GH receptor (GHR) were measured in liver. Concentrations of hepatic GH binding sites were measured by radioreceptor assay. Plasma GH concentrations on d 4 were lower (P<0.05) in DEXA-treated groups than in non-treated groups. On d 4 and 5, DEXA increased (P<0.05) plasma IGF-I concentrations. Plasma concentrations of IGFBP-2 on d 4 were lower (P<0.05) in DEXA-treated than in non-treated calves and were lower (P<0.05) in C-fed than in F-fed calves. Concentrations of IGF-I mRNA were higher (P<0.1) in DEXA-treated than in non-treated calves and were higher (P<0.05) in GrFD+ than in GrFD- and in GrC+D. IGFBP-2 and -3 mRNAs were higher (P<0.01) in F-fed than in C-fed calves and were higher (P<0.05) in DEXA-treated than in non-treated calves. GH mRNA was higher (P<0.01) in DEXA treated than in non-treated calves. IGF1R, IGF2R, and IR mRNAs were higher (P<0.05) in F-fed than in C-fed calves and were higher (P<0.05) in DEXA-treated than in non-treated calves. GH binding sites were higher (P<0.05) in GrC+D than GrC−. DEXA affected the maturation of the somatotropic axis in neonatal calves and these effects were partly modified by C feeding.

Key Words: neonatal calf, somatotropic axis, dexamethasone

536 Effects of plasma IgG concentration and milk replacer feeding on hormone and growth responses in stressed calves. J. D. Quigley, III1,2, T. A. Wolfe2, and T. H. Elssasser3, 1APC, Inc., Ames, IA, 2Iowa State University, Ames, 3USDA-ARS, BARC-East, Beltsville, MD.

This study was conducted to determine if milk replacer (MR) feeding program or plasma IgG concentration on d 0 were related to hormone concentrations, growth, and health in young calves. Holstein bull calves (n=120) were purchased from sale barns, transported to the research facility and fed 454 g/d of MR powder (20% CP, 20% fat) to 28 d (CON), or varying amounts of MR (26% CP, 16% fat; 454 to 908 g/d; total = 27.9 kg/calf) to 41 d (ACC), or ACC + Gammulin (APC, Inc.) at 30 to 60 g/d to 15 (GAM). Calf starter (CS) and water were available to 56 d. Calves were stressed by adding soiled bedding to each hutch prior to arrival. Calves were blocked by plasma IgG on d 0 (>10, 5-10, and <5 g/L). Blood was collected on d 7, 14, 28, 42 and 56 and samples were analyzed for IGF-1, TNF-a and growth hormone (GH) concentrations. Mean BW at 56 d, intake of MR, fecal scores, d scouring, d treated with antibiotics (AB) and plasma IGF-1 concentrations were lower in CON. Mean BW at 56 d, intake of MR, fecal scores, d scouring, d treated with antibiotics (AB) and plasma IGF-1 concentrations were lower in CON. Mortality was lowest in CON and tended to be lower in GAM. Intake of CS was higher in CON. Plasma GH was unaffected by treatment and declined from 7 to 56 d. Plasma IgG on d 0 had no effect on parameters measured, except TNF-a which was affected by a day by plasma IgG interaction. Calves with high IgG on d 0 had higher TNF-a from d 7 to 42. Calves fed increased amounts of MR grew faster, but experienced greater morbidity and mortality. Feeding GAM tended to reduce mortality in calves fed increased MR.


The role of intestinal development and the process of transitioning calves from their neonatal reliance on nutrients supplied by milk to nutrients supplied from grain are of substantial economic importance to the producer. Improvements to the calf nutritional regime can decrease mortality and disease susceptibility, increase post-weaning rate of gain, and ultimately, enhance the rate of herd genetic improvement (due to increased capacity for voluntary culling). Current feeding practices result in weaning from milk by 3 to 4 weeks of age by daily encouragement to eat grain diets. Although the mechanisms are not yet completely understood, development of a viable fermentation within the rumen is required to initiate the maturation of the rumen epithelia. The metabolic ramifications of this transition to calf growth rate are great, as tissues must convert from reliance on glucose supplied from milk to the metabolism of volatile fatty acids as primary energy substrates. This transition is the result of differential expression of numerous genes regulating both physical and metabolic characteristics of the tissue. While the most dramatic physical changes occurring during development are associated with the rumen epithelium, changes in intestinal mass and metabolism are also realized in response to dietary changes. Amino acid use by the intestinal tissues is high and may affect amino acid availability in support of growth. Moreover, because the metabolic and protein synthetic activities of the digestive tract are high, accounting for up to 30% of both whole animal energy use and whole animal protein synthesis, understanding their regulation is vital to the continued improvement in calf management. Specific nutrient-gene interactions have been identified across the digestive tract which serve to increase visceral organ mass and directly change nutrient metabolism by the epithelia. Similarly, humoral factors have been identified as having regulatory function over gastrointestinal tissue mass and metabolism. These and continuing efforts to better understand the factors affecting intestinal development will improve weaning strategies and foster better post weaning calf growth performance.

538 Influence of dietary nucleotides on calf health. C. E. Oliver, M. L. Bauer, C. M. De Jesus Arias, W. L. Keller, and C. S. Park, North Dakota State University, Fargo, North Dakota.

To determine the effect of dietary nucleotides on calf health, performance, and immune function, 20 newborn Holstein bull calves (41.9 ±1.1 kg initial body weight [BW]) were assigned to either standard milk replacer or milk replacer supplemented with purified nucleotides in the proportion found in cow milk, but at 5 times the level (AMP = 0.04 μmol/kg BW per d, CMP = 0.14 μmol/kg BW per d, GMP = 0.48 μmol/kg BW per d, IMP = 0.64 μmol/kg BW per d, and UMP = 1.03 μmol/kg BW per d). Calves were fed milk replacer by dry powder weight at 1.4 % of BW/d divided into two equal portions and fed by bucket in 1.9 L water at h 0630 and 1600. No other feed was offered during the trial. Calves were housed indoors in individual pens on an expanded metal floor with a vinyl coating. Rectal temperature and fecal score (1 = normal, 4 = watery) were recorded daily in the morning, and calves were weighed and blood was drawn weekly and analyzed for glucose, insulin, non-esterified fatty acids (NEFA), and immunoglobulin M (IgM) and G (IgG) and M (IgM). Calves were challenged with lipopolysaccharide (LPS) or saline at 3 to 4 wk of age; rectal temperature and blood were taken at h 24, 0, 1, 2, 3, 4, 6, 8, 12, and 24. Nucleotide supplementation did not affect weight, fecal score, rectal temperature, or serum glucose, insulin, NEFA, or IgM over the course of the trial. Nucleotide-fed calves tended to have higher mean IgG levels (P = 0.16) than controls (859.6 ± 98.9 vs 670.5 ± 85.4 mg/dl). During the LPS challenge, there was a treatment by challenge interaction in IgG level (P = 0.01). Dietary nucleotides do not affect metabolic status, but may enhance immunity in neonatal calves.

Key Words: Nucleotide, Immune, Calf

539 Effect of various levels of crude fiber and form of diet on rumen development in calves. J.A. Booth, H.D. Tyler, and J.D. Quigley III, Iowa State University, 2APC Company, Inc.

Consumption of solid feed is essential for making the transition from a prernatal animal to a functioning ruminant. The optimal amount of roughage for inclusion in the diet of young calves is still unclear. The objective of this study was to determine the effect of form of diet (coarse vs. ground) and the inclusion of various levels of hay on rumen development in calves. Holstein bull calves (n = 50) were randomly assigned to one of four treatments. Diets consisted of commercial coarse starter (C), a ground starter (G), coarse starter with 7.5% grass hay of consistent particle size (H1), and coarse starter with 15% hay (H2). All diets were formulated to be isocaloric and isonitrogenous. Total ADF in diets were 46.39, 64.44, 64.97, and 73.41%, respectively, and were constant across treatments until weaning when feed was given ad libitum. Jugal blood samples were obtained weekly and analyzed for BHBA. Body weight and rumen fluid samples were also obtained weekly. Daily scour scores and days receiving antibiotics and electrolytes did not differ with treatment. Calves receiving the H1 and H2 diets tended (P<0.07) to be heavier prior to weaning and were heavier postweaning (P<0.01) than the calves receiving C. Calves receiving C, G, and H1 diets consumed equal amounts of feed, but calves fed H2 had higher BW gain (ADG) and feed efficiency (GF) postweaning than calves fed C. Calves fed H1 diet tended to have higher ADG and GF postweaning than the calves fed H2 (P<0.07 and P<0.12 respectively). There were no differences in intake. Total VFA concentrations were higher for calves fed C diet versus G diet (P<0.01) and tended to be higher for calves fed H1 versus H2 (P<0.10). Calves fed H2 had greater acetate to propionate ratio (P<0.03) than calves consuming the H1 diet. Calves receiving the G diet had lower proportions of acetate (P<0.06) than calves fed C. Addition of hay to diets of young calves appears to favorably alter the rumen environment causing more efficient gain of body weight.

Key Words: Dairy calves, Rumen development, Forage

540 Influence of ratio of dietary fat to protein on body composition of Jersey bull calves. S. Bascom, R. James, E. Hovingh, M. VanAmburgh, and M. Mc Gilliard, 1Virginia Tech, 2Cornell University.

Calves were fed either milk or milk replacer (MR) at one of three ratios of CP:fat to determine effect on growth, feed efficiency, and body composition. Week-old calves (n=39) were assigned to one of four diets. Six calves were randomly selected and sacrificed to establish baseline body composition. Nine calves were fed a 28.3% CP: 16.4% fat MR (29/16). Eight calves were fed a 27.3% CP: 33.4% fat MR (27/33), and eight calves were fed a 20.6% CP: 20.6% fat MR (21/21). Calves fed 27/33, 29/16, and milk received 180 g/d CP, whereas calves fed 21/21 received 90 g/d CP. Weight, hip height, wither height, heart girth, and body length, were measured weekly for 4 wk. Weekly plasma samples were analyzed for PUN, NEFA, and glucose. A subset of calves [29/16 (n=7), 27/33 (n=6), 21/21 (n=6), and milk (n=5)] was sacrificed for body composition analysis. Feed efficiency and ADG were largest for calves fed milk and least for calves fed 21/21. Calves fed 27/33 or milk had the largest body fat percentage (>7.0%) in the empty body. Calves fed 29/16 or 21/21 had similar fat percentage (4.9, 3.7%) in EB and gains of fat (169, 238g/d). Calves fed 27/33 had a trend toward higher NEFA in wk 1 and 2. Overall, ADG of calves fed 27/33 and 29/16 was similar except that calves fed 29/16 were higher for calves fed H1 versus H2 (P<0.10). Calves fed H2 had greater acetate to propionate ratio (P<0.03) than calves consuming the H1 diet. Calves receiving the G diet had lower proportions of acetate (P<0.06) than calves fed C. Addition of hay to diets of young calves appears to favorably alter the rumen environment causing more efficient gain of body weight.
Meat Science & Muscle Biology: Genetics and management of meat quality

541 Effect of sire line and slaughter weight on pork quality. A. M. Bremére1, M. D. García-Cañón2, A. Fuentetaja3, R. Lazaro3, and G. G. Mateos1. 1Universidad Politécnica de Madrid, Spain, 2Estación Tecnológica de la Carne. Salamanca, Spain, 3Copese S.A. Segovia, Spain.

A trial was conducted to study the influence of sex (barrows; gilts), sire line (Danish Duroc, DD; Dutch Duroc X Large White, DHxLW; Pietrain X Large White, PLW and slaughter weight (120 kg; 135 kg) on meat quality. Dam line was Landrace X Large White in all cases. Each treatment was replicated four times and the experimental unit was formed by five samples of muscle longissimus dorsi (150 ± 15 g), obtained at the last rib level from five pigs penned together during the growth period. Carcasses were obtained from pigs that had a common feeding program with free access to diets based on corn and soybean meal. Meat from castrates had more intramuscular fat (2.8 vs 2.5%) and higher a* value (4.63 vs 4.34) than meat from gilts (P < 0.05), but gender did not modify tenderness or cooking or thawing losses. Loins from DD had less protein (23.8 vs 24.0%; P < 0.01) and more intramuscular fat (3.0 vs 2.4%; P < 0.001) and more tenderness (73.5, 73.9, and 73.7%; P < 0.01). The DHxLW sired-pigs had higher b* value than DD or DHxLW sired-pigs (9.89 vs 9.46 and 9.19; P < 0.01). No influence of boar line on resistance to cutting or water hold-up value was observed. An increase in slaughter weight increased protein content of the meat (73.6 vs 73.8%; P < 0.10). Loins from heavier pigs were redder (4.75 vs 4.21; P < 0.001) and had more intense color (10.7 vs 10.3; P < 0.01) and less thawing losses (6.4 vs 8.7%; P < 0.001) than loins from lighter pigs. We conclude that DD is an attractive sire line that can be used as an alternative to DHxLW or PLW for production of dry-cured products from heavy pigs. Also, an increase of slaughter weight improved some aspects of meat quality that might be of benefit for quality of dry-cured products.

Key Words: Sire line, Slaughter weight, Pork quality


The aim of this research was to establish effects of two different lorry types on meat quality traits. In addition, the objective was to establish relationships between meat quality parameters. A further question was whether there are differences in various parts of the same muscle in terms of meat quality traits measured at the cut surface of the medial and lateral sides of M. longissimus dorsi (LD). For transport of pigs two different lorry types were compared: (A) single-decker lorry and (B) double-decker one. Pigs (n=100) were transported from the pig farm to the abattoir (130 km distance). The animals were slaughtered according to commercial procedure. After slaughter and/or chilling for 24 h meat quality traits were recorded as follows: pH40 and temperature in LD, as well as pHu. Meat color was measured using MINOLTA CR 300 Chromameter (Minolta GmbH, Germany) at two anatomical (medial and lateral) parts of the LD cut surfaces. Data were processed and analyzed using software of SPSS 10.0 statistical program package. Significant differences were found between distributions of meat quality traits, which were assigned to PSE, normal and DFD categories. Lorry type A proved to be superior to lorry B showing a lower amount of PSE (18 vs. 34%). The reason for the adverse phenomenon might be due to loading and unloading which was rather complicated with lorry B, and in this case frequent use of different tools for driving of animals was needed. It resulted in higher level of stress. Comparing the medial and lateral sides of the LD revealed significant differences for L* and a*. Coefficients of correlation between meat quality traits revealed close to negative relationship of L* with pHu (r = -0.76). No association was established between L* and LD temperature and surface reflectance. A relatively low coefficient of correlation was calculated for the relationship of LD temperature with surface reflectance (r=0.36).

Key Words: Feeding, Pre-slaughter stress, Pork quality

543 Effects of available dietary carbohydrate and pre-slaughter stress on glycolytic potential and quality traits of pig muscles. G. Bee*, Swiss Federal Research Station for Animal Production, Posieux Switzerland.

The objective of the study was to evaluate the effects of pre-slaughter stress and dietary treatments known to affect post mortem muscle metabolism on the glycolytic potential (GP) and quality traits of the longissimus LM and semitendinosus muscles (light: STL; dark: STD portion). A total of 48 Swiss Large White pigs (24 gilts, 24 barrows) were selected at 88 kg and individually fed 2.6 kg of a diet either high (H) or low (L) in available carbohydrate up to 107 kg. In order to simulate pre-slaughter stress, 6 gilts and 6 barrows from each dietary treatment were subjected to a transporting stress for 3 h prior to slaughter. The remaining pigs were walked from the pen to the abattoir avoiding all unnecessary stress. In the samples collected 24 h post mortem of the LM, STL and STD the GP was determined. Measurements of the pH were carried out in the LM 30 min and 24 h post mortem and in the STD and STL 24 post mortem. Minolta L*, a*, b* values were assessed the day after dissection. In addition, muscles aged for 1 d and stored at -20°C were thawed overnight at 4°C (thawing loss) and then cooked to an internal temperature of 69°C (cooking loss). Compared to the H-pigs, muscles of L-pigs had a lower GP (LM: 144 vs. 154 µmol/g; STL: 116 vs. 104 µmol/g; STD: 101 vs. 88 µmol/g; P < 0.02 for each). Regardless of the diet, pre-slaughter stress reduced the GP in the STD (90 vs. 99 µmol/g; P < 0.05), but not in the LM and STL. Neither dietary nor pre-slaughter stress affected pH, but stress decreased meat temperature in the LM 30 min post-mortem (39.6 vs. 40.4°C; P < 0.01). In the STL, L* (5.16 vs. 5.41) and b* values (3.4 vs. 4.2) were lower in pigs fed diet L (P < 0.03). Unexpectedly, pre-slaughter stress further accentuated the differences within diets (P < 0.01). Diet L reduced cooking losses of the STD (14.5 vs. 16.0%) and STL (12.8 vs. 13.6%; P < 0.04). Pre-slaughter stress increased thawing (7.5 vs. 6.4%) and cooking losses (13.6 vs. 12.8%; P < 0.02 for each) only in the STL. The present data revealed that the diet induced decrease of the GP positively affected meat colour and reduced thawing and cooking losses, whereas pre-slaughter stress accentuated the negative effects only in the STL.

Key Words: Feeding, Pre-slaughter stress, Pork quality

544 Growth parameters and carcass merit of market hogs supplemented creatine monohydrate in conjunction with ractopamine hydrochloride (Paylean) and a high glycemic carbohydrate. C. A. Stahl1, M. S. Carlson1, D. L. McNamara1, T. B. Schmidt1, D. J. Newman1, C. M. Schultz Kaster2, and E. P. Berg1, 1University of Missouri, Columbia, MO, 2Premium Standard Farms, Milan, MO.

Crossbred barrows (n=128; 85kg) were blocked by weight and allotted to one of 16 pens (eight pigs/pen; four reps/treatment) using a completely randomized design. Treatments consisted of diets A (pelleted corn-soybean base formulated to meet or exceed all NRC requirements), B (diet A supplemented with 0.92% creatine monohydrate (CMH) and 2.75% dextrose), C (Diet B supplemented with 4.5 g/tone Paylean) and D (diet A supplemented with 4.5 g/tone Paylean). Animal weight and feed disappearance was recorded at 9d intervals throughout the 27d testing duration to determine ADG and feed efficiency. In addition, real-time ultrasound was used to establish 10th rib fat depth (FD) and loin muscle area (LMA) on d1 and 27. No treatment differences were noted when comparing ADG (P=0.66) and cold carcass weight (P=0.51). Over the 27d test, diets C and D expressed the greatest improvement in LMA growth (A: 6.84; B: 7.61; C: 9.35; D: 9.03 +/-0.58cm) and in this case frequent use of different tools for driving of animals was needed. It resulted in higher level of stress. Comparing the medial and lateral sides of the LD revealed significant differences for L* and a*. Coefficients of correlation between meat quality traits revealed close to negative relationship of L* with pHu (r = -0.76). No association was established between L* and LD temperature and surface reflectance. A relatively low coefficient of correlation was calculated for the relationship of LD temperature with surface reflectance (r=0.36).
fed diet C possessed a greater percentage of intramuscular fat than animals supplemented diet D (A: 2.43; B: 2.3; C: 2.45; D: 2.17 +/− 0.08%; P<0.07). Dietary treatment did not significantly affect the ultimate pH, Japanese color score or CIE L* and b* values of the loin; however, the CIE a* value of loins from animals fed diets B and D differed (A: 5.86; B: 6.49; C: 6.30; D: 5.20 +/− .23). (P<0.02) from those fed diets A and C. In conclusion, the addition of CMH and dextrose to diets containing 4.5 g/ton Paylean does not significantly improve growth performance; however, the data provide evidence that this dietary addition allows for the repartitioning of nutrients without significantly altering intramuscular fat deposition.

Key Words: Paylean, Creatine, Pigs

545 Fresh pork quality of Rendement Napole and/or Halothane carriers supplemented with sodium magnesium through drinking water. B. R. Frederick*, E. van Heugten, and M. T. See, North Carolina State University, Raleigh, NC.

Sixty-four pigs (117±0.7 kg BW) representing 1) non-carriers (NN/nrn*), 2) Rendement Napole carriers (RN/NR rn*), 3) Halothane carriers (Nn/rn*), and 4) carriers of both mutations (NN/NR rn*) in a factorial arrangement were individually penned and provided ad libitum access to feed (0.12% Mg) and water. Pigs were randomly allotted to receive 900 mg of Mg/L of drinking water from MgSO4 for 0 or 2 d prior to harvest. Longissimus dorsi (LD) and Semimembranosus (SM) chops were placed on trays, wrapped, and stored at 4°C to simulate display storage for 8 d. Magnesium had no effect on quality characteristics reported. Rendement Napole gene (N/NN∗−rn*), had lower (P<0.05) LD color scores (2.2 ± 2.9;0.2), LD pH at 24 h post-mortem (5.59 ± 5.81;0.02), SM pH at 24 h post-mortem (5.68 ± 6.00;0.03), and higher (P<0.05) initial LD Minolta L* (59.3 ± 54.5;0.07), final LD Minolta L* (61.7 ± 57.8;0.07), LD surface exudate (121 ± 98±5 mg), and display fluid loss of LD after 8 d (10.8 ± 7.6;0.4%) than normal nn pigs (Nn/rn*). Halothane carriers, regardless of the RN gene (NN/nrn*), had higher (P<0.05) initial LD Minolta L* (58.7 ± 55.1;0.7), final LD Minolta L* (61.4 ± 58.1;0.7), display fluid loss of LD after 8 d (9.8 vs. 8.6;0.4%) and lower (P<0.05) LD color scores (2.2 ± 2.9;0.2) than Halothane normal pigs (NN/NN∗−rn*). Interactions between genotypes were present for pH of the LD at 60 min post-mortem (5.89;6.02;5.84, and 5.78±0.03), surface exudate of the SM (72, 88, 72, and 112±7 mg), display fluid loss of LD after 4 d (5.7, 7.7, 5.9, and 9.6;0.5%), display fluid loss of SM after 4 d (4.5, 6.8, 4.1, and 8.7;0.6%), and display fluid loss of SM after 8 d (6.7, 9.3, 5.9, and 11.4;0.4%) for genotypes 1, 2, 3, and 4, respectively. Although magnesium did not affect pork quality, the RN and Halothane mutations negatively affected color and fluid loss and effects were much more pronounced in the presence of both mutations.

Key Words: Rendement Napole, Halothane, Magnesium


This study was conducted to determine the effect of Ractopamine (RA) feeding on carcass cutability, belly firmness, and fatty acid (FA) composition of pigs varying in prefinishing 10th rib backfat (BF). Crossbred barrows were assigned to a factorial arrangement with two BF classes (4 cm × 4 cm), vacuum packed, aged (6 weeks) C finishing at the posterior end LD slices were numbered 1 through 6. Slices 1-5 were 2.5 cm, slice 6 was 4 cm thick. Three cooking and measuring methods were applied, as follows: Method I. After thawing, slices 1, 3, and 5 were cooked in water bath to 70 °C internal temperature. Five 1.27 cm-diameter cylindrical cores were removed parallel to the muscle fiber orientation. The Warner-Bratzler (WB) shear force (SF) was determined with a Texture Analyzer TA.XT2 instrument using Wb attachment. Cores were sheared once with a V shaped 1.2 mm thick blade. Method II. Slices 2 and 4 were grilled to 70 °C internal temperature. The coring and shearing method was the same as in Method I. Method III. Slice 6 was stewed in exsiccator on 160 °C for 85 min. One to three, 2.54 cm-diameter cylindrical cores were removed from each slice. Muscle fiber orientation. The Warner-Bratzler (WB) shear force (SF) was determined with a Texture Analyzer TA.XT2 instrument using Wb attachment. Cores were sheared once with a V shaped 3 mm thick blade. Data were processed by ANOVA and
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549 Evaluation of the true ileal digestible (TID) lysine requirement for 7 to 14 kg pigs. A. M. Gaines*,1, D. C. Kendall1, G. L. Allee3, G. Gourley2, D. R. Cook3, and J. L. Usry4. 1University of Missouri-Columbia, Columbia, 2Kansas State University, Manhattan, 3Ajinomoto Heartland Inc., Chicago.

A series of experiments were conducted at three different commercial research sites in order to evaluate the true ileal digestible (TID) lysine requirement for 7 to 14 kg pigs. Exp.1, a total of 840 pigs (PIC 337 × C22; 7.6 ± 0.13 kg) were used in a completely randomized design with 7 replicate pens/treatment and 24 pigs/pen. In Exp. 2, a total of 1,260 pigs (PIC 337 × C22; 8.5 ± 0.14 kg) were used in a completely randomized design with 6 replicate feeders/treatment and 42 pigs/feeder. In Exp. 3, a total of 770 pigs (TR4 × C22; 7.4 ± 0.07 kg) were used in a randomized complete block design with 7 replicate pens/treatment and 22 pigs/pen. Pigs used in all three experiments were allotted to one of five dietary treatments containing 1.22, 1.32, 1.42, 1.52, and 1.62% TID lysine, respectively. Diets used in the above experiments were formulated to be isocaloric and contained the same inclusion of soybean meal (30%), fat (3%), fish meal, and blood cells. The dietary lysine content was increased by adding L-lysine HCl with additional synthetic amino acids supplied as necessary to meet minimum amino acid profile. For Exp.1, increasing dietary lysine increased (linear, P < 0.01; quadratic, P = 0.01) ADG (409, 427, 427, 422, and 440 g/d) and improved (linear, P < 0.001; quadratic, P = 0.001) G/F (0.756, 0.783, 0.832, 0.793, and 0.823). For Exp. 2, increasing dietary lysine increased (linear, P = 0.001; quadratic, P = 0.02) ADG (350, 386, 400, 409, and 413 g/d) and improved (linear, P < 0.001; quadratic, P < 0.01) G/F (0.673, 0.737, 0.753, 0.765, and 0.775). For Exp. 3, increasing dietary lysine increased (quadratic, P = 0.05) ADG (409, 427, 427, 422, and 409 g/d) and improved (linear, P < 0.001; quadratic, P < 0.01) G/F (0.752, 0.790, 0.809, 0.837, and 0.826). Results from these experiments indicate that the TID lysine requirement for 7 to 14 kg pigs may be as high as 1.42%.

Key Words: Lysine, Pigs, Growth


Two experiments were conducted to determine effects of high synthetic amino acid inclusion on growth performance of 11 to 25 kg pigs. Upon placement into the nursery, pigs were allotted by sex in a completely randomized design with three replicate pens per sex and housed at 25 pigs/pen (n=750, Exp. 1) or four replicate pens per sex and housed at 22 pigs/pen (n=880, Exp. 2). Exp. 1 was from 11 to 29 kg and lasted 28 d while Exp. 2 was a 21 d experiment from 11 to 22 kg. The two experiments were conducted at different commercial nurseries with pigs fed one of three different diets prior to reaching a target weight of 11 kg. Both experiments utilized 5 dietary treatments differing in the inclusion of Lys-HCl (0, 0.12, 0.24, 0.36, and 0.48% Lys-HCl) with all diets containing the same level of lysine (1.32% true ileal digestible [TID] Lys) and energy (3.42 Mcal ME/kg). Dietary lysine content was maintained by adding soybean meal (45, 41.25, 37.5, 33.75, and 30.0%). The 1.32% TID Lys level was determined as the lysine requirement in both facilities from previous experimental results. Additional synthetic amino acids were supplied as necessary to meet minimum amino acid ratio requirements. In Exp. 1, no differences existed for ADG (620, 660, 651, 623, and 640 g/d, respectively), ADFI, or G:F (0.714, 0.727, 0.720, 0.730, and 0.725, respectively) between the dietary treatments. Likewise, no Exp. 1 differences were detected for ADG (495, 485, 507, 497, and 502 g/d, respectively), ADFI, or G:F (0.783, 0.776, 0.773, 0.784, and 0.777). These experiments demonstrate that at least 0.48% L-Lysine HCl can be supplemented in diets for 11 to 25 kg pigs, as long as minimum ideal amino acid ratios are maintained.

Key Words: Pigs, Lysine, Nursery

551 Estimation of the ideal ratio of sulfur amino acids:lysine in diets for nursery pigs weighing 11-22 kg. A. M. Gaines*,1, D. C. Kendall1, R. W. Fent1, J. W. Frank1, G. F. Yi1, B. W. Ratliff1, G. L. Allee1, and C. D. Knight2. 1University of Missouri-Columbia, 2Novus International, St. Louis, MO.

Two experiments were conducted to evaluate the ideal ratio of sulfur amino acids:lysine (SAA:LYS) for late nursery pigs using two sources of supplemental methionine (DL-methionine vs. Alimet®). For Exp.1, a total of 330 nursery pigs (TR4 × C22; 11.4 ± 0.10 kg) were allotted to one of nine dietary treatments in a randomized complete block design with six replicate pens per treatment. The control diet (Diet 1) was formulated to contain 10% true ileal digestible lysine (TID) with no supplemental Alimet® or DL-methionine (49% SAA:LYS). Diets 2-9 consisted of the control diet supplemented with four levels of DL-methionine or Alimet® that corresponded to SAA:LYS ratios of 54, 59, 64, and 69%, respectively. For Exp. 2, a total of 341 nursery pigs (Genetiporc; 12.8 ± 0.56 kg) were allotted to one of six dietary treatments in a randomized complete block design with six replicate pens per treatment. The control diet (Diet 1) was formulated to contain 1.05% TID lysine with no supplemental DL-methionine (49% SAA:LYS). Diets 2-5 consisted of the control diet supplemented with four levels of DL-methionine that corresponded to SAA:LYS ratios of 54, 59, 64, and 69%, respectively. To evaluate the effect of methionine source on growth performance, a 59% SAA:LYS diet was also formulated using Alimet®. In Exp. 1, increasing the SAA:LYS ratio increased (quadratic, P = 0.09) ADG (472, 500, 509, 500, and 495 g/d) and improved (quadratic, P = 0.02) G/F (0.627, 0.650, 0.669, 0.677, and 0.663). There was no effect of methionine source on ADG (P > 0.34) and or methionine source × SAA:LYS interactions (P > 0.89) for ADG, ADFI, or G/F (Diets 2-9). In Exp. 2, increasing the SAA:LYS ratio increased (quadratic, P = 0.05) ADG (605, 642, 631, 636, and 639 g/d) and improved (linear, P = 0.01; quadratic, P = 0.03) G/F (0.598, 0.617, 0.613, 0.620, and 0.616). There was no effect of methionine source on ADG (P = 0.16) or G/F (P = 0.28). Results from these two studies indicate that the ideal ratio of SAA:LYS is as high as 59%, regardless of methionine source.

Key Words: Sulfur amino acids, Pigs, Growth

552 Determination of the TID tryptophan:lysine ratio for 90 kg barrows. D. C. Kendall*,1, B. J. Kerr3, R. D. Boyd3, J. W. Frank1, A. M. Gaines1, B. Ratliff1, R. W. Fent1, and G. L. Allee1. 1University of Missouri-Columbia, 2USDA-ARS-MWA-SOMMRRU, Ames, IA, 3The Hanor Company, Spring Green, WS.

A 29 d experiment was conducted to determine the TID tryptophan:lysine (Trp:Lys) ratio for 91 to 124 kg barrows (n=210, TR4 × PIC C-22). Pigs were allotted in a completely randomized design and fed one of five dietary treatments with six replications of seven pigs per pen. A four point titration curve was constructed with a basal diet (0.55% TID lys, 3.47 Mcal ME/kg, 9.3% CP) formulated to contain 0.072% TID Trp (0.130 Trp ME) Additional amino acids were supplied from synthetic sources to meet minimum ratios. L-Trp was added at the expense of corn, creating the three other Trp:Lys treatments (0.165, 0.200, and 0.235 Trp:Lys). A control corn-soybean meal diet was formulated to contain 0.55% TID lys, 3.47 Mcal ME/kg, 11.7% CP, and 0.110% TID Trp (0.200 Trp ME). Blood samples were collected from four pigs/pen at d 0 and d 29 for determination of blood urea nitrogen (BUN). A linear increase in ADG (0.986, 1.11, 1.12, and 1.16 kg/day, respectively; P<0.001) and ADFI (P<0.01) was observed with increasing Trp:Lys for the 29 d trial. There were quadratic improvements in d 29 BW (P<0.06) and G:F (0.304, 0.327, 0.327, and 0.330, respectively;
P< 0.05) with increasing Trp:Lys. The change in BUN level from d 0 to d 29 decreased quadratically (P< 0.09) with increasing Trp:Lys. Pigs fed the 0.165 Trp:Lys diet had greater d 29 BW, ADG, G:F, and lower BUN levels than pigs fed the basal diet (P< 0.05). However, the 0.165 Trp:Lys diet did not differ from the 0.200 and 0.235 Trp:Lys diets for any criterion measured. Pigs fed the control diet had similar ADG and G:F (0.335 vs. 0.327) compared to pigs fed the 0.200 Trp:Lys diet, but d 29 BW was greater (P< 0.001). This experiment demonstrates that a TID tryptophan:Lysine ratio of .165 appears adequate in maintaining performance for pigs from 91 to 124 kg.

Key Words: Pigs, Tryptophan, Growth

553 A meta-analysis to estimate the optimum threonine to lysine ratio in growing pigs. J. van Milgen1* and L. Le Bellego2*.

A meta-analysis was performed using data from widely different origin in order to estimate the optimum threonine (thr) to lysine (lys) ratio in growing pigs. Data from 22 different studies were used including those for piglets, growing and finishing pigs. All studies concerned growth trials in which different levels of thr were used. The thr to lys ratio was expressed on a standardized ileal digestibility basis. If this information was not reported, it was calculated from the reported feed ingredients using table values (AmiPig). The experimental unit used in the meta-analysis was the average response criterion (i.e., average daily gain (ADG) or gain to feed (G/F) ratio) for each treatment within a study. A total of 39 responses were obtained. Data were analyzed through non-linear regression of the response criterion on the thr to lys ratio using a generic response model and a fixed study-effect (Yi) indicative of the maximum performance within each study (i.e., Yi = Yi × (generic model)). The generic model was either a linear-plateau (LP) or a curvilinear-plateau (CLP) model parameterized to have a maximum value of 1. One data set was analyzed using the NLIN-procedure of SAS. Maximum ADG within a study ranged from 320 to 1000 g/d and maximum G/F within a study ranged from 290 to 690 g/kg. The thr to lys ratio that maximized the response criterion (i.e., ADG or G/F) averaged 61% for the LP model and 70% for the CLP model. However, the interpretation of these values is different. The breakpoint for the LP model corresponds to a minimum thr to lys ratio; a 1%-point reduction of the thr to lys ratio below the breakpoint reduced ADG by 94%. In contrast, the optimum thr to lys ratio for the CLP model corresponds to a safe ratio as a small deviation from the optimum only marginally affects performance. In a subsequent analysis, the optimum thr to lys ratio was allowed to vary linearly with body weight. Using the LP model, the optimum thr to lys ratio increased from 58% at 15 kg BW to 65% at 110 kg BW. For the CLP model, the optimum values were 66 and 73%, respectively. For most of the studies concerned, lys may not have been limiting protein deposition throughout the experiment. Consequently, 65% appears to be the minimum standardized ileal thr to lys ratio in growing pigs.

Key Words: Pigs, Threonine, Requirements

554 Prediction of the energy value of corn from the dietary composition in piglets. J. Noblet1* and M. Champion2*.

The energy value of ingredients for swine depends mainly on their chemical composition. Dietary fibre (DF) contributes to reduction of energy concentration whereas fat increases energy content. For corn, both constituents can vary largely and, from a prospective point of view, it is important to predict the energy value of any future type of corn. The objective of the trial was then to propose equations predicting the energy content of corn from its chemical composition. For this purpose, the energy digestibility and the DE content of 11 different corns were measured in piglets according to the difference method. The inclusion rate of the corn was 35% and the basal diet contained wheat, barley, corn, swine meal and beet pulp. All diets were pelleted and fed for 16 days; excreta were collected over the last 9 days. Mean BW of the piglets was 17 kg. On average, the 11 corns contained (% of DM) 1.6% ash, 11.9% CP, 5.2% fat, 66.9% starch (ST), 2.5% sugars (SU), 3.0% ADF and 11.8% DF (DM - (ash + CP + fat + ST + SU)); the corresponding values ranged between 1.4 and 2.1%, 7.8 and 17.9%, 3.5 and 8.5%, 2.7 and 7.5%, 3.3% and 3.5%, 27.7 and 57.5%, and 9.0 and 27.6%, respectively. The gross energy content averaged 19.07 MJ/kg DM (range: 18.41 to 19.74 MJ/kg DM). The energy digestibility and the DE content of the 11 corns averaged 88.0% (range: 79.4 to 90.3%) and 16.78 MJ/kg DM (range: 15.52 to 17.52 MJ/kg DM). According to a multiple regression model without intercept accounting for the total OM in corn, the calculated gross energy content of CP, fat, ST+SU and DF were 24.0, 39.8, 17.3, and 18.0 kJ/g, respectively (RSD of the model: 0.09 MJ/kg DM). The corresponding values for DE content were 18.9, 30.0, 17.2, and 8.6 kJ/g, respectively (RSD of the model: 0.26 kJ/kg DM). The average digestibilities of energy of CP, fat, ST+SU and DF in corn were then 79%, 75%, 99%, and 47%, respectively. A more simple but less precise prediction equation of corn DE would be: DE (MJ/kg DM) = 16.82 + 14.76 x Fat (g/g) + 26.76 x ADF(g/g) (RSD: 0.31 MJ/kg DM). In conclusion, this study allows estimating variation in DE content of corn according to changes in fat or DF content when fed, as pellets, to piglets. Results can be extrapolated to growing pigs.

Key Words: Pig, Corn, Energy value


The energy value of ingredients for swine depends mainly on their chemical composition, the applied technological treatment and the BW of animals. The objective of trial 1 was to estimate the nutrients and energy digestibilities in growing pigs of two samples of corn (corn 1 and corn 2) according to two preparation technologies. For this purpose, a corn-soybean meal basal diet and two diets containing 65% of the basal diet and 35% of either corn 1 or corn 2 were fed for 3 wk to pigs weighing initially 55 kg (4/treatment), either as mash or as pellets. Excreta were collected for the last 10 d; average BW was then 61 kg. The energy and nutrients digestibilities of the corn samples were calculated according to the difference method. Corn 1 had a conventional composition (% of DM): 1.5% ash, 7.3% CP, 4.3% fat and 73.4% starch. The corresponding values for corn 2 were 1.6%, 9.5%, 8.2% and 67.3%, respectively. In combination with its higher fat content, the gross energy content of corn 2 was higher (19.57 vs 18.79 kJ/g DM for corn 1). Pelleting of diets improved (P<.01) fecal digestibility of fat (77 vs 61%) and energy (90.3 vs 88.4%) and the mean DE content of the three diets was 2% higher after pelleting. The energy digestibility of the corn samples was also improved by pelleting; 90.0 vs 88.0% for corn 1, 90.5 vs 88.0% for corn 2. The corresponding DE values were 16.91 vs 16.53 MJ/kg DM and 17.70 vs 17.21 MJ/kg DM. The increased energy value of corn after pelleting was mainly due to the improved digestibility of the fat fraction: 75 vs 54% for corn 1, 84 vs 65% for corn 2. In trial 2, a basal diet containing wheat, barley, corn, fish meal and soybean meal and two diets with 65% of the basal diet and 35% of either corn 1 or corn 2 were fed as pellets to piglets (4/treatment) for 16 d and their feces were collected for nine days at a mean BW of 18 kg. The energy digestibility was 90.3 and 89.5% for corn 1 and corn 2, respectively; the corresponding DE values were 16.96 and 17.52 MJ/kg DM. Fat digestibility averaged 77% for both corns. In conclusion, the DE content of corn depends mainly on its composition and is equivalent in piglets and growing pigs, at least as pellets. Pelleting improves fat digestibility and the subsequent energy values of corn.

Key Words: Pig, Corn, Energy Value

556 Effect of high ambient temperature and feeding level on fatty acid deposition in growing pigs. M. Kloareg, L. Le Bellego, J. Mourot, J. Noblet, and J. van Milgen*, INRA-UMRVP, St-Gilles, France.

Predicting aspects of pork quality becomes increasingly important from both a nutritional and technological point of view. However, little information is available concerning the quantitative relation between nutrient intake and fatty acid deposition at the whole animal level. Eight blocks of five littermate barrows were used in a comparative slaughter trial to determine the effect of feeding level and ambient temperature on fatty acid (FA) deposition. All diets were pelleted and fed for 24 BW, one pig from each litter was slaughtered to determine the initial FA composition. The other littermates were assigned to one of four feeding levels (100%, 90%, 80%, and 70% of ad libitum intake) and were given a diet based on wheat, corn, and soybean meal containing 3.1% lipid and 1.9% FA (of which 16% palmitic acid (C16:0), 2% stearic acid (C18:0), 21% oleic acid (C18:1), 58% linoleic acid (C18:2), and 3% linoleic acid (C18:3)). Pigs were housed individually and the temperature for each block was maintained at either 23 or 30°C. At 65 kg, pigs were slaughtered and the lipid and FA

composition in the empty body was determined. Approximately 77% of the estimated digested C18:2 was deposited as-is versus 55% for C18:3. Although the complement can be oxidized or used for synthesis of other FA, 80% of the digested ω-6 FA and 55% of the ω-3 FA were deposited. For the non-essential FA, deposition exceeded intake of digestible FA by a factor of ten-fold. Based on the assumption that the nitrogen retained from the digested components of HP was estimated by regression of HP on estimators of physical activity and feed consumption. Fasting HP was measured for one day after the energy balance period. Data were analyzed through analysis of variance using litter and betaine as main factors. Weight gain and N balance during the collection period averaged 950 and 27.4 g/day, respectively. Protein gain was affected by betaine. Digestive utilization of energy and nutrients was equivalent in both treatments. None of the response criteria for energy utilization was affected by the addition of betaine (P < 0.1). The ME intake averaged 2451 kJ/(kg BW) 0.68/d. Heat production averaged 1266 kJ/(kg BW) 0.66/d and was repartitioned between fasting HP (745 kJ/(kg BW) 0.66/d or 59% of HP), thermic effect of feeding (27% of HP), 14% of ME intake and HP due to physical activity (13% of HP, 7% of ME intake). On average, 1185 kJ/(kg BW) 0.67/d was retained, 28% of which as protein and 72% as lipid. The respiratory quotient averaged 1.12. Under these experimental conditions, the addition of betaine to the diet did not affect the partitioning of energy.

Key Words: Pigs, Betaine, Energy partitioning


Variation in muscle mitochondria energy production among animals from a single strain, gender and rearing environment was quantified and the effects of these differences on the efficiency and rate of body growth were evaluated. Forty-three male Sprague Dawley rats, initially weighing 54 grams, were individually penned and allowed to consume a nutritionally adequate diet ad libitum for 21 ± 2 days. Body weight gains, feed intakes and feed wastage were quantified and mitochondria from the gastrocnemius muscle were isolated and mitochondrial protein content and State 4 (proton leak-dependent respiration) and State 3 (maximum rate of respiration) rates per unit of mitochondrial protein content were determined. The mitochondrial RCR (ratio State3/State4), a measure of mitochondrial bioenergetics also affecting the efficiency of mitochondrial ATP production was not associated with efficiency of whole body feed utilization. Specifically, lower rates of mitochondrial proton leak-dependent respiration (r = 0.42, P < 0.01) or improved mitochondrial metabolic efficiencies (r = 0.33, P < 0.05) were associated with improved BW gain/feed ratios. In addition, rats with a lower muscle mitochondrial protein content exhibited improved efficiencies of feed utilization (r = 0.43, P < 0.01) and improved rates of growth (r = 0.31, P < 0.05). Body growth rates were not associated with mitochondrial State 3 and State 4 oxygen consumption rates or RCR. Based on multiple regression analysis, differences among animals in mitochondria protein content (SD = 0.6) and proton leak-dependent respiration to one standard deviation were associated (r = 0.33, P < 0.01) with additive changes in body weight gain/feed (g/g) ratios of 0.04 and 0.024, respectively. These additive shifts in efficiency of feed utilization represent a 10% change among the two animal subpopulations. These data establish that the efficiency of mitochondrial energy production and mitochondrial protein content in skeletal muscle influence efficiency of animal growth.

Key Words: Mitochondria, Proton leak, Energetic efficiency


A conventional (NP) or a low-protein diet (LP) were fed to growing pigs weighing 27 kg, 57 kg and 89 kg (stages 1, 2 and 3, respectively) to study the effect of a reduction in dietary CP level on heat production (HP) and energy gain according to stage of growth. The difference in dietary CP level between diets NP and LP was about 4.5 points but both diets provided equivalent levels of essential amino acids. The absolute levels of CP (21.9, 19.4 and 17.4% at stages 1, 2 and 3, respectively) did not affect heat production. Tissue essential amino acids (1.05, 0.88 and 0.72 g digestible lysine/MJ NE) were adapted to each growth stage; ratios between essential amino acids corresponded to the ideal protein profile. Diets were
based on wheat, corn, and soybean meal and variation in CP content was achieved by substituting soybean protein isolate by corn starch and free amino acids (lysine, methionine, tryptophan, threonine, isoleucine and valine). Six blocks of two littermate barrows were used at each stage. Littermates received either the NP or the LP diet. Performance, nutrient digestibility, energy, protein and fat balance, and components of HP (indirect calorimetry) were measured for 10 d in pigs housed individually at 24°C and fed four meals daily at about 90% of their ad libitum intake; feed intakes were similar within a litter. Performance was not affected (P>0.05) by diet characteristics (915 g/d for ADG and 2.17 for FCR) and differed between stages. Nitrogen gain was lower (P<0.05) at stage 1 (24.2 g/d) than at stages 2 and 3 (26.6 g/d) and lower for diet LP (24.5 g/d) than for diet NP (27.0 g/d). When adjusted for identically

gills compared to CO gilts. The number of fetuses weighing >900 g (2.5 ± 0.3 and 2.7 ± 0.3) and the number of placentas weighing >225 g (2.0 ± 0.3 and 2.2 ± 0.3, respectively) did not differ between treatments. In contrast, the number of fetuses weighing <900 g (2.2 ± 0.4 and 4.6 ± 0.4) and the number of placentas weighing <225 g (2.8 ± 0.4 and 5.0 ± 0.4, respectively) were less (P<0.01) in RU486-treated gilts than in CO gilts. Thus, RU486 decreased uterine capacity, primarily by reducing the number of smaller conceptuses at d 105 of gestation. These results, combined with previous results, suggest that optimal uterine capacity is associated with an optimal progesterone concentration on d 2 and 3 of pregnancy.

Key Words: Progesterone, RU486, Fetus


Rapid development of the placenta and fetus is associated with elevated levels of circulating high density lipoprotein (HDL) in humans. HDL receptor SR-BI (CD36L1) mediates selective cholesterol uptake and it is expressed in the human placenta. Endometrial expression of HDL receptor SR-BI mRNA has not been studied. We hypothesized that HDL receptor SR-BI may be expressed in porcine endometrium to take up maternal HDL cholesterol during early pregnancy to support endometrial development. The objectives of this study were to 1) clone and sequence the full coding region for HDL receptor SR-BI and 2) characterize SR-BI gene expression in the endometrium during the estrous cycle and early pregnancy in swine. By iterative screening of a porcine expressed sequence tag library, we obtained a clone (2601 bp, GenBank AF467889) containing the full coding region of HDL receptor SR-BI. Percent identities of porcine SR-BI amino acid sequence with bovine, human, mouse and rat SR-BI were 88, 87, 80 and 79%, respectively. Endometrial expression of SR-BI mRNA in White composite gilts (n=3 to 4) was determined by Northern blotting using total RNA from d 10, 13 and 15 cycle and from d 10, 13, 15, 20, 30 and 40 pregnant gilts, followed by densitometry. There was an interaction (status x day) in SR-BI mRNA expression (P<0.01). In cyclic gilts, endometrial expression of SR-BI mRNA did not change between days 10 and 13, and increased (P<0.01) between d 13 (84.4±10.8 arbitrary units) and 15 (151.7±13.6). In pregnant gilts, endometrial expression of SR-BI mRNA increased (P<0.01) between d 10 (100.0±9.3) and 13 (140.5±9.3), remained elevated until d 30 (157.5±10.9), and decreased (P=0.015) on d 40 (113.4±10.8). These results show that endometrial SR-BI mRNA expression is temporally regulated during early pregnancy and the estrous cycle. This pattern of gene expression suggests that HDL receptor SR-BI plays a role in endometrial function during the estrous cycle and early pregnancy in swine.

Key Words: Endometrium, Early pregnancy, Cholesterol uptake

564 Timing of dinitrophenol treatment during in vitro culture of bovine embryos. J. F. De La Torre-Sanchez* and G. E. Seidel, Jr., Colorado State University, Fort Collins, CO USA.

Dinitrophenol (DNP) uncouples oxidative phosphorylation (OXPh) and reduces glucose oxidation in vitro-cultured embryos. Partial inhibition of OXPh by DNP is beneficial for porcine and bovine embryos around the time of compaction. In this work we evaluated effects of timing
The size of the morula and the timing of blastocyst formation influence the resistance of bovine blastocysts to pro-oxidant agents. J. M. Feugang*, L. Donnay, F. Desse, and A.-S. Lequarre, Veterinary Unit, Catholic University of Louvain, 1348 Louvain-la-Neuve.

In previous studies (Feugang et al., Theriogenology 55, 1, 2001), we showed that exposure of bovine embryos from the morula stage to pro-oxidants induced the degeneration of some blastocysts while the others remained unaffected. The degeneration process was only observed at day 7.5 post-insemination (pi) with no sign before. Here, the two populations of blastocyst (degenerated or resistant) were further characterized using time-lapse cinematography. In vitro produced zygotes were cultured under 5% O2 in SOF medium with 5% FCS. At Day 5 pi (120 hpi), morulae were collected and cultured in a cinematography chamber in the same medium containing 0.01 mM 2,2'-azobis(2-mesylopropane) (AAPH), an exogenous radical generator, or 0.4 mM buthionine sulfoximine (BSO), an inhibitor of glutathione synthesis. Frames were recorded every 4 min during 72 h. For each embryos developing to the blastocyst stage, the timings of cavitation and expansion as well as the diameter of the morula (including the zona pellucida) were recorded. The proportion of morula reaching the blastocyst stage and of degenerated blastocysts on Day 8 pi (192 hpi) were similar with both pro-oxidants (84% and 50% for AAPH - 91% and 54% for BSO: Chi square P≥0.05). Cinematographic analysis showed that, for both pro-oxidants, the population of resisting blastocysts derived from morulae with a larger mean diameter (Table 1). These resisting blastocysts also had started earlier their cavitation process and had a tendency to expand more rapidly than degenerated ones (P≥0.05). These results suggest that the capacity of a blastocyst to resist to oxidative stress depends on the morula size and the kinetics of blastocyst formation. Because the diameter of an embryo remains quite unchanged from the oocyte up to the morula stage, it is likely that blastocyst resistance can be correlated with the diameter of the oocyte from which it was derived. Further studies are needed to confirm this hypothesis and evaluate if a selection can be performed prospectively on those parameters.

Table 1. Effects of pro-oxidants on the kinetic of bovine morula/blastocyst transition.

<table>
<thead>
<tr>
<th></th>
<th>AAPH-exposed embryos</th>
<th>BSO-exposed embryos</th>
<th>Survived Degenerated</th>
<th>Survived Degenerated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External diameter of morula (μm)</strong></td>
<td>161±1b</td>
<td>156±1b</td>
<td>161±2a</td>
<td>152±1b</td>
</tr>
<tr>
<td><strong>Timing of cavitation (hpi)</strong></td>
<td>134±1a</td>
<td>141±2b</td>
<td>136±2a</td>
<td>143±2b</td>
</tr>
<tr>
<td><strong>Timing of expansion (hpi)</strong></td>
<td>145±2a</td>
<td>152±4c</td>
<td>144±2a</td>
<td>149±2a</td>
</tr>
</tbody>
</table>

Data were analyzed by ANOVA 1 and expressed as means. a, b Values significantly different within the same pro-oxidant (P≤0.05). Total of 3 replicates (45 embryos for each pro-oxidant).

Key Words: Bovine embryo, In vitro production, Oxidative stress

567 Physiology of pregnancy and calving characteristics of Holstein cows bred to Holstein or Gir (*Bos indicus*) sires, S. J. Schmidt*, B. S. Gandy, F. Hoholm, K. Graves, J. White, and S. T. Willard, *Mississippi State University, Mississippi State, MS.

The crossbreeding of Holstein dairy cows with Gir, which has a higher milk production potential than many other *Bos indicus* breeds, has not been evaluated extensively in the U. S., nor have the physiological characteristics of such crossbreeding efforts been documented completely. The objective of this study was to evaluate the physiology of pregnancy and calving characteristics of Holstein cows (n = 36) bred (AI) to Holstein (H) or Gir (G) sires. Blood serum samples were collected at 14-d intervals from 60 days of gestation to calving for evaluation of the effects of breed sire on serum concentrations of progesterone (P4; quantified by RIA). Placentome measurements were also recorded at 14-d intervals during gestation using transrectal ultrasonography between 45 and 180 days of pregnancy. Following calving, placenta were collected (n = 5; G: n = 5) for analysis of cotyledon size, weight and number, and total placental weight. A calving difficulty score (1 = no difficulty, 5

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<table>
<thead>
<tr>
<th>Morulae</th>
<th>Blastocysts</th>
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<tbody>
<tr>
<td>Equilibration time (min)</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>57a</td>
</tr>
<tr>
<td>2</td>
<td>37a</td>
</tr>
<tr>
<td>3</td>
<td>40ab</td>
</tr>
<tr>
<td>Non-vitriﬁed control</td>
<td>65b</td>
</tr>
</tbody>
</table>

a, b Values within columns without common superscripts differ (P<0.05).

Key Words: Embryo, Vitrification, In vitro
568 Marked physical changes occur in yearling beef bulls during natural breeding. R. W. Ellis*,1, G. P. Rupp1, P. J. Chenoweth2, L. V. Cundiff3, and D. D. Lunstra1,1 Great Plains Veterinary Educational Center, University of Nebraska, Clay Center, NE, 2Kansas State University, Manhattan, KS, 3USDA, ARS, US Meat Animal Research Center, Clay Center, NE.

To assess changes in body condition score (BCS), body weight (BW), scrotal circumference (SC), mating activity, and semen quality during natural breeding, 74 yearling (15 to 16 mo) beef bulls were evaluated biweekly before, during, and after a 63-d pasture breeding period (mid-June to August). Bulls used for breeding (UFB; n = 60) were compared to control bulls not used for breeding (NFB; n = 14). For multiple sire breeding, subgroups of 9 to 10 UFB bulls were exposed to cows at a bull/cow ratio of 1:20 in 80- to 160-acre pastures. At the start of observations, all bulls averaged 61 ± 0.1 BCS, 554 ± 5 kg BW, 36.3 ± 0.2 cm SC. In UFB bulls during the 63-d breeding period, BW decreased 73 ± 3 kg (P < 0.001; range = -25 to -103 kg), BCS declined 1.5 ± 0.1 units (P < 0.01; range = -1.0 to -2.5 units), and SC decreased 1.4 ± 0.2 cm (P < 0.01; range = -0.5 to -4.0 cm), compared to values observed in NFB bulls. Percentage of normal spermatozoa decreased in both UFB and NFB bulls through the observation period. In general, mating proficiency increased and abortive mounting activity decreased as UFB bulls gained mating experience. In UFB bulls, 75% (n = 45) incurred musculoskeletal (n = 38) or reproductive (n = 7) injuries and weight (24.8 ± 0.14 kg) and false mounts (0.8 ± 0.01) were not affected by treatment x time (P > 0.1). The percentage of morphologically normal sperm cells, assessed at wk 21, was similar (P > 0.1) between groups (80.8 ± 1.0). Gel-free semen volume was similar (P > 0.1) between groups from wk 0 to 5 (191.3 ± 5.4 mL), but tended to be lower (by up to 23%) in Lutalyse-treated boars from wk 5 to wk 21 (treatment x time, P = 0.08). Libido was evaluated from wk 5 to 21. There was an effect of treatment (P = 0.04), but no effect of time or treatment x time (P > 0.1) on the period from injection to the first attempt to mount the artificial sow (182.8 ± 30.9 s and 89.3 ± 30.9 s, for Lutalyse- and control boars, respectively). Duration of ejaculation was affected by treatment (P < 0.01; 472.0 ± 43.1 s and 280.4 ± 43.1 s, for Lutalyse- and control boars, respectively) and time (P < 0.01), but not by treatment x time. The period from injection to the start of ejaculation (225.6 ± 9.1 s) and false mounts (0.8 ± 0.1) were not affected by treatment, time or treatment x time (P > 0.1). Overall, there were no dramatic positive or negative effects of long-term treatment with Lutalyse on semen quality and libido in boars.

Key Words: Lutalyse, Semen, Boars

570 Breed effects on immune and endocrine profiles in growing pigs. M. A. Sutherland*, M. Ellis, and J. L. Salak-Johnson, University of Illinois, Urbana-Champaign, IL.

The objective of this study was to determine effects of breed and age on baseline immune and endocrine measures, Meishan (n = 54), Landrace (n = 36), Yorkshire (n = 36), Berkshire (n = 36) and Duroc (n = 18) pigs were weaned at 17 to 21 d and kept in a common facility. Littermates were assigned to the new environment ≥ 7 d prior to initial blood sample. Samples were obtained via venipuncture at 4, 8 and 12 wk of age to determine plasma cortisol (CORT), chemotaxis (CHTX), phagocytosis, natural killer cytotoxicity (NK), lymphocyte proliferation (LIPA), total white blood cell (WBC) and lymphocyte differentials. At 4, 8 and 12 wk baseline plasma CORT level was greater (P < 0.0001) in Meishan than Yorkshire, Landrace or Berkshire pigs. Durocs had higher (P < 0.0001) basal CORT level at 4 and 12 wk compared to Yorkshire, Landrace or Berkshire pigs. Berkshires had a higher (P < 0.0001) neutrophil count at 4 wk than any other breed, but there were no other breed or age effects on total WBC or lymphocyte cell counts. At 8 wk of age, Yorkshires had greater (P < 0.05) neutrophil phagocytosis than Landrace, Duroc or Meishan pigs. Neutrophil CHTX in response to human C5a was lower (P < 0.05) in Berkshires at 4 wk than in Duroc, Landrace or Meishan pigs. At an E:T ratio of 50:1, NK activity was higher (P < 0.05) in Yorkshires than in Landrace or Duroc pigs. There were breed and age effects (P < 0.0001) for leukocyte differentials. In addition, Meishans gained less (P < 0.05) weight after 8 and 12 wk than Duroc, Landrace or Yorkshire pigs. These results indicate that breed and age significantly affect both baseline immune and endocrine traits.

Key Words: Immune, Swine, Breeds

571 Assessments of velvet antler growth rates using digital infrared thermography in red deer stags. S. Bowers*,1 S. Gandy,1 D. Neuendorff,2 T. Dickerson1, S. Mozisek2, R. Randel2, and S. Willard1,1 Mississippi State University, Mississippi State, MS, 2Texas A&M University - TAES, Overton, TX.

Velvet antler (VA), a by-product of the deer farming industry, is usually harvested based on morphology, conformation and size. However, the use of Digital Infrared Thermal Imaging (DITI) to assess thermal gradients of the antler may permit the harvesting of VA at its peak in the growth phase. The objective of this study was to evaluate whether DITI would pattern VA growth. Antler growth rates, DITI measurements (main and beam VA base, mid and tip temperatures and bw and scrotal circumference (SC) were obtained from red deer stags (n=11) every 14-d following eruption (d 0) through d 126. For analysis, antler growth patterns were split into three time points: early, mid and late, or were tested relative to day of eruption. Velvet antler growth rates increased (P<0.001) from 0.45 ± 0.03 cm/d in the early period to 0.52 ± 0.03 cm/d in the mid period, and then decreased (P<0.001) to 0.16 ± 0.03 cm/d in the late growth period. Velvet antler DITI changed (P<0.001) over time for all stags and differed (P<0.001) between base, mid and tip. Base, mid and tip DITI were positively correlated (R ≥ 0.80) with one another (P<0.001), and base, mid and tip DITI were positively correlated to VA growth (R=0.52, R=0.54, R=0.68 respectively, P<0.001). During the total antler growth period, VA temperatures increased (P<0.05) from 38.9 ± 0.2 °C at the base to 39.3 ± 0.2 °C at the tip of the antler. In addition, there was a tendency (P<0.10) during the
mid growth phase for the tip (38.4 ± 0.3 °C) to have a higher DITI than the base (37.9 ± 0.2 °C) of the antler. In contrast, during the late growth period, DITI was higher (P < 0.001) at the base (36.8 ± 0.3 °C) than at the tip (35.7 ± 0.3 °C) of the antler. During the time of VA growth, SC was positively correlated with BW (R = 0.70, P < 0.001), and increased (P < 0.001) from 11.0 ± 10.5 to 20.5 ± 6.7 g/d when changing from the early to the late growth period. In conclusion, VA thermogenesis patterned VA growth with higher VA temperatures occurring during the early and mid growth periods, and lower VA temperatures occurring during the late growth period when VA growth ceased to be apparent. This suggests that DITI measurements may have value in determining the period of peak VA growth.

Key Words: Red Deer, Velvet antler, Digital infrared thermography

572 Relationship between placental characteristics, delivery parameters and placental retention. A. L. Riddle, H. D. Tyler, and J. D. Quigley. Iowa State University, Ames, IA, APC Company, Inc., Ames, IA.

Retained placenta and dystocia are increasing problems within the dairy industry. Optimal delivery conditions can improve overall health status of the calf and dam, along with reducing the incidence of retained placenta. The objectives of this experiment were to determine placental factors that may be associated with dystocia and retained placenta. Calves (n=70) and placentae (n=44) were obtained from Holstein cattle following parturition. Delivery parameters include calving ease scores, duration of calving, calf weight and parity. Placental characteristics evaluated after expulsion included color index (1-light to 5-dark) of cotyledons located at center and tips of placenta, cotyledon number, placental weight and length of umbilical stump. After delivery, calves were weighed, blood samples were collected to evaluate hematocrit, and placentae were weighed after expulsion. Placentae were analyzed for cotyledon number, diameter at the base, diameter at the tip, and umbilical stump length. Calves (n=70) and placentae (n=44) were obtained from Holstein cattle following parturition. Delivery parameters include calving ease scores, duration of calving, calf weight and parity. Placental characteristics evaluated after expulsion included color index (1-light to 5-dark) of cotyledons located at center and tips of placenta, cotyledon number, placental weight and length of umbilical stump. After delivery, calves were weighed, blood samples were collected to evaluate hematocrit, and placentae were weighed after expulsion. Placentae were analyzed for cotyledon number, diameter at the base, diameter at the tip, and umbilical stump length. Calves (n=70) and placentae (n=44) were obtained from Holstein cattle following parturition. Delivery parameters include calving ease scores, duration of calving, calf weight and parity. Placental characteristics evaluated after expulsion included color index (1-light to 5-dark) of cotyledons located at center and tips of placenta, cotyledon number, placental weight and length of umbilical stump. After delivery, calves were weighed, blood samples were collected to evaluate hematocrit, and placentae were weighed after expulsion. Placentae were analyzed for cotyledon number, diameter at the base, diameter at the tip, and umbilical stump length.

Key Words: Retained placenta, Calf, Parturition


This study was conducted to evaluate the impact of the environment and coat color on rectal and surface temperatures of Holstein heifers. Heifers were evaluated for 40 d during April-May (Spring; n = 30; 16.4 ± 0.2 mo of age) and September-October (Fall; n = 20; 20.2 ± 0.3 mo of age). Ambient temperature, relative humidity (RH) and temperature humidity index (THI) were measured at 10-min intervals using data loggers. Rectal temperature (RT) of heifers was measured every other day. Coat surface temperature (CST) of white and black coat of heifers was measured every other day. Coat color of heifers had an effect on pregnancy with light colored heifers having a higher PR. Selecting of light colored dairy cattle may be a way of enhancing pregnancy rates under tropical conditions.

Key Words: Heifer, Coat color, Pregnancy

574 The effect of hair coat color on rectal and surface temperatures of Holstein heifers in the tropics. R. W. Godfrey, O. T. Isles, A. J. Weis, and R. E. Dodson. University of the Virgin Islands, Agricultural Experiment Station, St. Croix.

This study was conducted to evaluate the impact of the environment and coat color on rectal and surface temperatures of Holstein heifers. Heifers were evaluated for 40 d during April-May (Spring; n = 30; 16.4 ± 0.2 mo of age) and September-October (Fall; n = 20; 20.2 ± 0.3 mo of age). Ambient temperature, relative humidity (RH) and temperature humidity index (THI) were measured during this time using data loggers. Percentage of black hair coat (BHC) was determined using image analysis software (Sigma Scan 5.0). Heifers were categorized as dark (>50% BHC) or light (<50% BHC). Data were analyzed using GLM procedures of SAS. Temperature humidity index (THI) was measured at 10-min intervals using data loggers. Rectal temperature (RT) of heifers was measured every other day. Coat surface temperature (CST) of white and black coat of heifers was measured every other day. Coat color of heifers had an effect on pregnancy with light colored heifers having a higher PR. Selecting of light colored dairy cattle may be a way of enhancing pregnancy rates under tropical conditions.

Key Words: Heifer, Coat color, Environment

Ruminant Nutrition: Fats and fatty acids

575 Conjugated linoleic acid (CLA) and milk production. M. A. McGuire* and J. M. Grinnar1,1 University of Idaho, Moscow, 2University of Helsinki, Finland.

Dairy products are an important source of nutrients in the human diet. However, many scientists view dairy fat unfavorably due to the risk of coronary heart disease. A substantial body of literature now demonstrates that fatty acids in dairy fat possess important benefits to human health. Conjugated linoleic acid (CLA) and its precursor, trans-11 C18:1 or vaccenic acid, have been shown to be potent anticarcinogens in various cancer models, and dietary intake and plasma concentrations of these fatty acids are related to a reduced risk of breast cancer. Enhancing the concentrations of CLA in bovine milk would improve the healthful nature of milk fat as well as the perception by the consumer. Conjugated linoleic acid refers to a family of 18 carbon fatty acids with 2 double bonds separated by a single bond. Many isomers exist that arise from biohydrogenation of polyunsaturated fatty acids in the rumen. Desaturation of vaccenic acid within mammary tissue is the main source of cis-9, trans-11 CLA, the principal CLA in milk fat, shown to have anticarcinogenic effects. Another isomer is trans-10, cis-12 CLA produced by pigs and rats.
in the rumen under conditions that promote milk fat depression. The trans-10, cis-12 CLA potently inhibits lipogenesis as well as reduces tumor formation. Many studies have outlined potential nutritional methods, from altering forage to concentrate ratio to supplementation with various oils, to enrich milk fat with cis-9, trans-11 CLA. The feeding strategies that boost milk fat CLA also boost trans fatty acid content of milk. Although, the increase is attributable mostly to an increase in vaccenic acid, it is not clear how CLA-enriched milk products would be viewed by new food labeling rules. Additionally, feeding a rumen-protected CLA may soon be available. One could enrich milk fat with cis-9, trans-11 CLA to supply a healthy milk niche market, although other feeding methods may be more cost effective. Alternatively, one could provide trans-10, cis-12 CLA to cause milk fat depression. This strategic use may be a tool for management to control energy output or meet milk fat quotas. Vaccenic acid and CLA are minor fatty acids in milk fat important for human health.

Key Words: Milk fat, Conjugated linoleic acid, Vaccenic acid

576 The challenges of supplying omega fatty acids to body tissues of cattle to meet critical metabolic and physiologic functions. T. C. Jenkins* and A. AbuGhazaleh, Clemson University, Clemson, SC 29634.

The omega system of describing the double bond position in a fatty acid chain designates the number of carbons between the methyl end of the chain and the closest carbon having a double bond. Oleic acid (omega-9), linoleic acid (omega-6), and linolenic acid (omega-3) with one, two and three double bonds, respectively, are found in low concentrations (mg/g DM) in cereal grains and forages, but in high concentrations in vegetable oils. Fish oils contain high concentrations of two unique omega-3 fatty acids referred to as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) with five and six double bonds, respectively. Tissue desaturases can synthesize omega-9 fatty acids, but not all of the omega-3 or omega-6 acids. Because the omega-3 and omega-6 fatty acids are required for the synthesis of prostaglandins and other physiologic regulators, but cannot be synthesized by body tissues, they must come from dietary sources and are considered essential. Even when omega fatty acids are fed to cattle in vegetable or fish oils, their intestinal absorption remains low because of biohydrogenation by ruminal microorganisms. Despite extensive biohydrogenation in the rumen, it is often accepted that cattle fed “normal” diets do not show signs of essential fatty acid deficiency. This assumption has been challenged in recent years based on results that show positive metabolic changes, such as improved reproductive performance, when cattle were fed fat sources high in omega-3 or omega-6 fatty acids. Aside from determining the type and amount of omega fatty acid needed for optimal tissue function, a major challenge is regulating ruminal biohydrogenation to deliver the desired quantity of omega fatty acid at the proper time. Information needed to meet this challenge includes describing in more detail the pathways of biohydrogenation including all intermediates and end products, how the pathways are influenced by environmental conditions in the rumen that affect many diet changes, determining how these pathways may be altered chemically or physically to increase protection from biohydrogenation, and exploring the use of molecular techniques to establish microbial species with altered biohydrogenation activities.

Key Words: Omega fatty acids, Biohydrogenation, Ruminants

577 Increasing milk fat cis-9, trans-11 Conjugated Linoleic Acid content in pasture-fed cows. J. K. Kay*, J. R. Roche†, N. A. Thomson†, J. M. Griniari‡, and K. J. Shingfield§, 1Dexcel, New Zealand, 2University of Reading, UK, 3University of Helsinki, Finland.

More than 90% of cis-9, trans-11 conjugated linoleic acid (CLA) secreted in the milk of grazing cows is produced from endogenous conversion of trans-11 18:1 in the mammary gland. Attempts to manipulate milk fat CLA content in grazing cows have been relatively unsuccessful. This study examined the potential of feeding lipid supplements for 4 weeks to increase milk fat CLA content of cows at pasture. Twenty-eight multiparous Friesian cows in mid lactation were randomly allocated to 1 of 4 dietary treatments; pasture alone (P), or pasture supplemented with 150 g/d fish oil (FO), 350 g/d sunflower oil (SO) or 150 g/d fish oil and 350 g/d SO (FSO). Milk yield and milk protein output were not affected by lipid supplements. Milk protein and fat content and milk fat yield were decreased (P<0.05) by FO and SO supplements. Milk fat concentrations of trans-10 and -11 18:1 and cis-9, trans-11 CLA were all increased (P<0.05) in response to FO, SO and FSO treatments. The increase in trans-11 18:1 and decrease (P<0.01) in milk fat 18:0 content suggests that FO supplements inhibited the reduction of trans 18:1 fatty acids in the rumen. On the basis of milk fatty acids responses, it appears that trans-11 18:1 production in the rumen can be further enhanced when SO is used in combination with FO. In conclusion, fish oil alone or in combination with sunflower oil can be used as an effective supplement for increasing milk fat cis-9, trans-11 CLA content in grazing cows.

Key Words: Pasture, Fish oil, Conjugated linoleic acid

578 Dose response to supplementation with calcium salts of conjugated linoleic acid during the transition period and early lactation. E. Castaneda-Gutierrez*, T. R. Overton, and D. E. Bauman, Cornell University, Ithaca N.Y.

The objective of this study was to evaluate the production response of dairy cows to supplementation with two doses of calcium salts of conjugated linoleic acid (CLA) during the transition period and early lactation. Multiparous Holstein cows (n = 48) were divided into three groups, receiving one of the following treatments: 1) control (271 g/d of calcium salts of palm oil; EnerGill®, Bioproducts Inc.), 2) CLA low dose (CLA-L; 147 g/d of calcium salts of CLA plus 136 g/d of calcium salts of palm oil), and 3) CLA high dose (CLA-H; 295 g/d of calcium salts of CLA). The calcium salts of CLA contained 4.7% cis-9, trans-11; 4.6% trans-8, cis-10; 6.2% trans-10, cis-12; and 6.1% cis-9, trans-11. Each treatment provided 230 g/d of fat, and was top dressed each day from 2 wk prior to predicted calving until 9 wk postpartum. Milk production and feed intake were recorded daily, milk components determined weekly, and body weight and body condition score were recorded weekly. Over the 9 wk treatment, supplementation with calcium salts of CLA resulted in decreased milk fat percentage (P<0.05) (3.88%, 3.48%, and 3.17% for control, CLA-L and CLA-H, respectively). However, milk fat percent was similar among treatments during the first 3 wk of lactation. Milk fat yield was progressively decreased, averaging 1.65, 1.49 and 1.31 kg/d for control, CLA-L and CLA-H, respectively. This represented a 21% decrease between control and CLA-H (P<0.001). Milk production did not differ among treatments averaging 43.4, 43.6 and 43.0 kg/d for control, CLA-L and CLA-H, respectively. Secretion of milk protein and milk lactose, feed intake, body weight and body condition score were also unaffected. The supplementation with both doses of calcium salts of CLA induced reduction of milk fat in early lactation, with effects being readily apparent after 3 wk postpartum.

Key Words: CLA, Early lactation, Milk fat depression

579 Comparison of the effect of different rumen protected forms of CLA on milk fat synthesis. M. J. de Veth*, J. W. McFadden†, J. M. Griniari2, S. K. Gulati3, N. D. Luchini3, and D. E. Bauman4, 1Cornell University, Ithaca, NY, 2Clanet Ltd, Espoo, Finland, 3University of Sydney, Rumentek (Pty) Ltd, Australia, 4Bioproducts Inc., Fairlawn, OH.

Abomasal infusion studies have shown trans-10, cis-12 conjugated linoleic acid (CLA) decreases milk fat synthesis. However, a delivery that bypasses the rumen will be required for commercial application of
Blood samples were taken on day 42 from early lactating cows (Experimental period was 42-d in length. Milk production was recorded and 29% (linear; 11, 16 and 34%, and milk fat concentration was reduced linearly 16, 21 DIM) to determine the metabolic profile. Milk fat yield was decreased affected by treatments. The addition of Ca-CLA decreased the milk fat yield for FP-CLA relative to Ca-CLA involved reductions in fatty acids an 8 d interval between periods. Milk fat yield was reduced (P < 0.01) for CLA treatments compared to control, as was FP-CLA compared to Ca-CLA (P = 0.01). Milk fat content showed the same pattern of response as observed for milk fat yield. Relative to control (0.77 kg/d), milk fat yield of Ca-CLA decreased by 34% and FP-CLA decreased by 44%. CLA treatment had no effect (P > 0.28) on DMI and milk protein yield, but a small decline in milk yield (8%) occurred. The decrease in milk fat yield for CLA treatments was due to reductions in both de novo fatty acid synthesis and preformed fatty acids utilisation because yield of all fatty acids was reduced (P < 0.01). Likewise the lower milk fat yield for FP-CLA relative to Ca-CLA involved reductions in fatty acids of most chain lengths. Trans-10, cis-12 CLA levels in milk fat increased (P < 0.01) from < 0.01% in controls to 0.07% for Ca-CLA and 0.18% for FP-CLA. Efficiency of transfer of abomasally infused trans-10, cis-12 CLA into milk fat was 3.2% and 7.0% for Ca-CLA and FP-CLA, respectively. These values are much lower than transfer efficiencies reported for abomasally infused CLA, suggesting much of the two CLA forms were metabolized in the rumen. Overall, results indicate formaldehyde encapsulation of CLA provides greater protection from rumen metabolism than formation of Ca salts.

Key Words: Conjugated linoleic acid, Milk fat depression, Rumen protection

580 Lactational response of cows to different levels of ruminally protected conjugated linoleic acids. R. Gervais*, R. Spratt, and P. Y. Chouinard, Université Laval, 4Agribris Purina Canada.

Dietary CLA supplements have been shown to reduce milk fat synthesis in dairy cows. This technology may be useful as a tool to produce low fat milk where it is economically feasible. A rumin-protected source of CLA is required for commercial feed applications. The conversion of dietary lipids to a calcium salt (Ca-CLA) is proposed as a method to protect dietary lipids from ruminal biohydrogenation, because Ca-CLA is thought to be insoluble in the rumen. Our objective was to determine whether feeding Ca-CLA under commercial conditions would affect milk production, milk composition and blood metabolic profile. In this multi-site trial, 248 dairy cows from 8 farms were blocked according to the calving date, and randomly assigned to four treatments, which consisted of four doses of Ca-CLA, providing 0, 8, 16 and 32 g/d of CLA. The predominant CLA isomers were trans-8, cis-10 (5%), cis-9, trans-11 (34%), trans-10, cis-12 (37%), and cis-11, trans-13 (12%). Experimental period was 42-d in length. Milk production was recorded and milk was sampled on days 0, 7, 14, 28 and 42 of the feeding period. Blood samples were taken on day 42 from early lactating cows (LIM DIM) to determine the metabolic profile. Milk fat yield was 16, 11, 16 and 34%, and milk fat concentration was reduced linearly 16, 21 and 29% (linear; P <0.01) when cows received 8, 16 and 32 g/d of CLA, respectively. Milk yield and milk protein content and yield were not affected by treatments. The addition of Ca-CLA decreased the milk fat content of short- and medium-chain fatty acids, and increased the proportions of long-chain fatty acids (linear; P <0.01). The concentration of trans-10, cis-12 CLA increased in milk fat (P <0.01), and there was no change in cis-9, trans-11 CLA. Blood parameters (glucose, urea, total protein, albumin, globulin, Ca, P, Mg, creatinine, total bilirubin, aspartate amino transferase, creatine kinase, alkaline phosphatase, alanine transaminase) were not affected. Ca-CLA can be used as an effective tool to manipulate milk fat content on commercial dairy farms.

Key Words: Conjugated linoleic acid, Milk fat, Rumen protection

581 Synthesis of Trans fatty acids and isomers of Conjugated Linoleic Acid in the rumen of cows fed grass silage based diets supplemented with rapeseed, soybean and linseed oil. K. J. Shingfield, S. A. Odenjako, W. T. Ochotorena, P. Huhtanen, and J. M. Griinari, School of Food Biosciences, The University of Reading, UK, Animal Production Research, MTT Agrifood Research Finland, Jokioinen, Finland, Department of Animal Science, University of Helsinki, Finland.

Based on in vitro incubations and measurements of fatty acids in digesta, it is increasing evident that biohydrogenation of unsaturated fatty acids in the rumen results in the formation of a wide range of trans C18:1 fatty acids and isomers of conjugated linoleic acid (CLA). This study attempted to identify the origin of biohydrogenation intermediates produced in the rumen using supplements of rapeseed (R), soybean (S) and linseed (L) oil as a source of cis-9,18:1 and cis-9,18:3 (n-3), respectively. Four lactating cows fitted with rumen cannula were used in a 4 x 4 Latin square with 14 d experimental periods. Cows were offered 18 kg DM/d of a basal (B) diet consisting of grass silage and a cereal based-concentrate (60:40; forage:concentrate ratio, on a DM basis) alone or supplemented with 500 g of R, S or L. The flow of fatty acids leaving the rumen was assessed using the omasal sampling technique and a triple indigestible marker method. Oil supplements had no effect on DM intake, but shifted rumen fermentation towards propionate and butyrate at the expense of acetate, and increased the flow of C18:0 (280, 632, 634 and 581 g/d for B, R, S and L, respectively), trans C18:1 (42, 112, 133 and 151) and CLA (4.5, 5.7, 7.9, 7.4) entering the omasal canal. Quantitatively, trans-11 was the most important isomer accounting for proportionately 0.44, 0.33, 0.38 and 0.37 of total trans CLA flow, for B, R, S and L, respectively. Similarly, cis-9, trans-11 was the most abundant CLA isomer (0.66, 0.66, 0.73 and 0.47). Rumenal synthesis of trans-4, 5 and 6-8 C18:1 was increased by higher cis-9 and cis-11 C18:1 intakes. Formation of trans-10 and cis-12 C18:1, trans-10, trans-12; trans-9; trans-11; trans-8; trans-10; cis-12 and cis-9, trans-11 CLA was increased in response to dietary T (n=6), while cis-18:3 (n-3) stimulated the formation of trans-13-14, -15 and -16 C18:1, trans-12, trans-14; trans-11, trans-13 and cis-12, trans-14 CLA biohydrogenation intermediates.

Key Words: Trans fatty acids, Conjugated linoleic acid, Biohydrogenation

582 WITHDRAWN . . .


A study was conducted to evaluate the effect of including alfalfa preserved either as silage or long-stem or chopped hay on DMI and milk fat production of dairy cows fed corn silage-based diets with supplemental tallow (T). Fifteen Holstein cows that averaged 117 DIM were used in a replicated 5 x 5 Latin square design with 21 d periods. Treatments (DM basis) were: 1) 50% corn silage: 50% concentrate without T (CS); 2) 50% corn silage: 50% concentrate with 2% T (CST); 3) 25% corn silage: 25% short alfalfa hay: 50% concentrate with 2% T (SAHT); 4) 25% corn silage: 25% long alfalfa hay: 50% concentrate with 2% T (LAHT); 5) 25% corn silage: 25% alfalfa silage: 50% concentrate with 2% T (AST). Diets averaged 16.4% CP and 30.3% NDF. Mean particle size of SAHT and AST was 3.4 and 3.6 mm, respectively. Including 2% T in diets with corn silage as the sole forage source decreased DMI and milk fat % and yield. Replacing part of corn silage with alfalfa in diets with 2% T increased milk fat % and yield. Milk fat of cows fed CST was higher in trans-10 C18:1 than that of cows fed diets with alfalfa. No effect of alfalfa preservation method or hay particle length was observed on DMI and milk fat production of dairy cows fed corn silage-based diets with supplemental tallow (T).
Flaxseed, Heat treatment, Nutrient utilization

**Key Words:** used to increase ruminal undegraded protein content in flaxseed while

We concluded that inclusion of flaxseed in dairy cow diets up to 2 kg

and nutrient digestibilities were found between cows fed EF and those fed MF. No differentiated in whole tract nutrient digestibilities of rumen- inert fat sources had no effect on milk yield or composition but type of fat affected DMI and tissue energy gain.

**Key Words:** Rumen-inert fat, Saturation, Hypophagic effects


Measurements (n=27) from 95 cows in previous experiments conducted in the milk of the cows were used to evaluate the potential relationships between liver triglyceride content (TG), liver metabolism, blood metabolites, and cow performance. Initially, data was subjected to Pearson correlation analysis. Those variables that were significantly (P < 0.05) correlated with TG on d1 and 21 postpartum were used to develop equations for predicting liver TG content. Variables were removed from multiple regression analysis in a stepwise, backward fashion until all variables had a probability of a greater F < 0.05. For TG on d1 postpartum, the TG 21d prepartum, the capacity of liver to store [1-14C]palmitate intracellularly (SEP) 21d prepartum, the capacity of [1-14C]propionate conversion to CO2 (POx) on d1 postpartum, the area under the curve for concentration of NEFA in plasma from d7 prepartum to d21 postpartum (NAUC), and the area under the curve for NEFA from d7 prepartum to d21 postpartum (BAUC), multiple regression analysis on d1 postpartum, in d1 postpartum, capacity of liver to convert [1-14C]propionate to glucone 21d postpartum (GNG), calving body condition score (BCSm), and NAUC were significant resulting in the development of the equation TG21 (r2 = 0.61). For TG on d21 postpartum, TG on d21 prepartum and d1 postpartum, capacity of liver to convert [1-14C]propionate to glucose 21d postpartum (GNG), calving body condition score (BCSm), and NAUC were significant resulting in the development of the equation TG21 (r2 = 0.61). Other correlations suggested relationships between TG and GNG (r = 0.39 and 0.48 for d1 and d21), cumulative DMI from d7 to 21d (r = 0.37 and 0.35 for d1 and d21), DCSm (r = 0.29 and 0.36 for d1 and d21) and BW change from calving to 3 wk postpartum (r = 0.33 and 0.34 for d1 and d21). These findings reemphasize the importance for optimal BCS for cows at calving to reduce the severity of fatty liver and confirmed the negative relationship between liver TG accumulation and gluconeogenic capacity.

TG1 = -8.6245 + (1.8047 × TG21) + (0.0284 × SEP) - (0.0006 × POx) + (0.0002 × NAUC) + (0.0041 × BAUC)

TG21 = -26.4965 + (2.1958 × TG21) + (0.4472 × TG1) + (0.0014 × GNG) + (6.6574 × BCSm) + (0.0005 × NAUC)

Key Words: Periparturient cow, Liver

587 Effects of cinnamonamide, garlic and monensin on nitrogen metabolism and fermentation profile in continuous culture. M. Busquet1, S. Calsamiglia4, A. Ferret1, and C. Kame12, 1Universidad Autonoma de Barcelona, Spain, 2University of Leeds, UK.

Eight 1.3-L dual flow continuous culture fermenters were used in three periods (10 d) to study the effects of natural plant extracts on N metabolism and fermentation profile. Fermenters were fed 95 g/d of a 50-50 forage-to-concentrate diet. Treatments were: no additive (Negative Control, NC), Monensin (4 or 40 mg/d per fermenter, M and M10), Cinnamamide (100 or 1000 mg/d per fermenter, CI and CI10) and Garlic (100 or 1000 mg/d per fermenter, G and G10). Fermenters were maintained at constant temperature (39°C), pH (6.4) and solid (5%) dilution rates. Each day, a sample was taken 2 h after the morning feeding for the determination of peptide N (Pep-N), amino acid N (AA-N), ammonia N (NH3-N) and volatile fatty acids (VFA). During the last 3 days, samples were taken at 0, 2, 4 and 6 h

Ruminant Nutrition: Additives, enzymes and feedstuffs analysis

587 Effects of cinnamonamide, garlic and monensin on nitrogen metabolism and fermentation profile in continuous culture. M. Busquet1, S. Calsamiglia4, A. Ferret1, and C. Kame12, 1Universidad Autonoma de Barcelona, Spain, 2University of Leeds, UK.

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after the morning feeding, and analyzed for Pep-N, AA-N and NH3-N concentrations. Data were analyzed using the PROC MIXED (SAS, 1996) and significance declared at P < 0.05. Total VFA (mM) was higher in M10 (128.7) compared with NC (119.0). Acetate proportion (mol/100mol) was lower for CI (58.6), G (59.6), G10 (48.3) and M10 (46.1) compared with NC (63.1). Propionate proportion (mol/100mol) was higher in CI (23.6), G10 (27.1) and M10 (45.3) compared with NC (19.8). Butyrate proportion (mol/100mol) was higher in G10 (18.3) and lower in M10 (4.1) compared with NC (10.3). The Pep-N concentration across all hours (mg/100ml) was similar in all treatments. The AA-N concentration across all hours (mg/100ml) was higher in G10 (4.6) and M10 (4.4) compared with NC (1.9). The NH3-N concentration across all hours (mg/100ml) was lower in M10 (13.0) compared with C (19.2). The CI and G10 modified propionate and acetate proportions in the same direction as M10. However, the higher proportion of butyrate observed in G10 compared with M10 suggests a different mechanism of action may be involved. The accumulation of AA-N, and the decrease in NH3-N in M10 suggests that deamination was inhibited.

Key Words: Rumen fermentation, Monensin, Cinnamaldehyde


Malate (Rumalato®; Norel & Nature) as a feed additive was evaluated in a total of 76 Manchega and Lacaune lambs. After weaning (35 d of age), lambs were allotted in balanced groups and fed ad libitum with a pelletized concentrate (18.2% CP; 1.82 Mcal NE/kg, DM basis) and chopped barley straw. Four types of concentrate were prepared according to the inclusion of malate (0.2% in concentrate) and type of cereal (barley or corn). Treatments were: B (barley); BM (barley–malate); C (corn); and, CM (corn–malate). In Exp. 1, 64 lambs (16.4 kg BW) were kept in straw bedded pens and used in a 2×5 factorial design with each hour of incubation analyzed separately. The experiment was repeated three times and ruminal fluid used was obtained 24 h before in vitro digestion. Substrates were incubated in triplicate for 6, 24, and 48 h in buffered, ruminal fluid within Ankom Dairy II incubators. Treatments were arranged in a 3×5 factorial design with each hour of incubation analyzed separately. The experiment was repeated three times and ruminal fluid used was collected from two cows fed bermudagrass hay supplemented with 0.4 kg soybean meal. Increasing the enzyme application rate resulted in a quadratic increase (P = 0.005) in IVMD of B (135, 155, 169, 188, and 177 g/kg), C (175, 195, 204, 205, and 224 g/kg), and T (103, 110, 121, 143, and 145) hay at 6 h and in a linear increase (P = 0.007) in IVMD of B (493, 501, 513, 520, and 521 g/kg), C (479, 487, 495, 504, and 512 g/kg), and T (486, 478, 481, 506, and 506 g/kg) at 48 h. Increasing enzyme application rate also resulted in quadratic increases (P = 0.001) in NDF digestibility (IVNDFD) of B (15, 26, 53, 37, and 36 g/kg), C (46, 41, 51, 38, and 59 g/kg), and T (19, 17, 30, 41, and 33 g/kg) at 6 h. At 6 h, optimum IVNDFD for B was at the 1% application rate but that for the C and T hays was at the 3 and 2% rates respectively (B vs. (C + T) by quadratic interaction (P = 0.030) and C vs. T by quadratic interaction (P = 0.076)). The main effect of enzyme addition on IVNDFD at 24 h and 48 h was not significant. This work demonstrates the potential of fibrolytic enzymes for enhancing the digestion of tropical grass hays.

Key Words: Beef Cattle, Enzymes, Supplementation

590 Effect of fibrolytic enzyme preparations containing esterase, cellulase, and endoglucanase activity on the digestibility of mature, tropical grass hays. N. Krueger*, D. Dean, W. Krueger, C. Staples, and A. Adesogan, 1 University of Florida, Gainesville, FL USA

This study examined the effect of applying an enzyme complex (Depol 670L, Biocatalyst, UK) containing high esterase (7 U/g) activities on the digestibility of three tropical grass hays. The enzyme was applied in liquid form at 0, 0.5, 1, 2, or 3 g/100g DM to hay produced from 12-wk regrowths of Common bahiagrass (B) (Paspalum notatum), Coastal bermudagrass (C) (Cynodon dactylon), and Tifton 85 bermudagrass (T) (Cynodon dactylon)24h before in vitro digestion. Substrates were incubated in triplicate for 6, 24, and 48 h in buffered, ruminal fluid within Ankom Dairy II incubators. Treatments were arranged in a 3 x 5 factorial design with each hour of incubation analyzed separately. The experiment was repeated three times and ruminal fluid used was collected from two cows fed bermudagrass hay supplemented with 0.4 kg soybean meal. Increasing the enzyme application rate resulted in a quadratic increase (P = 0.005) in IVMD of B (135, 155, 169, 188, and 177 g/kg), C (175, 195, 204, 205, and 224 g/kg), and T (103, 110, 121, 143, and 145) hay at 6 h and in a linear increase (P = 0.007) in IVMD of B (493, 501, 513, 520, and 521 g/kg), C (479, 487, 495, 504, and 512 g/kg), and T (486, 478, 481, 506, and 506 g/kg) at 48 h. Increasing enzyme application rate also resulted in quadratic increases (P = 0.001) in NDF digestibility (IVNDFD) of B (15, 26, 53, 37, and 36 g/kg), C (46, 41, 51, 38, and 59 g/kg), and T (19, 17, 30, 41, and 33 g/kg) at 6 h. At 6 h, optimum IVNDFD for B was at the 1% application rate but that for the C and T hays was at the 3 and 2% rates respectively (B vs. (C + T) by quadratic interaction (P = 0.030) and C vs. T by quadratic interaction (P = 0.076)). The main effect of enzyme addition on IVNDFD at 24 h and 48 h was not significant. This work demonstrates the potential of fibrolytic enzymes for enhancing the digestion of tropical grass hays.

Key Words: Tropical grass, Esterase, Cellulase
on the in vitro digestibility of three tropical grasses. The enzyme was applied at 0, 0.5, 1, 2, and 3 (g/100g DM) on the in vitro digestion of hay produced from 12-wk regrowth of Common bahiagrass (B), Coastal bermudagrass (C), and Tifton 85 bermudagrass (T) 24 h before in vitro digestion. Forages were incubated in triplicate for 6, 24, and 48 h in buffered, ruminal fluid with an in situ Ammonia DII incubators. Treatments were arranged in a 3 x 5 factorial design with each hour of incubation analyzed separately. The experiment was repeated three times and ruminal fluid used was collected from two cows fed bermudagrass hay supplemented with 0.4 kg/d of soybean meal. The IVMD of B (133, 159, 165, 156, and 182 g/kg), C (180, 165, 178, 207, and 212 g/kg) and T (99, 113, 97, 149, and 159 g/kg) at 6 h increased linearly (P = 0.001) as the enzyme application rate increased. The increase in IVMD at the 2% application rate was greater for T compared to C (C vs. T by quadratic interaction, P = 0.018). Likewise, the IVMD of C at 48 h tended to increase linearly as enzyme application increased (487, 484, 489, 506, and 510 g/kg) but that of T at 48 h was unaffected (485, 481, 478, 485, and 497 g/kg). C vs. T by linear interaction, P = 0.069). The NDF digestibility (IVNDFD) of T at 6 h (41, 34, 29, 61, and 72 g/kg) increased linearly with increasing enzyme addition whereas that of C (56, 58, 41, 75, and 63 g/kg) did not increase (C vs. T by linear interaction, P = 0.011). The IVNDFD of B at 24 h (325, 310, 330, 270, and 373 g/kg) increased linearly whereas that of C (305, 280, 299, 300, and 284 g/kg) and T (310, 338, 304, 337, and 331 g/kg) were unaffected by increases in enzyme addition (B vs (C + T) by linear interaction (P = 0.036). In conclusion, the enzyme enhanced the digestion of the hays but the pattern and extent of the improvement was forage specific.

Key Words: Tropical grass, Esterase, Digestion

592 The potential for enhancing the digestion of C4 grass hays with proprietary fibrolytic enzymes. D. Dean*, N. Krueger, L. Sollemberger, and A. Adesogan, 1University of Florida, Gainesville, FL/USA.

This trial examined the effect of applying four proprietary cellu-lase/hemicellulase enzymes on the digestibility of two tropical grasses. Promote (P), Biocellulase X-20 (X), Cattle-Ase (CA) and Biocellulase A-20 (A), were applied at: 0, 0.5x, 1x and 2x the recommended rates on hays produced from 12 week regrowths of Coastal bermudagrass (BE), Cynodon dactylon (BA) and Common bermudagrass (Paspalum notatum) (BA) and the hays were stored for three weeks. In vitro digestibil-ity of dry matter (IVMD) and neutral detergent fiber (IVNDFD) were calculated after digesting the hays in buffered rumen fluid for 6 or 48 h in two ANKOM14 Dairy Incubators. Separate randomized complete block designs were used to quantify the effects of enzyme application on each hay at each period. Increasing the enzyme application rate pro-duced linear and quadratic increases (P < 0.01) in 6h IVMD in BE hays treated with X (72.1, 89.6, 98.5 and 119.5 g/kg), and linear increases (P < 0.05) in BE hays treated with CA (72.1, 75.9, 88.2 and 91.6 g/kg) at 6h and X at 48 h (410.3, 501.7, 518.9 and 534.2 g/kg) respectively. As enzyme application increased, IVNDFD was increased (P < 0.01) linearly in BE hays treated with P at 6 h (410.0, 47.8 56.9 and 70.2 g/kg) and 48 h (429.9, 460.9, 442.8 and 492.1 g/kg) but a linear decrease (P < 0.05) occurred in BE hays treated with CA at 48 h. BA hays treated with CA (129.6, 122.2, 112.3 and 144.8 g/kg) had linear (P < 0.05) increases in 6h IVMD as enzyme application increased, but a cubic (P < 0.05) response was observed in BA hays treated with A at 48 h. There was a quadratic (P < 0.05) increase in 6h IVNDFD of BA hays treated with P, and a linear increase (P < 0.05) in that of BA hays treated with A. There were also cubic (P < 0.05) re-sponses in the 48h IVNDFD of BA hays treated with P and A at 48 h. This work shows that some fibrolytic enzymes complexes can enhance digestion of C4 grasses. However, improvements vary with digestion stage and forage type.

Key Words: Enzymes, Digestibility, C4-grasses

593 Effects of dietary sodium bicarbonate and sodium chloride on ruminal pH and digesta characteristics in dairy cows. C. S. Mooney* and M. S. Allen, 1Michigan State University, East Lansing.

Six ruminally and duodenally cannulated, mid-lactation (176 ± 12 DIM, mean ± SD) Holstein cows were used in a duplicated 3 x 3 Latin square design to evaluate effects of sodium bicarbonate on ruminal character-istics. Periods were 28 d in length with the last 14 days for data and sample collection. Treatments were control, sodium bicarbonate at 1% of dietary DM, and an isomolar concentration of sodium chloride. Each diet contained a common base mix (95% of diet DM) to which treatment premixes (5% of diet DM) were added. The control premix was composed of 50% finely ground dry corn and 50% ground rice hulls on a DM basis. Sodium bicarbonate and sodium chloride were included in place of rice hulls in their respective premixes. Diets were formulated to 20% forage NDF and 17.5% CP. Ruminal pH was measured every 5 seconds for 5 days by indwelling pH probes. Mean ruminal pH was 6.2 and was not affected by treatment (P = 0.97), nor was any other measure of pH (minimum, maximum, range, standard deviation, or time or area under pH 5.5, 5.8, or 6.0; P > 0.28). Dry matter intake and 3.5% FCM were similar across treatments (22% and 35.7 kg/d, respectively). Mean milk fat concentration was 3.51% and was not affected by treatment. Both sodium treatments increased water intake compared to control (103.8 vs. 98.6 L/d, italizeP = 0.05) but there was no difference between sodium treatments (P = 0.83). Volume of rumen contents was increased by sodium bicarbonate compared to control (102.8 vs. 90.3 L, P = 0.02) but not by sodium chloride (P > 0.50). Density of ruminal contents was greater for sodium chloride compared to sodium bicarbonate (0.87 vs. 0.81 kg/L, P < 0.01). Differences in effects of the two sodium treat-ments on ruminal digesta volume and density might be because of their osmotic effects on water and DM turnover in the rumen. Lack of ef-fect of sodium bicarbonate on ruminal pH or milk fat concentration was probably because buffering capacity of bicarbonate was in excess for all treatments.

Key Words: Sodium bicarbonate, Sodium chloride, Ruminal characteristics


Forty-two multiparous Holstein cows (60-180 days in milk) housed in a free-stall barn were blocked by parity and previous 305-d mature equivalent milk production, and randomly assigned to a control TMR or a TMR containing fibrolytic enzymes in a study with a crossover design with two 28-d periods. The enzymes contained primarily cellulase, xy-lanase and neutral protease activities, and were added as a dry powder to the concentrates prior to addition of forages in the mixer wagon. En-zymes were applied at the rate of 1g/kg of non-forage DM of the Enzyme TMR compared 45% forages and 55% concentrate bases, and contained 18% CP and 31-33% NDF. Cows were group-fed by treatment and DM intake for each pen was recorded. During the fourth week of each period, milk production was recorded from all cows, and total tract digestion measured from a subset of animals using chromic oxide as an external marker. Fibrolytic enzymes enhanced digestion of DM, OM, and nonfiber carbohydrates (P < 0.05), but had no effect on digestion of CP and fiber or milk yield and composition.
The official EU method for starch analysis on feedstuffs is a polarimetric procedure utilizing the optical activity of dispersed starch. For pure starches and high-starch commodities, this method provides reliable and accurate results. When applied to feedstuffs low in starch and high in fiber or protein, reliability is considerably reduced and values often overestimate true starch values. The objective of this work was to compare the polarimetric method with different enzymatic procedures. All enzymatic procedures involved a preliminary digestion step with a heat-stable \(\alpha\)-amylase (Termamyl 120 L), dissolved either in a Na-citrate buffer at pH 5.8 or in water, and release of glucose by action of amyloglucosidase in a Na-acetate buffer at pH 4.6. Glucose was quantified subsequently using either phosphorylation or oxidation to gluconic acid. Free glucose was determined in a separate assay to yield unbiased estimations of glucose from starch. Eleven test samples were utilized comprising low-starch (distillers’ grains, soybean meal, citrus pulp, total mixture with 25% citrus pulp) and high-starch (corn starch, potato starch, hominy feed) commodities. As a general observation, starch values determined polarimetrically (mean, 49.8% of dry matter) were higher \((P < 0.0001)\) than those determined enzymatically (mean, 43.1% of dry matter). Comparisons among enzymatic procedures showed that Na-citrate buffer as an incubation medium for the \(\alpha\)-amylase yielded higher starch values than water \((P < 0.0001)\). Type of quantification of glucose (phosphorylation versus oxidation to gluconic acid) gave the same average starch concentration \((43.1\% \text{ of dry matter}; P < 0.7846)\). Results from this study indicate that Na-citrate buffer was better than water as an incubation medium for \(\alpha\)-amylase, and that glucose released by \(\alpha\)-amylase plus amyloglucosidase action can be quantified by phosphorylation or oxidation. Differences between polarimetric and enzymatic methods, and variation among enzymatic procedures require further investigation.

**Key Words:** Starch, Feed analysis, Methods

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1. Average pen DM intake of group-fed animals. 2. Nonfiber carbohydrates \(= 100-\text{(ash + NDF + CP + fat)}\). 3. Somatic cell count.

**Key Words:** Dairy cow, Fibrolytic enzymes, Digestion and milk yield

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595 Effect of pH and enzyme supplementation to a total mixed ration on microbial fermentation in continuous culture. D. Colombo, M. Hervás, W. Yang, and K. Buchtin.

The effects of pH and enzyme addition were examined in continuous culture using a 4 x 4 Latin square design, with four 9-d periods consisting of 3-d fermentation and 3-d for determinations. The buffer pH was adjusted to 100% (high) or 60% (low) of the normal concentration of artificial saliva. Fermenters were fed twice daily a diet consisting of 30% alfalfa hay, 30% corn silage, and 40% rolled corn (DM basis). The silage was milled fresh and the TMR was fed fresh to the fermenters (64% DM). The EM was a protease containing no other major activities, and was applied daily to the TMR, at least 12 h before feeding. Treat ferment was stored at 4°C until fed. Ranges of pH were 6.0-6.6, and 5.4-6.0 for high and low, respectively. Degradability of OM, NDF, ADF, and cellulose were reduced \((P < 0.05)\) by low pH, but hemicellulose and protein degradation were not affected. EM addition increased \((P < 0.01)\) NDF degradability \((by \, 43\% \text{ and } 25\% \text{ at high and low pH}, \text{respectively})\), largely due to an increase in hemicellulose degradation \((by \, 79\% \text{ and } 51\%, \text{respectively})\). Total volatile fatty acids (VFA) and its molar proportions were decreased \((P < 0.05)\) by low pH, but were not affected by EM. Protein degradation was only numerically \((P = 0.17)\) increased by EM. Total N flow tended \((P = 0.07)\) to be reduced with EM, but neither bacterial nor dietary N flow was affected by the treatments. Microbial protein synthesis was not affected by either pH \((P = 0.29)\) or EM \((P = 0.86)\). Methane production, expressed as a proportion of total gases, was decreased \((P < 0.001)\) at low pH, but was not affected by EM. It is concluded that it is possible to adapt the CC system to use fresh feeds instead of dried feeds. Overall, the results indicate that the EM used in this study has significant potential to increase fiber degradability without increasing methane production.

**Key Words:** Continuous culture, Digestion, Enzymes

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596 Effect of the sequence of fat and antibiotic-ionophores on ruminal fermentation and microbial lipids. M. G. Daves* and V. Fellner.

Rumen inoculum was obtained from a fistulated cow, filtered, and inoculated with duplicate fermenters. The basal diet consisted of 100% alfalfa pellets and was offered twice daily \((14g \text{ DM/d})\). Cultures were allowed two days of adaptation and then used to test the sequence effects of fat, monensin, and bacitracin addition. On day 3, two fermentors received monensin, two received bacitracin, and the other four received fat. On day 6, fat was added to the cultures receiving monensin and bacitracin, and two of the four fermentors fed fat were offered monensin and the other two bacitracin for an additional three days. A total of four replications were conducted. Data were analyzed using the Mixed procedure of SAS for repeated measurements. Monensin reduced methane 15% and 23% when compared to fat and bacitracin, respectively. Adding monensin prior to fat lowered methane by 22% compared to the addition of fat prior to monensin. Monensin increased \((P < 0.01)\) propionate compared to bacitracin but increased valerate \((P < 0.03)\) and iso-valerate \((P < 0.001)\) compared to fat. Addition of monensin prior to fat increased \((P < 0.03)\) valerate when compared to cultures that received fat prior to monensin. Fat increased \((P < 0.003)\) isobutyrate compared to monensin. Isobutyrate was higher in cultures that received bacitracin prior to fat than those that received fat first. Monensin increased \((P < 0.01)\) C16:0 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased \((P < 0.05)\) cis-C18:1 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased \((P < 0.05)\) cis-C18:1 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased \((P < 0.05)\) cis-C18:1 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased \((P < 0.05)\) cis-C18:1 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased \((P < 0.05)\) cis-C18:1 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of fat addition had no effect. The addition of additives and their sequences did not alter total or trans-C18:1 levels. Monensin increased \((P < 0.05)\) cis-C18:1 compared to fat. Levels of C18:0 ranged between 23mg/g of total FA \((\text{monensin})\) to 30 mg/g of total FA \((\text{fat})\), but the difference was not significant. Cultures receiving monensin had lower concentrations of C18:0 than those receiving bacitracin, but the sequence of}
proved to be reliable, repeatable, and simple, and warrants future field application.

**Key Words**: Particle size, Forage, Total mixed ration

599 Comparison of three systems to estimate the fraction of non-fiber carbohydrate, and its ruminal digestibility, in common feedstuffs. A. Offner and D. Sauvagnet, INRA P-G INRA, Paris, France.

The objective of this study was to compare the prediction of the non-fiber carbohydrate content and ruminal digestibility by three systems for the estimation of feed values (CNCPS, NRC, and INRA models). The comparison was based on twenty common feedstuffs. The fraction of non-fiber carbohydrate (NFC, % of DM) and the fraction of digestible NFC (dNFC, % of DM) were determined with the three systems. The NRC used an empirical approach to estimate dNFC: dNFC = 0.98 × PAF × (NFC + NDICP); with PAF, the processing adjustment factor, and NDICP, the neutral detergent insoluble protein. The CNCPS and INRA considered a more mechanistic approach of rumen digestion based on the “competition” between degradation and passage; the fractional passage rate was set at 6 % h⁻¹. The fractional degradation rates were from in vitro (CNCPS) and in situ studies (Offner et al., 2003). The results showed close correlations (r > 0.88) between the NFC fractions predicted by the three systems. However, the CA fraction defined in the CNCPS was not accurately linked to starch (-2.6, r = 0.92) or degradable NFC (+15.9, r = 0.87). Results for the dNFC fraction outlined significant differences ranging from 1.5 to 31 % of DM among the three systems. The NRC significantly overestimated dNFC compared to CNCPS (+10.8, r = 0.88) and INRA (+12.0, r = 0.93). Moreover, the NRC significantly underestimated dNFC compared to CNCPS (+10.8, r = 0.88) and INRA (+12.0, r = 0.93). The CA fraction defined in the CNCPS was not accurately linked to starch (-2.6, r = 0.92) or degradable NFC (+15.9, r = 0.87). Results for the dNFC fraction outlined significant differences ranging from 1.5 to 31 % of DM among the three systems. The NRC significantly overestimated dNFC compared to CNCPS (+10.8, r = 0.88) and INRA (+12.0, r = 0.93). Moreover, the NRC and the CNCPS did not take into account all the variability observed in NFC digestibility when different processing treatments were applied. Differences among the three systems were surprising and indicated the need for a more consistent estimation of NFC and dNFC. This will perhaps be possible by integrating enough NFC sub-fractions, like those for starch, into the systems.

**Key Words**: Non-fiber carbohydrate, Rumen digestion, Feeding systems

### Contemporary Issues Symposium: Designing animal experiments for power

600 Near infrared reflectance spectroscopy prediction of digestion rates for cereal grains. C. Lanzas* and A. N. Pell, Cornell University, Ithaca, NY.

Near infrared reflectance spectroscopy (NIRS) is used for commercial feed analysis because of its speed and precision. NIRS calibrations for digestion rates would be a step towards the field use of models that require digestion rates as inputs. Our objective was to assess the accuracy of NIRS in predicting digestion rates of dried cereal grains obtained by measurement of gas production. Eighteen barley, 99 corn, 23 sorghum, and 57 wheat samples were collected from 22 countries. Samples were ground to pass a 4-mm screen and fermented in vitro with rumen fluid for 48 hours. Gas production was measured with a computerized system and the data were fit to an exponential model to derive the fractional rates. The mean and SD of gas production rates were 0.24±0.029 h⁻¹ for barley, 0.14±0.025 h⁻¹ for corn, 0.06±0.015 h⁻¹ for sorghum, and 0.26±0.038 h⁻¹ for wheat. Samples were scanned from 1100 to 2498 nm with a visible/near-infrared scanning monochromator machine at 1 nm intervals. Modified partial least squares regressions were used to calibrate spectral data against gas production rates. Two calibration models were developed with the same data set. In the first model, 189 samples were used to develop the calibration model; the coefficient of determination was 0.89, and standard error of cross-validation (SECV) was 0.029 h⁻¹. In the second model, 98 samples were used to develop the calibration model, the remaining samples (n= 91) were used as a validation set. The coefficient of determination was 0.84, and standard error of validation (SEV) was 0.03 h⁻¹. For the validation set, SEV was partitioned into three orthogonal components: lack of correlation, bias, and non-unity slope. The error distribution was 88.8 % for lack of correlation, 11.2 % for the bias component and 0 % for the non-unity slope. The coefficients of determination of the models suggest that NIRS had the ability to predict digestion rates. However, the ratio between SECV (2.8) indicated lower prediction ability of the equations compared with NIRS models for chemical fractions.

**Key Words**: Near infrared reflectance spectroscopy, Digestion rates, Gas production


When analyzing the results of a trial that has been conducted to compare treatments, it is usually the desire of the researcher to demonstrate a significance result for the contrasts of the group means that are of interest. This is certainly the case when an improved product is desired. However, in establishing the bio-equivalence of a test product to a standard, the objective is usually to conclude, with reasonable justification, that no difference has been detected. In making such determinations, the probabilities of accepting false hypotheses of equality, or those of rejecting correct hypotheses of differences must be taken into account. Prior to beginning the trial, the researcher should have a good estimate of the power that will be associated with the detection of a given maximum acceptable difference. The required sample size for achieving the desired power for these tests depends, among other things, upon the coefficient of variation (CV) in the data collected. The lower the CV, the smaller the detectable difference becomes. A reduced CV can be achieved, in some cases, by using an appropriate experimental design to account for elements such as variation in either moisture or fertility of the soil on which a crop is grown. A Latin Square design adds another dimension of control for bias and variance. Regardless of the design chosen, it is imperative to identify the proper experimental unit receiving the treatment. If animals are treated individually they may each represent a unique experimental unit. If they are exposed to the treatment as a group at the same time, for example animals housed together in a pen, such that they do not represent independent, random observations, the group may be the correct experimental unit to consider. There are many considerations to take into account when planning a bio-equivalence trial, or any other trial for comparing performance under different treatments. This talk will discuss some of these items that are often overlooked and will attempt to make suggestions on how they may be handled.

**Key Words**: Bio-equivalence, Power of test, Sample size

602 The power of tests for feed experiments with poultry. W. B. Roush*1 and P. Tozer,1 USDA-ARS Mississippi State, MS, 2Penn State University, University Park, PA.

The power of tests can be used to determine the ability of an experimental design to detect treatment differences. The power of tests is rarely formally considered in poultry research. The definition of statistical power is the probability of rejecting the null hypothesis when it is, in fact, false and should be rejected. The complement of statistical power is the Type II error. That is, accepting the null hypothesis that there is no difference in treatments when, in fact, there is one. With power analysis, the sample size that is needed can be calculated to detect a given change. A priori power analysis can indicate the probability at which the sampling regime or experiment can actually detect an effect if a difference exists. Post hoc power analysis indicates either the sufficiency or the sample size needed for an experiment that has already been conducted. Because the sample size for a priori and post hoc power analyses can be larger than may be considered practical, a compromise power analysis can be conducted that calculates sample size based on a ratio of beta and alpha errors (Erdfelder, 1984). In the current study, examination was made of the power of tests for experiments published in the literature where significant and non-significant differences were reported between control birds and birds fed diets. Examination of the power of tests was conducted with G*Power, a readily available freeware program.

**Key Words**: Statistical power, Poultry, Experimental design
603 How many pigs? Statistical power considerations in swine nutrition experiments. D. K. Aaron* and E. W. Hays, University of Kentucky, Lexington.

Replication refers to the assignment of more than one experimental unit (EU) to the same treatment. Each replication of a treatment is an independent observation; thus, each replication involves a different EU. In swine nutrition research, the EU may be an individual animal, as in sow reproduction experiments, or a group of animals, as in growing-finishing pig experiments. In either case, calculation of the number of replicates needed to give an accurate and reliable outcome is an important step in a pre-experiment protocol. Although investigators often appear to choose replication arbitrarily on the basis of cost or availability of animals, convenience, or tradition, the question of "how many pigs" (i.e., how much replication is necessary) is a statistical one that has a statistical answer.

A power analysis, performed while in the process of designing an experiment, will provide an investigator with the number of replicates needed for an experiment of known power and sensitivity. This a priori power analysis ensures that an investigator does not waste time and resources carrying out an experiment that has little chance of finding a significant effect, if one exists. It also makes sure resources are not wasted by including more EU than are necessary to detect an effect. A second type of power analysis may also be useful. If no significant effects are found in an experiment, the investigator can assess post-hoc the actual power of the experiment, or may determine the size of treatment effect that could have been detected using the standard deviation and number of replicates in the experiment. This a posteriori or retrospective power analysis can be very useful in explaining results. If the actual power to detect an effect of the size found in the experiment is high, it can be safely concluded the treatment has no effect. If the actual power is low, results will not be sufficient to say there is no effect. The objective of this paper is to discuss a priori and a posteriori power analyses as they relate to the kinds of experiments typically conducted in swine nutrition research.

Key Words: Power, Replication, Swine Nutrition

604 Experimental design in companion animal and equine nutrition: issues and insights. C. M. Grieshop* and E. A. Fickinger, University of Illinois.

Numerous challenges exist in designing experiments for companion animals and horses including the small number of animals available, subjective response criteria, and high variability in most responses of interest. One of the greatest challenges in companion animal research is the inability to use large numbers of animals due to lack of availability or prohibitive costs. Experimental designs such as the Latin square and crossover design can be used to maximize power for detecting differences while minimizing the number of animals required. These designs allow animals to serve as their own baseline or controls, thus reducing variation among treatments. Another challenge that exists in designing experiments for companion animals is the subjectivity for many response criteria. Responses such as longevity, quality of life, and palatability are difficult to assess in a quantifiable and objective manner. Various defined experimental protocols have been designed in an attempt to decrease subjective variability in these measurements, but often it remains difficult to detect and interpret statistical differences. A high level of variation exists naturally for most of the responses of interest. Sources of this variation can be both within and between herds or colonies. Significant differences in genetic backgrounds and in management practices exist that can result in large differences in many different response criteria. Due to the challenges outlined, designing experiments for companion animals is a complex task. Specialized statistical designs and defined experimental protocols are necessary to minimize variability and maximize the ability to detect statistical differences in biologically significant responses in companion animal and equine experiments.

Key Words: Experimental design, Equine, Companion animals

605 Design of experiments for bioequivalence testing of biotechnology derived crops as feeds for dairy cattle. R. J. Tempelman*1 and M. A. Faust2, 1Michigan State University, 2Iowa State University.

Experiments for dairy feed product testing have been primarily designed for the purpose of providing sufficient power of test to detect economically important differences in various performance measures, e.g., milk production. The emerging importance of biotechnology derived feed crops have led to their recent comparisons with conventional feedstuffs for their effects on dairy. A current and future goal of these studies may be to assess bioequivalence of hybrids or feedstuffs. However, experimental designs that are appropriate for testing bioequivalence may be subtly different from designs for detecting mean differences. We discuss experimental designs that may be more suitable for the purpose of bioequivalence testing in dairy cattle nutrition studies, noting that the crossover design has been already widely advocated for bioequivalence testing in clinical research studies. We further discuss the design issues pertinent to dairy nutrition studies such as group-fed versus individually fed animals and multiple testing and data reduction concerns surrounding the collection of many different performance measures. Literature estimates of mean differences and variability are used to derive representative sample size requirements for dairy bioequivalence studies.

Key Words: Dairy nutrition, Bioequivalence testing, Biotechnology crops

680 Power of the test considerations for beef cattle experiments. C. R. Richardson*1, G. A. Nunnery1, D. B. Wester1, N. A. Cole2, and M. L. Galyean1, 1Texas Tech University, Lubbock, TX, 2USDA-ARS-CPRL, Bushland, TX.

The inherent value of evaluating the power of a test procedure in beef cattle experiments is similar to that for other species; however, because of major differences in the methods and conditions involved compared with other species, considerations for the use of power test procedures are distinct and specific for beef cattle experiments. Some of these major differences include: 1) lack of similar research facilities, which leads to wide fluctuations in the number of animals used per experimental unit (pen) by researchers; 2) variation in types of pens (totally or partially enclosed indoor pens, open outdoor pens, enclosed fields, or open ranges); 3) use of individual animal data from Pinpointers, Calan gates, and metabolism studies; 4) seasonal effects by region on animals housed outside; and 5) variation in the performance of control groups among locations because of differences in diet composition and animal genetics. When power tests are used in the planning and experimental design phase of a research study, they provide critical information on sample sizes necessary to detect a treatment effect at a predetermined α level. In using power tests across different experimental designs, attention should be given to the consequences of both Type I and Type II errors. Lowering the Type I error rate increases the Type II error rate and vice versa. For several common statistical procedures and experimental designs, power tables are available; however, none specifically addresses beef research, and software is not readily available. Data will be reviewed from published beef cattle research in which comparisons can be made to determine the effects that experimental design, numbers of animals within the experimental unit, number of replications, type of housing, regional effects, feed composition, and genetics have on power tests. Estimation of power in beef cattle experiments is important.

Key Words: Beef cattle, Statistics, Power test

Lactation Biology Symposium: Altering the lactation cycle in dairy cows

606 Why re-evaluate length of dry period? R. R. Grummer* and R. R. Rastani, University of Wisconsin, Madison.

Possible advantages of reducing length of dry period include increased income from milk production, simplified dry cow management, and alleviation of over-crowded dry cow facilities. Current recommendations are a 60-d dry period. Physiologists describe the dry period as consisting of three phases: active involution, steady state involution or rest phase, and redevelopment of secretory tissue. The importance of a rest phase has never been established. There are abundant data in the literature to support a 6 to 8 week dry period. However, interpretation of the data is difficult. The great majority of data is from studies using farm records (e.g., DHI data). In these data sets, cows with less than 6 to 8 wk dry periods probably were not intended to have short dry periods and consequently were not managed for short dry periods.
Additionally, recommendations from observational data may be biased due to interactions between parameters such as milk yield or calving interval and length of dry period. Some experiments specifically designed to compare 30 and 60-d dry periods indicate that shorter dry periods are possible without sacrificing milk production the next lactation. Additional studies are necessary to confirm the findings and determine the effects of shortened dry periods on body condition, incidence of health disorders, and reproductive performance. If 30-d dry periods can be achieved without negative effects the next lactation, the next logical question becomes: can the dry period be reduced further? To study the effects of no dry period, twins or quarters within a cow have been assigned to continuous milking or a traditional 60-d dry period. These results have indicated a 25 to 40% drop in milk yield the following lactation due to continuous milking. However, these and other studies have utilized low cow numbers and cows with extremely low milk production. As milk yield and persistence of lactation increases, either through genetic selection or administration of exogenous agents such as bST, the likelihood of successfully shortening or eliminating the dry period should increase.

Key Words: Dry period length, Continuous milking, Lactation

607 Effect of POSILAC® (bST) and dry period management strategy on milk yield. E. L. Annen2,1, M. A. McGuire2, J. L. Vicini3, and R. J. Collier1,1, 1Univ. of Arizona, Tucson, 2Univ. of Idaho, Moscow, 3Monsanto Co., St. Louis, MO.

A dry period of 40-60 d has been a routine practice in the dairy industry and was intended to provide a balance of maximum lifetime milk and profitability. A dry period less than 40 d reduces yield in the subsequent lactation by 5 to 15%. Omitting the dry period completely results in production losses of 20 to 40% in the subsequent lactation due to reduced functionality of mammary parenchyma rather than nutritional status or endocrine regulation. This study evaluated milk production effects of shortened or omitted dry periods on today’s high-yielding cows treated with bST (500 mg every 14 d). The study utilized 3 commercial dairy herds and included four treatment groups. Initially, five multiparous and five primiparous cows from each farm were assigned to each group. Treatments included: 1) control: 60-d dry period, bST per label (bST started at 57-70 DIM to end of lactation), 2) 30-d dry period, bST per label, 3) continuous milking, bST per label and 4) continuous milking with continuous bST. Average milk yield was reduced in primiparous cows during the first 17 wk postpartum for treatments 2, 3 and 4, compared with controls (40.1, 32.2, 34.6, vs. 43.1 kg/d; P<0.01, N=57). Milk production in multiparous cows was not affected by treatment (45.6, 42.0, 45.5 vs. 47.3 kg/d; N=38). We hypothesize that a shortened or omitted dry period impeded mammary growth in primiparous animals and may have minimal production effects in multiparous cows treated with bST. In addition, profitability in multiparous cows was improved through increased net milk income generated by omitting the dry period. In multiparous cows, treatment 4 improves net milk income over controls by $130/cow for the first 17 wk of the lactation due to continuous milking. However, these and other studies have utilized low cow numbers and cows with extremely low milk production. Further research is required to examine the effects of continuous milking and bST on mammary involution and mammary proliferation.

Key Words: Continuous lactation, Shortened dry period


Sixty-five Holstein cows were utilized in a randomized block design to evaluate different management schemes involving altered dry period lengths on subsequent milk production and metabolic variables. Cows began the experiment 90 d prior to expected calving date. (ECD) and were assigned to one of three treatments: traditional 56 d dry period (cows fed a low energy diet from -56 to -28 d and a moderate energy diet from -28 d to parturition; T), 28 d dry period (cows continuously fed a high energy diet; S), and 0 d dry period (cows continuously fed a high energy diet; Z). Contrasts were 56 vs. 28 d dry management scheme (T vs. S) and 28 vs. 0 d dry period (S vs. Z). Prepartum (PRE) DMI was 13.9, 16.8, and 18.1 kg/d for T, S, and Z, respectively (T vs. S, P<0.01; S vs. Z, P<0.01). There were no differences in concentrations of non-esterified fatty acid (NEFA), glucose, liver triglyceride (TG), PRE and postpartum (POST) -hydroxybutyric acid, and POST DMI. Liver TG were greater for S compared with Z at 1 d POST (8.82 vs. 5.23, % DM; P<0.02) and at 35 d POST (5.54 vs. 3.23, % DM; P<0.02); liver TG were similar for T and Z (P>0.15). There were no differences in POST NEFA between T and S, but NEFA were greater for S compared with Z (394 vs. 235 Eq/L; P<0.01). Postpartum glucose concentrations were lower for S compared with Z (55.0 vs. 59.3 mg/dl; P<0.01) and there was a tendency towards lower glucose concentrations for T vs. S (52.5 vs. 55.0 mg/dl; P<0.12). There was no difference in POST 4.0% FCM yield in cows on T vs. S (42.4 vs. 41.5 kg/d; P>0.15). However, there was a tendency towards lower POST 4.0% FCM yield in cows on Z vs. S (36.1 vs. 41.5 kg/d; P<0.11). In summary, T and S management schemes have similar response on FCM yield and metabolic variables in the subsequent lactation. Shortening the dry period length from 28 to 0 d may improve metabolic status, but decrease FCM yield.

Key Words: Dry period length, Transition period


The objective of this study was to determine whether the half of a bovine mammary gland that had been dry for 30d would produce as much milk, during the subsequent lactation, as the non-dry half of the udder that had been dry concurrently for 70d. Multiparous Holstein cows were assigned randomly to control (C, n=14) and treatment (T, n=26) groups. All mammary quarters of cows in C group were allowed to have a full 70d (67±10) dry period. At 8d before expected calving dates (ECD), milk production of left and right half-udders for cows in T group was measured for 10d. No difference was detected in the yield or distribution of milk produced by left (8.00 kg/d; 50.9%) and right (7.70 kg/d; 49.1%) half-udders. At random, within each cow of the T group, one half-udder was dried off at 70d before ECD while milk removal from the other half-udder continued twice daily until 30d before ECD. Average daily yields and distribution of milk produced from 80 to 70d before ECD for the half-udders (n = 12L, 14R) subsequently dry for 68±9 d (7.74 kg; 49.3%) did not differ from the values for the control half-udder (n = 14L, 12R) subsequently dry for 27±7 d (7.96 kg; 50.7%). During the postpartum period, milk removed from the left half-udder was measured using a “True-test” milk meter and total-udder milk production was obtained from the parlor meter. Right half-udder production was estimated by difference. Through 30 DIM, the two mammary quarters within the 30d dry half-udders produced less milk (P<0.01) than the two mammary quarters within the 70d dry half-udders (14.2 vs. 18.3 kg/d; 43.7 vs. 56.3%). C group, managed with the T group, produced more milk through 30 DIM (38.3 vs. 32.2 kg/d; P<0.01). Mean BW (kg) did not differ at calving (C=68.45 vs. T=67.19) or postpartum (C=64.89 vs. T=66.92). Although mean BCS did not differ at calving (C=3.54 vs. T=3.54), T group lost body condition during the feed period (C=3.17 vs. T=3.35; P<0.1). Milk yield results from this within-cow experimental design suggest that a 30d dry period decreases subsequent milk production.

Key Words: Dry period, Milk yield, Days dry

610 Effect of delayed breeding and POSILAC® on milk production and reproduction of dairy cows during 2 lactations. M. McGrath1, S. Betts1, C. Bilby2, R. Hintz1, E. Piunkett1, J. Vicini1, D. Armstrong1, J. Fetrow1, D. Galton4, J. Shereck1, C. Galton1, A. Smith1, M. C. Horst1, J. Fetrow1, J. Christiansen1, M. S. Gulay*, K. C. Bachman, M. J. Hayen, and D. R. Bray, University of Florida, Gainesville.

Extended voluntary wait (VW) and POSILAC (POS) were evaluated in 26 US herds. Primiparous (Prim, N=2331) and multiparous (Mult, N=1184) Holstein cows were studied in one complete lactation (L1). Prim cows from L1 that followed treatment protocol were also examined in the subsequent lactation (L2). Cows were assigned to a: 1) 60-d day VW with no POS (C60), 2) 60-d day VW with POS (P60), or 3) 160-d day VW with POS (P165). POS was administered per label (500 mg bST every 14 d (T 57-70 DIM to end of lactation). A 135-d day breeding period followed each VW. Testday milk (kg) was evaluated from 60 to 195 DIM (M1) or 195 to 315 DIM (M2). Persistency was evaluated
as the slope of declining production from 100 to 195 DIM (M3) and in M2. Total milk yield was greater in P60 and P165 vs. C60 for both parities (P<0.05) in M1 and M2 in both L1 and L2. Milk yield was greater in P165 vs. P60 (P<0.05) during M2 for both parities in L1 but no difference was detected in L2. P165 Prim and Mult cows were more persistent vs. P60 (P<0.05) in late lactation (M2) during L1. No significant difference in persistency was detected in L2. Milk production at dry-off (MPD) for Prim cows was greater in P60 vs. C60 or P165 (P<0.05). MPD was not affected by treatments for Mult cows. Days dry was shorter (P<0.05) for all P60 cows vs. P165 cows in both lactations. Days dry was not different for C60 vs. P60. Days to first insemination after the VW were less for P165 cows vs. C60 or P60 cows in both lactations and both parities (P<0.05). A greater percentage of P165 Prim cows became pregnant in the L1 breeding period vs. P60 Prim cows (P<0.01). There was no difference in percent pregnant between P165 vs. C60 Prim cows in L1 or among any of the Mult groups in L1 or L2. There was no effect of POS or delayed breeding on mastitis case rate.

Key Words: Delayed breeding, Milk production, Reproduction

611 Induced lactation: the need for enhanced mammary development and differentiation. B. A. Crooker*1, R. J. Collier2, J. L. Vicini3, M. F. McGrath3, and W. J. Weber1, 1University of Minnesota, St. Paul, 2University of Arizona, Tucson, 3Monsanto Agricultural Group, St. Louis, MO

Induction of lactation has the potential to increase farm profitability through retention of healthy reproductive culls for one or more additional lactations. Of the approximately 1 million dairy cows culled in the US due to reproductive failure each year, about half are healthy and in appropriate condition for another lactation. These potential culls would be retained if they were profitable. Methods to induce lactation have been described for more than 50 years and most utilize twice daily subcutaneous injections of 17β-estradiol (0.05 mg/kg BW/injection) and progesterone (0.125 mg/kg BW/injection) for 7 d with a secondary treatment such as dexamethasone (0.05 mg/kg BW/d). However, these methods have been plagued by considerable variation in the proportion of treated cows that actually produce milk and their subsequent milk yield. Recent efforts to improve the technique have included administration of bST during the induced lactation and inclusion of bST in both the induction treatment phase and subsequent lactation. Although these efforts have increased milk yield, variation in response and in yield relative to previous production remain greater than desired. Clearly the pregnancy and parturition dependent processes of extensive ductal and lobuloalveolar development, proliferation of alveolar cells, and terminal differentiation of these secretory epithelial cells is not mimicked adequately by current methods to induce lactation. More recent efforts to induce lactation have attempted to enhance mammary development and/or differentiation by intramammary infusion of mammogenic compounds. Results from a half-udder model indicate intramammary infusion of prostaglandin E2 either enhanced mammary development or differentiation which resulted in increased milk yield from cows induced to lactate. Continued refinement of this technology is required before it can be considered as a practical on-farm technology.

Key Words: Induced lactation, Mammary development, Differentiation

612 Energy density of pig diets: effect of energy evaluation system, technology and pig body weight. J. Noblet*1 and J. van Milgen1, 1INRA, UMRVP, Saint Gilles, France

The feed cost is the most important cost in pig production and energy represents the greatest proportion of this cost. Ad libitum energy intake depends on many animal and environmental factors in which feed energy density (or its chemical composition) play an important role. Under satisfactory protein supply, performance of animals depends directly on the energy supply. Finally, nutrient requirements must be expressed relative to energy intake in order, for instance, to take into account changes in the partitioning of energy gain between protein and lipid during growth. It is then important to express feed energy value on an appropriate basis. Both energy supply (a diet characteristic) and requirement (an animal characteristic) should be expressed using the same system. From that point of view, a NE system may be a good compromise. Energy density depends on the nutrient composition which differ markedly in GE content (23.0, 19.0, 17.4, and 18.4 kJ/g for CP, fat, starch (ST) and dietary fiber (DF), respectively). In addition, nutrient digestibility is variable so that the contribution of nutrients to DE supply in growing pigs ranges from 31.7 kJ/g for fat to 22.4 kJ/g for CP, 17.2 kJ/g for ST and only 3.2 kJ/g for DF. Nutrient composition also affects the metabolic utilization of ME: the ratio of NE to ME varies from 90% for fat to 82% for ST and 60% for CP. Consequently, the relative energy density of feeds for pigs depends on the energy system (DE, ME or NE). For instance, the energy values (relative to a conventional diet with corn, wheat, soybean meal and fat containing 14.2, 13.6 and 10.3 MJ/kg of DE, ME, and NE, respectively) of corn, soybean meal and animal fats are 100, 104 and 235 on a DE basis, 102, 99 and 244 on a ME basis, and 107, 79 and 289 on a NE basis. The existing confusion about energy systems is partly due to the existence of different NE systems and care has to be taken when combining values obtained from different systems. The energy density of pig feeds can also be affected by technology. For instance, pelleting increases markedly the fat and energy digestibilities in corn or full fat rapseseed. Finally, digestion of DF becomes more efficient with increasing BW with subsequent differences in energy density of feeds according to pig BW.

Key Words: Pig, Feed, Energy value

613 Is iodide responsible for the heat-relief effects of Ascophyllum nodosum? P. A. Eichen*1, M. J. Leonard1, M. A. Kozma1, B. M. Kronk1, L. E. McVicker1, D. E. Spiers1, and D. P. Colling1, 1University of Missouri, Columbia, MO, 2Acadian AgriTech, Kansas City, MO

Previous studies indicate that adding seaweed (Ascophyllum nodosum) extract (Tasco-EX®) to the diet results in decreased core body temperature (TC) in rats experiencing heat stress and feces toxicity. A rat model was used to test Tasco-EX (Acadian Seaplants Limited, Nova Scotia) versus ethylendiamine dihydroiodide (EDDI, International Nutrition, Omaha), at an iodide level equal to Tasco-EX (1215 µg I/g). Experiment I was designed to observe changes during each phase of treatment/temperature exposure. Diets contained no additive, 1% Tasco-EX or EDDI. Male rats (n=72: 372 g av BW) were maintained at thermoneutrality (TN; 21°C) for 5 days before treatment to record baseline feed intake and BW. Treatment diets were fed for seven days at TN, followed by exposure to heat stress (HS; 31°C) for 14 days, with a final seven days at TN. Body weight and feed intake were recorded daily. Six rats from each treatment were sampled for organ weight, and blood T3 and T4 at the end of each phase (four sample weeks). Experiment I was designed to look at Tc response to treatment/temperature. Male rats (n = 24; 288 g av BW) were implanted with telemetric temperature transmitters (Mini Mitter, Bend, OR) to record Tc and activity under conditions similar to Experiment I. At the end of week four, all rats were euthanized for determination of organ weights and blood T3 and T4 levels. Feed intake and weight gain were not different for any of the treatments. There were no T3 differences by treatment or sampling time. In contrast, T4 was lower in all treatment groups at the end of week three (P<.004), and was higher in rats receiving either Tasco-EX or EDDI (P<.007) compared to controls. Rats fed Tasco-EX or EDDI tended to have lower average daily Tc compared to control animals during HS. Average daily maximum Tc of rats receiving Tasco-EX was decreased below control level during a period of HS. These results indicate that dietary iodide is associated with some, but not all, responses to Tasco-EX.

Key Words: Heat stress, Seaweed, Telemetry
Dietary administration of seaweed (*Ascophyllum nodosum*) extract (TascoEX™) to cattle produces a reduction in core body temperature (Tc) during heat stress. The present study was conducted to monitor Tc of Angus steers on endophyte-infected tall fescue pastures, and determine if previous treatment with Tasco14™ meal could reduce the impact of fescue toxicosis. Cattle were implanted with telemetric temperature transmitters and fed daily either Tasco14 (1.0% DMI) or control diet for 48 days. They were then removed from the diets and, after 21 days, randomly assigned to either uninfected (E−) or infected pastures (E+). Hormonal measurements included Tc and ambient conditions (air and black-globe temperatures, percent relative humidity) during onset of summer heat stress (61 days). An early period of heat stress occurred at 15-19 days followed by a second longer period at 35-55 days. Relationship between Tc and air temperature (Ta) for the entire period was a second-order polynomial equation, with a 2-hour delay in Tc behind Ta (R=0.84; P<0.001). Weight gain on pasture was highest for E− control group (33.1 kg) and lowest for E+ control group (20.3 kg). Both Tasco14 groups exhibited intermediate weight gain (25.4 kg). The E+ group had higher Tc levels primarily during Ta increase (e.g., 15-19 days), with less evidence of a difference between E+ and E− groups over days of continuous heat stress. Evaluation of the first heat stress period showed that Tasco14 treatment reduced Tc response to Ta from E+ to E− level. Magnitude of the Tasco14-induced Tc reduction during this period was 0.3°C. Also, E+ control steers began to increase Tc at 12°C Ta, whereas E+ Tasco14 steers did not increase Tc until 17°C Ta.

These results suggest that pretreatment with Tasco14 meal treatment may produce a short-term reduction in Tc response to heat stress.

**Key Words:** Heat stress, Cattle, Fescue toxicosis

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**615 Effect of social regrouping and relocation on the hypothalamic-pituitary-adrenal axis and immune function of finishing beef steers. S. Gupta*, 1,2, B. Earley1, S. T. L. Ting1, 2, and M. A. Crowe2, 1 Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland, 2 Faculty of Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland.**

To investigate the effect of repeated regrouping and relocation (mixing) on the hypothalamic-pituitary-adrenal (HPA) axis and immune function, 72 Holstein-Friesian (14-mo-old; 441±7.2 kg) steers were randomly assigned to either control (n=30; C) or regrouped (n=42; R) treatments. C steers were housed in the same pen with the same pen-mates. The HPA-axis function, haptoglobin and concanavalin A (Con A)-induced in vitro interferon (IFN)-γ production were assessed 2 h before treatment, and 2 h after the first, third and sixth mixing. Median area under the plasma cortisol curve (AUC) was higher (P<0.05) in R than C steers after first mixing, with no differences among treatments after the third and sixth mixings. Over time, median values for cortisol AUC in R steers decreased (P=0.0001) following the third and sixth mixing compared with the first. However, median values for cortisol AUC in response to exogenous adrenocorticotropic hormone (1.98 IU/kg metabolic BW, follow- ing administration of 20 μg/kg BW of dexamethasone at -12 h) after the third mixing were not different among treatments. Similarly, there was no difference (P<0.01) in the cortisol AUC in response to exogenous bovine corticotrophin-releasing hormone (0.3 μg/kg BW) in C versus R steers after the sixth mixing. There were no differences (P<0.01) among treatments in haptoglobin and Con A-induced in vitro IFN-γ after the first, third and sixth mixing. In conclusion, social regrouping and relocation increased plasma cortisol immediately after the first mixing. The HPA-axis of steers repeatedly exposed to regrouping and relocation adapted with a reduction in cortisol secretion.

**Key Words:** HPA-axis, Social regrouping, Steers

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**616 Restaurant audits have maintained high standards of stunning and handling at beef slaughter plants. T. Grandin*, Colorado State University, Fort Collins, CO USA.**

From 1999 until the present, restaurant companies such as McDonald’s Corporation, Wendy’s and Burger King have been auditing stunning and handling at beef slaughter plants for animal welfare. This has resulted in great improvements in stunning and handling. To pass the audit, a plant must comply with the American Meat Institute guidelines at an acceptable level of performance. On a 100 animal audit, 95% or more of the cattle must be stunned with one captive bolt shot. 100% rendered insensible on the bleed rail, 75% moved without an electric prod and only 3% of the cattle vocalize during handling and stunning. Data collected prior to the restaurant audits indicated the following percentages of plants at the acceptable level were stunning 30%, insensibility 90%, electric prod use 43% and vocalization 43%. Four years of restaurant audit data (1999 to 2001) indicate an improvement in the percentage of plants at the acceptable level. For stunning, the percentage of plants passing the audit were 90%, 90%, 91% and 94%. Insensibility was 97%, 98%, 93% and 95%. Vocalization was 71%, 80%, 86% and 91%. Electric prod use was 76%, 67%, 76% and 82%. The number of plants audited was 1999, N=41; 2000, N=49; 2001, N=44 and 2002, N=57. Data from 2002 indicated that 54 plants that were experienced with audits all passed the stunning audit and only one had a partially sensible animal. Three out of four new plants did not know what was expected and they performed poorly. Two of these plants stunned less than 90% of the cattle with one shot. Plants that have good internal auditing usually perform better than plants which do not have internal auditing. On the 2001 audit, eight plants did not pass the audit. The percent of plants scored acceptable on stunning by three different auditors. There was no significant difference between auditors (Chi Square .077 p < 0.75).

**Key Words:** Restaurant audit, Stunning and handling, Beef

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**617 The pharmacological effect of small doses of naloxone on sexual exhaustion in white New Zealand male rabbits. V. O. Fuentes*, C. Villagran, R. Orozco, and J. J. Alvarez, 1 Centro universitario de los Altos, Universidad de Guadalajara.**

Rationale: Reproductive behaviour is modulated by endogenous opioids. The study of these neurohormones will give further information related to the control of reproduction. Objectives: To study the effect of small doses of naloxone in the sexually exhausted New Zealand male rabbit. Methods: Six young rabbits (6 to 12 months old) and six mature rabbits (14 to 20 months old) male rabbits were used. Three days prior to the start of the experiment, naloxone was administered through a subcutaneous implant of 8 mg. With a previous three day rest, male rabbits were first studied to find out how many females they were capable of mounting and ejaculating before becoming sexually exhausted. For this purpose oestrous females were introduced to the male’s cage and four minutes were given for mating to occur, whereas the female was replaced with a new oestrous female, this procedure continued until the male refused to mate with a new female. Results: It was observed that young rabbits mated 9 to 10 females and mature male rabbits mated 6 to 8 times to reach sexual exhaustion (p=0.002). After naloxone treatment young rabbits mated 11 to 12 females and mature rabbits mated 9 females to reach sexual exhaustion (p<0.001). 1 Conclusions: Naloxone treatment increased sexual activity in the male white New Zealand rabbits, giving further support to endogenous opioids as modulators of sexual behaviour.

**Key Words:** Rabbits, Sexual exhaustion, Naloxone
Behavioural and physical variation among cloned litters of pigs. G. S. Archer1, T. H. Friend2, J. Piedrahita2, C. H. Neivil1, and S. Walker2, 1Department of Animal Science, Texas A&M University, College Station, 2College of Veterinary Medicine, Texas A&M University, College Station.

A series of tests were used to quantify the variation in food preference, temperament, and time budgets of two genetically identical cloned Duroc litters (n = 5.4) and their matched naturally bred controls (n = 4.4). Food preference was determined for all pigs using apples, bananas, crackers, and carrots. Each food type was offered ten times per trial for two trials. To assess variation in temperament a Towel Test, Back Test and Pick-up Test were used. The Towel Test consisted of recording the average time for each pig to remove a towel from its head ten times in each of three trials. The Back and Pick-up Tests were conducted only on the second set of matched litters at 7 weeks of age. They consisted of counting the number of vocalizations and escape attempts each pig made during one-minute of restraint when held on its back and picked up by a person. Time budgets of the pigs were determined for three consecutive 24 h periods at three different ages using time-lapse video. Time spent lying in bedding, lying on concrete, standing, feeding, and play/fighting was quantified. An F-test was used to determine if any differences in variation between litters existed. The cloned litters were found to be similar or more variable (P < 0.05) than the naturally bred controls: in their preference for the foods in thirteen of the sixteen comparisons; in five of the eight comparisons during the Towel Test; in all four comparisons in the Back and Pick-up Tests; and in all ten of the comparisons in the time budget analysis. Physical variation among the clones was also observed: one clone had curly hair while the rest had straight hair, one clone developed hyperkeratosis while the others did not, and one clone had 13 teats and the rest had 14. These results indicate that environmental and epigenetic phenomena have major effects on the behavior and physical development of cloned pigs and question the feasibility of using cloning by nuclear transfer to replicate animals with specific behavioral or physical characteristics.

Key Words: Clone pig, Variation, Behavior

Effect of stressors on serum concentration of acute phase proteins and performance in pigs. C. Pinheiro1, E. Lorenzo1, J. Morales1, E. Gomez2, and G. G. Mateos3, 1PigCHAMP Pro Europa S.A., Spain, 2CPP Hontalbilla, JCyL, Spain, 3UPM, Spain.

Two trials were conducted to assess the effect of stressors on serum concentration of acute phase proteins (APP), pig-MAP (MAP) and haptoglobin (HPT), and performance of pigs. In trial 1 we studied the effect of room temperature in young piglets. A total of 208 piglets were allotted at weaning (21 d) into two identical rooms with eight pens of 13 piglets each. Room temperatures were reduced from 32 C at 28 d to 28 C at 40 d in the control group (CON) and from 26 C at 28 to 24 at 40 d in the cold room (COOL). From 40 to 60 d room temperature was identical for both groups. From 21 to 28 d of age COOL piglets grew less (73 vs 119 g/d; P = 0.0003) and had worse feed conversion (1.17 vs 2.05 g/g; P = 0.0003), than CON piglets, but the differences disappeared thereafter. From 21 to 28 d of age APP concentrations increased (0.74 vs 1.2 mg/ml for MAP and 0.22 vs 0.37 mg/ml for HPT at 21 and 28 d, respectively; P < 0.05). At 40 d of age APP concentrations decreased in CON group but not in COOL group (1.02 vs 0.75 mg/ml for MAP; P = 0.12 and 0.43 vs 0.10 mg/ml for HPT; P = 0.006 for COOL and CON groups respectively). In trial 2 we studied in growing pigs (74 to 116 d of life) the effects of feeding frequency on the same parameters. A total of 240 piglets were randomly distributed in 24 pens. The experimental treatments consisted of pigs fed ad libitum (AL) or disorderly (DIS). Total feeding rate constant in both groups. From 74 to 102 d of age, AL pigs grew more than DIS pigs (542 vs 482 g/d; P < 0.05) but no differences were observed at the end of the trial. Serum APP were higher for the DIS group than for the AL group (P = 0.004 for MAP and P = 0.001 for HPT). We conclude that stressors impair pig performance and that the differences may be the result of concurrent variations in plasma APP concentrations. The variation in serum concentration of Pig-MAP and HPT. When the stressors disappears pig compensate for the losses in performance and serum levels of APP return to basal levels.

Key Words: Stressors, Acute phase proteins, Pig performance

Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: productivity measures. J. McGlone1, J. Morrow2, and J. Smith3, 1Texas Tech University, 2USDA-ARS.

Eighty three Camborough-22 (PIC USA) gilts with known estrus dates were used to determine the effects of two penning systems (crates vs. pens of 5) and feeding system (drop fed vs. trickle fed) on reproductive performance. The four treatments were arranged in a 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period. Gilts with a known estrus date and a predicted next estrus date were randomly selected and moved from their acclimation group pen to their assigned treatment. Estrus detection, maintenance of pregnancy and litter performance measures were collected. Measures of behavior and physiology will be reported elsewhere. Overall farrowing rate was not different among treatments. However, more gilts were not bred (not detected in estrus) among penned (4.9%) than crated gilts (0.5%). Fewer gilts recycled after mating when in TRICK-Pen (15%) than in TRICK-Crate (25%), DROP-Pen (29.2%), or DROP-Crate (24.2%) treatments.
Other measures (mean SEM) not significantly influenced by treatments included: gilt body weights at breeding (135.5 ± 2.7 kg), farrowing (205.0 ± 2.02 kg) or weaning (189.4 ± 2.82), backfat thickness (11.05 ± 0.57), and per litter measures of pigs born alive (10.9 ± 0.61), pigs born dead (1.13 ± 0.28), piglet birth weights (1.7 ± 0.04 kg), number weaned (8.8 ± 0.57), pre-feeding behavior (83.7 ± 3.91%), piglet weaning weight (6.21 ± 0.14 kg) and shoulder lesions (scored 0-3 with 0 = no lesion; 0.53 ± 0.13). Overall reproductive rates and sow and litter productivity were similar for gilts in the four treatments. Differences in estrus detection and recycle rates after mating were probably due to ease of animal observation in the different systems. In conclusion, productivity of breeding and gestating gilts was similar in the four systems evaluated.

Key Words: Pig, Welfare, Housing

624 The effects of dietary sodium bicarbonate on abnormal behavior and heart rate in sows. J. N. Marchant-Forde*1 and E. A. Pajor2, 1USDA-ARS, 2Purdue University.

Many oro-nasal behaviors are considered to be stereotypic and abnormal and have been implicated as an indicator of poor welfare in swine. There is some evidence in other monogastric species to suggest that oral stereotypies serve a pH buffering function and reduce ulceration of the stomach resulting from restricted feeding practices. Stomach ulceration is prevalent in swine and a weak link between stereotypies and ulceration has been established. The objective of this study was to determine whether the incidence or types of oro-nasal behaviors were affected by dietary sodium bicarbonate. Sixteen sows housed in gestation crates were subjected to change-in diet for 2 wk of a 6-wk experimental period, with each animal therefore acting as its own control. During wks 1 & 2 and wks 5 & 6, all sows were fed standard commercial ration. During wks 3 & 4, all sows were fed a diet containing 2% sodium bicarbonate but identical to normal diet in other ingredients and total energy content. Behavior and heart rate were recorded on the middle day of each week from 0.5h before feeding to 2h after feeding and analysed to determine incidence and durations of oro-nasal behaviors and heart rate responses to feeding. Sows spent 46.2% of the pre-feeding observation period engaged in oro-nasal behaviors, increasing to 55.23% of the post-feeding period (P<0.05). The main pre-feeding behaviors were nose the floor (NC = 11.7%) and bar biting (BB = 11.6%). The main post-feeding behaviors were nose the floor (NF = 22.3%) and sham chewing (SC = 10.2%). The post-feeding durations of BB and NF were both lower after the diet contained bicarbonate (BB wks 1 & 2 = 330s, wks 3 & 4 = 166s wks 5 & 6 = 175s, P<0.01, NF wks 1 & 2 = 2010s, wks 3 & 4 = 1412s, wks 5 & 6 = 1140s, P<0.05), but the post-feeding incidence of nose the trough (NF) increased (wks 1 & 2 = 192s, wks 3 & 4 = 514s, wks 5 & 6 = 559s, P<0.01). The heart rate response to feeding was higher (p<0.01) in wk 4 (163bpm) than any of the other wks (151 bpm). The results suggest that the addition of dietary bicarbonate may affect both the performance of feeding-related stereotypic behaviors and the cardiac response to feeding. Further investigation is required to elucidate the mechanisms by which bicarbonate may be acting.

Key Words: Swine, Stereotypies, Well-being

625 Effect of housing systems on implantation in sows. L. Anil*, S. Baidoo, R. Walker, J. Deen, R. Morrison, and S. Anil, University of Minnesota, Saint Paul, Minnesota.

A study was conducted to evaluate the effect of housing systems during breeding and gestation in sows on subsequent reproductive performance in terms of piglets born alive, mummies and stillborn piglets. The 3 housing systems were: 1. Sows bred and reared for their entire gestation in stalls (TS, n = 87). 2. Sows bred and reared for their entire gestation in pens with electronic sow feeder (TP, n = 49) and 3. Sows bred and maintained in stalls for 28 days and then transferred to pens with electronic sow feeder for the rest of gestation (PS, n = 43). Analysis of variance was performed to compare the housing systems. The mean born alive varied significantly among the housing systems (TS 11.71 ± 0.27; TP 11.27 ± 0.27; PS 10.42 ± 0.28; P<0.01). The difference between PS and TP housing systems was not significant. However, significant differences (P<0.01) were found between the TS and TP and between TS and PS. Litter weight (kg) showed the same trend as that of born alive (18.33 ± 0.35, 16.77 ± 0.59 and 16.74 ± 0.58 for TS, TP and PS respectively with P<0.05). There was no difference among the groups in terms of farrowing rate, mummies and stillborn. Sows housed in stalls and pens during gestation are equally susceptible to factors causing stillborn and mummies and therefore, there was no difference among sows with respect to mummies and stillborn. There was no difference in farrowing rate among sows, as farrowing success is independent of litter size. The higher live born numbers in stall-housed sows indicates the beneficial effect of stall housing in reducing stress during the implantation period.

Key Words: Gestation, Implantation, Housing


Recently in the US there has been intense marketing interest in animal welfare and on-farm production guidelines. Multiple communications with the marketing sector indicate that animal welfare assurances may be transferred back to the producer. The National Pork Board’s (NPB) Animal Welfare Committee (AWC) has worked with an international panel of experts to develop a program by which pork producers can objectively assess pig welfare on the farm. The Gestating Sow Welfare Index was the first phase of this collaboration and concentrated on gestating sow welfare. The index was tested in early 2002 by animal and veterinary experts. Results were presented to the AWC who expanded the program to include the farrowing sow and the neonatal piglet, nursery and finisher pigs. It has been renamed the Swine Welfare Assurance Program (SWAP). Three sections of SWAP will assess swine welfare. The first is an evaluation of records, which assesses herd health and nutrition and caretaker training. The second is animal observations, which assesses regularity of animal observation, body condition score, euthanasia, and handling and movement. Third is an assessment of the facilities, which evaluates facility conditions emergency support and continuing assessment and education. SWAP was tested on farm in late 2002 and modifications and refinements to the program have been completed. SWAP Instructor Teams (SIT) will train Certified SWAP Educators (CSE) who will educate producers and provide assessments. SWAP will benefit producers by providing them with a voluntary, uniform, producer-developed tool to help maintain market availability or open up new marketing avenues if selling to a market that asks for information about animal welfare. SWAP can also help producers evaluate and track animal performance and welfare over time and identify weaknesses in management, nutrition or health programs before they become welfare and production problems. SWAP will also demonstrate the US pork producers’ commitment to the welfare of their animals.

Key Words: Assessment, Swine, Welfare

627 Factors affecting cow preference for stalls with different freestall bases in pens with different stocking rates. W. K. Fulwider* and R. W. Palmer, University of Wisconsin-Madison.

Stall use was monitored using a close circuit television system in a 4-row, 232 stall freestall barn. Stall status was recorded four times each day, 1400, 2000, 0400, and 0900h, for a 6-month period, 6/19/02 to 12/17/02. Two measures of cow preference, stall with cow lying or stall occupied (cow lying or standing in stall) were recorded. The objective was to compare percentages of cow preference measures for each factor affecting use of stalls with different freestall bases. Six factors were analyzed: freestall base, distance to closest water, stall location within a stall type section (End vs. No-TEND), row of stalls (INTERIOR vs. EXTERIOR wall side), inside barn temperature (TEMP), and length of time animals exposed to freestall bases (XPOS). One pen had a low stocking rate (LowSR, 65%), six different freestall bases, [cork-based mattresses-CMATR; foam-based mattresses, FMATR3, FMATR4; rubber-based mattresses RMATR2, waterbeds (WATR), and rubber mat (RMAT3), and cows were milked with a robotic milker. The other pen had a 100% stocking rate (100SR), seven different freestall bases [foam-based mattresses-FMATR1, FMATR2; rubber-based materials RMATR1, RMATR2; and rubber mats, RMAT1, RMAT2, and RMAT3, and cows were milked twice daily in a herringbone parlor. Each pen was analyzed separately because of different stocking rates. Freestall bases were grouped with 3 to 8 stalls/section and randomly placed in each row. Results show significant differences (P<.05) between pens for different freestall bases for lying and occupied. Stall usage for the 100SR side for lying was FMATR1 (62%), RMATR2 (59%), RMATR2 (57%), FMATR2 (52%), RMAT1 (51%), RMAT2 (43%), RMAT3 (42%), whereas, occupied was FMATR1 (58%), RMATR1 (54%), RMAT2 (52%), RMAT3 (57%), RMAT1 (73%), RMAT3 (65%), and RMAT2 (64%). Stall usage for the LowSR side for lying was FMATR3 (49%), FMATR4 (35%), and FMATR2.
Key Words: trointestinal tract development, differentiation, and function and can be turnover rate of the intestinal epithelium, some Caspase genes were sig-
that occurs in the wall of the rumen. In agreement with the high cell
intestines. This result is consistent with the high fatty acid absorbance
were over expressed in the rumen with respect to the small and large

The 99.9% bootstrap confidence interval limits of tissue
demonstrate the importance and benefits of modeling on-chip variation.
This approach allows the control of within-chip variation. To
is to replicate genes within array without increasing the number of ar-

Comparative and Functional Genomics, University of Illinois, Urbana, IL.

Scant information is available on the levels of gene expression in the
digestive system of cattle. A study was conducted to characterize tran-
script profiles in rumen, large intestine, small intestine and reference
tissues. The absolute intensities obtained from cDNA microarrays that included 76533 cattle and control sequences were used as indicators of the transcript levels. The experimental design included dye-swaps totaling six arrays and sequences were duplicated within array. Data normal-
ization included a LOWESS fit to remove dependencies between tissue effect and average expression level. The remaining variation was ana-
yzed using a linear mixed effects model including the effects of array,
dye, gene, and gene by tissue. A total of 218 sequences were significant at $P<10$ to the -6 power, of which 28 were significant at $P<10$ to the -9 power. The 99.9% bootstrap confidence interval limits of tissue contrasts indicated that 625 genes were expressed at different levels be-
tween large and small intestines, 448 were different between the large intestine and rumen, and 401 were different between the small intestine and rumen. Multiple sequences associated with fatty acid metabolism were over expressed in the rumen with respect to the small and large intestines. This result is consistent with the high fatty acid absorbance that occurs in the wall of the rumen. In agreement with the high cell

Key Words: Cattle, Digestive system, Microarray

629 Analysis of microarray data: are you better off by replicating genes or arrays? R. Rekaya*, The University of Georgia.

Maximizing information content of gene expression experiments is es-
tential for successful application of the technology. The way data is collected (design) and analyzed determines the information content of a study and the power of detection of true changes. Gene expression technology is still very expensive especially for animal agriculture appli-
cations. As a result, most expression experiments have less than a
decisive. Given the noisy data we are dealing with, such small num-
ber of arrays will have little power for detecting genuine changes. One
way of increasing power is to increase the number of arrays. However,
this option is not the most cost effective way. An alternative approach is to replicate genes within array without increasing the number of ar-

ays. This approach allows the control of within-chip variation. To
demonstrate the importance and benefits of modeling on-chip variation and compared with the simple approach of increasing the number of ar-

rays, a simulation study was carried out. A mixed linear model includ-
ing the fixed effect of treatment, a random effect for on-array variation at each gene with variance $\sigma^2_A$ and the residual term (between arrays variation) with variance $\sigma^2_R$ was fit to the normalized expression level. Three cases of within array replication where each gene was replicated 2, 4 and 8 times were considered. Also examined was the ratio of variance $R=\sigma^2_A/\sigma^2_R$ from 0.01 to 1. For each combination of number of on-chip replication and variance ratio, 50 datasets with 10 arrays and 200 genes were simulated. For small variance ratio (0.2), the power of the design with on-chip replication was 2.5, 3.6 and 3.9 fold greater than the de-

sign without gene replication. The difference in power decreases with the increase in $R$ and at $R=1$ they are equivalent. However, the rate of increase in power was obtained using 4 arrays with 4 on-chip replication and 10 ar-

rays without gene replication. Results indicate that on-chip replication is a cost effective way to increase power.

Key Words: Microarray, Power, Replicate

630 Normalization, replication, and significance tests in cDNA microarray experiments. G. J. M. Rosa*, R. J. Templeman, S. Suchyta, S. A. Madsen, J. L. Barton, and P. M. Coussens, Michigan State University, East Lansing, MI.

Spotted cDNA microarray experiments are being increasingly used in animal science to compare gene expression of tissues under different biologi-

cal states, such as different environmental stress conditions or a time course. These experiments generate large, complex, and noisy data sets, which must be appropriately analyzed for satisfactory mining of impor-
tant biological information. Several procedures have been proposed for normalizing the data regarding different kinds of biases and sources of systematic variation, e.g. intensity- or spatially-dependent dye biases. Also, a variety of statistical approaches have been suggested for the de-
termination of significant differences between mean expression signals. We apply and contrast some of these methodologies, using robust lo-
cal regression technique, ANOVA models and mixed model approaches.

Four microarray experiments are used to illustrate these methods and to
discuss their advantages and drawbacks. The experiments were con-
ducted at the Center for Animal Functional Genomics at Michigan State University, using a bovine-specific cDNA microarray system containing 3,888 total spots representing 709 bovine EST clone inserts, 345 am-
plicons of known genes derived from bovine sequence, and numerous blank and control gene spots. The first dataset derives from a self-self hybridization trial where the same tissue sample was arrayed with two fluorescent dyes, in a reverse labeling experiment. A second loop de-
sign experiment was used to monitor gene expression profile changes in blood neutrophils collected from cows multiple times as they proceeded through parturition. The other two experiments compare gene expres-

sions of peripheral blood cells from control and Johne’s disease positive cows. Special attention in the statistical analyses is given to spatial variability, the use of control genes for data normalization, bi-

ological replication, multiplex testing and the false positive rate. Some

suggestions for further research on the statistical treatment of microar-
ray data are outlined, including the use of mixtures and thick-tailed processes, and different alternatives for modeling heterogeneity of vari-
ances across genes and slides.

Key Words: Microarray, Normalization, Significance test

631 Accounting for genotyping errors in QTL analyses. G. J. M. Rosa*, Michigan State University, East Lansing, MI.

Construction of genetic maps and the identification of QTL should in-
volve genetic data of high fidelity. However, the rate of mistyping is considerable in most genotypic data, substantially reducing statistical power on detection of linkage between loci and associations between markers and phenotypic traits. Checks for genotyping errors are then crucially important prior to gene mapping analysis based on traditional statistical methods. Common strategies include comparison of duplicate samples, independent calling of alleles, and Mendelian-inheritance error checking. These strategies, however, are not able to detect all errors. A statistical approach that simultaneously infers upon genotyping er-
or rates and allows for the possibility of miscoded genotypes in QTL analyses is presented. The methodology treats observed marker geno-
types as a measurement function that links these vari-
ables (which include errors) to the actual (unknown) genotypes. The model includes an additional parameter, which describes the probabil-
ity of genotype miscoding. A Bayesian approach based on Markov chain Monte Carlo methods is adopted. Backcross data sets with 150 or 300 individuals, genotyped for 5 loci (including some missing data), and with recombinant rates between adjacent loci ranging from 0.01 to 0.15 were simulated. Miscoding probabilities were 0, 1, 3 and 5%. Anal-
yses were conducted ignoring or contemplating miscoding in the model.

Key Words: Freestall base, Cow preference, Stocking rate

the use of a combined approach for the detection of QTL in designed experiments of crosses between outbred populations.

Key Words: QTL analysis, Outbred populations


Sufficient variation in production traits exists in commercial populations of livestock to exploit allelic variation of superior animals to increase production efficiency and improve the quality of livestock products. Identification of predictive markers by constructing dense comparative maps with human and mouse genomes will allow identification of genomic regions that impact production traits in swine. Several quantitative trait loci (QTL) for important reproductive traits (age of puberty, AP; ovulation rate, OR; nipple number, NN; and plasma FSH, FSH) have been identified on the long arm of porcine chromosome 10, which by bi-directional chromosome painting has been shown to be homologous to human chromosome 10p. Because few anchored markers have been placed on SSC10, we wanted to increase the density of known genes that map to this region of the porcine genome. A total of 20 genes on human chromosome 10p were mapped to pig chromosome 10q and 7 genes from human 10q mapped to pig chromosome 14. Genes from human 10p represent 36 megabases (Mb) that correspond to 53 centimorgans (cM) of pig chromosome 10q with an average marker distance of 2.9 cM (2 Mb of human DNA). Gene order was highly conserved within these markers from centromere to telomere of porcine chromosome 10q, as compared to human chromosome 10p, with 1 large rearrangement along the center of 10q. The large gap in the pig map was 16 cM (104-120 cM on the pig map) corresponding to human 10p14 (8-11 Mb), a region which is very gene-poor in the human. The breakpoint for pig chromosomes 10 and 14 was at the centromere of human chromosome 10. Positional candidate genes were identified for AP (aldo-keto reductase, AKR1C), OR (cAMP regulatory element modulator, CREM), FSH (mammone receptor C1, MRC1) and NN (enhancer of polycomb, EPC1). Nucleotide variation in AKR1C, MRC1 and EPC1 is currently being evaluated in the multi-generation reciprocal backcross resource population as markers for quantitative traits.

Key Words: Genomic markers, Quantitative trait loci, Mapping

635 QTL mapping in extended halfsib families. N. Vukasinovic1 and M. L. Martinez2, 1Monsanto Animal Genomics, 2Embrapa – CNPGL.

QTL mapping in dairy species is usually conducted in presumably unrelated halfsib families, often resulting in imprecise estimates of QTL parameters. Including relationships among sires can improve precision of QTL mapping. In this study we compare sib pair linkage analysis that assumes unrelated sire families with a general pedigree approach that extends halfsib families by considering relationships among sires. Two base individuals were simulated and mated to produce 3 sons. The sons were randomly mated to 4 dams each to produce one male offspring per mating. These 12 sires were then mated to 25 dams each to produce one daughter per mating. The terminal generation included 300 individuals in 12 halfsib families. A 60cM chromosomal segment with equally distributed polymorphic markers was simulated. A 5-allelic QTL was simulated at 20cM or 40cM. The QTL heritability was 0.25. Only marker genotypes on all sires and daughters and phenotypes on daughters were assumed available for analysis. QTL mapping was performed using the random model approach in which phenotypic (co)variances between related individuals are functions of the proportion of alleles identical-by-descent (IBD) shared at a putative QTL. The IBD proportions within families in the standard halfsib analysis were inferred from genotypes at flanking markers. In the general pedigree analysis, the IBD proportions within and between families were obtained by a recursive deterministic method using the closest informative marker bracket. Maximum likelihood techniques were used to estimate QTL parameters. In the halfsib analysis, the 95% confidence intervals for QTL position were 14.6 to 41.4cM and 27.9 to 58.7cM for QTL located at 20cM and 40cM, respectively. In the general pedigree analysis, the corresponding 95% confidence intervals were 16.9 to 25.1cM and 41.6 to 48.4cM. The halfsib analysis, in contrast, resulted in likelihood ratio profiles showing little peaks and bumps, whereas the general pedigree analysis produced profiles with a clearly defined peak. The estimates of QTL heritability.
were 0.29 and 0.55 from the general pedigree and halfsib analyses, respectively. Considering relationships among sires is an efficient way to improve results of QTL mapping without considerable cost increase.

Key Words: QTL mapping, Pedigree, Simulation

636 Comparison of statistical methods used to analyze marker data from daughter design with selective genotyping. Y. Pan1,2, N. Caron1, G. B. Jansen3, E. B. Burnside1,2, and J. P. Chesnais1,3,4,1 The Semex Alliance, Saint-Hyacinthe, Quebec, Canada, 2L’Alliance Boviteq, Saint-Hyacinthe, Quebec, Canada, 3University of Guelph, Guelph, Ontario, Canada.

A daughter design (DD) was used to identify linkage between markers and QTLs. Selective genotyping can considerably reduce the cost of genotyping for a DD; however, it can result in biased estimates of allele substitution effects when simple regression methods are used. A simulation was carried out to compare three methods. They were maximum likelihood (ML: Lander and Botstein, 1989), mean difference between two marker genotypes (MD: Darvasi and Soller, 1992) and logistic regression (LR: Henshall and Goddard, 1999). Phenotypic measures were simulated for a typical trait in dairy cattle ($h^2 = 0.36, \sigma_p = 41.6$ kg).

Ten marker loci (3 to 10 alleles at each locus) and a QTL (2 alleles) located on one chromosome were simulated. The allele substitution effect was 0.0, 0.2, or 0.5 $\sigma_p$. Selective genotyping with equal and unequal proportions of daughters from each tail was used in a DD. Equal selection proportions were 0.50, 0.25 and 0.05 from each tail and unequal selection proportions were 0.30 (top) vs. 0.20 (bottom) and 0.06 (top) vs. 0.04 (bottom). The accuracy of estimation of allele substitution effects was evaluated as the deviation between estimated and true values. All three statistical methods (ML, MD and LR) provided similar means and standard errors of allele substitution effects when equal proportions were selected from each tail. Estimation errors ranged from 0.002 to 0.017 $\sigma_p$ in all cases. However, ML and LR methods performed slightly better than MD when unequal proportions of animals were selected.

Compared with LR using a SAS standard procedure, ML required much more computing resources. All three methods were suitable for analysis of marker data from selective genotyping in a DD.

Key Words: Statistical methods, Selective genotyping, Daughter design

637 Superiority of QTL-Assisted Selection in Dairy Cattle Populations with Nucleus Herds. G. A. Abdel-Azim1 and A. E. Freeman1, Iowa State University.

Two-stage selection of dairy sires, the conventional method currently in use, was applied to the simulated data as the reference or base-line scheme. As reported by several simulation studies, QTL-Assisted Selection (QAS) has been most useful in nucleus herds. However, stochastic simulation studies that investigated the superiority of QAS in nucleus herds often simulated small closed nucleus herds with simple selection and mating plans. In the current study, a juvenile hybrid nucleus herd scheme with a hierarchical mating design was simulated. The nucleus herd partially contributed to the group of young bulls tested in the current study. The contribution of nucleus herds to QAS superiority at plateau computed as percentage difference from QTL-Free Selection.

Key Words: QTL-assisted selection, Nucleus herd, Dairy cattle


The multiple chromosome genome scan approach to detecting QTL for production and conformation traits in dairy cattle has been gaining popularity as the number of documented microsatellite markers increases. This study reports on the use of microsatellite markers covering six chromosomes in a granddaughter design to detect QTL for production and conformation traits in 25 Holstein sire families. A total of 1,835 sons of 25 sires were genotyped for 54 microsatellite markers distributed across chromosomes BTA1 (12 markers), BTA3 (10), BTA9 (9), BTA10 (8), BTA14 (8) and BTA20 (7). The performance data for this study were the USDA production genetic evaluations (PTA) and the Holstein USA conformation genetic evaluations (STA) released in February 2002. Weighted least squares interval mapping was performed across and within sire families using a modified version of the software developed by S. Knott and C. Haley. Analyses were performed at one cM intervals separately for each trait. Permutation testing and false discovery rate were used to control type 1 error. The information content of the markers genotyped in this study ranged from 0.57 to 0.89 with most between 0.75 and 0.85. Six significant QTL effects were evident from the multiple size analyses for production traits. Evidence for a QTL for both PTA milk and PTA fat% was found on BTA14 (0 cM) and a QTL at 81 cM for PTA protein%. On BTA3 and BTA 20, there was evidence for QTL associated with PTA protein% at 26 and 41 cM respectively. Three significant QTL effects were evident from the multiple sire analyses for conformation traits. All three QTL were found on BTA10; a QTL associated with STA Strength was located at 43 cM, a QTL associated with STA Body Depth was located at 45 cM and a QTL associated with STA Dairy Form was located at 49 cM.

Key Words: QTL, Production, Conformation

639 Putative quantitative trait loci affecting perinatal survival in eleven Holstein families. P. J. Berger1, J. Koltes1, M. H. Healey1, M. S. Ashwell2, R. D. Shank3, H. Schlesser1, and H. A. Levin3, Iowa State University, Ames, IA, USDA-ARS-GEML, Beltsville, MD, University of Illinois, Urbana, IL.

Perinatal survival (PS) is a categorical trait expressed as the proportion of calves alive 48 h after birth. Recent estimates of predicted transmitting ability (PTA) for PS for elite Holstein sire families were used to identify putative quantitative trait loci (QTL) for PS. From 55 sire families with 50+ sons, 17 families were shown to have a bimodal distribution for PTA-PS; 11 of the 17 families had genotypic data. Full genome-wide scans were available for two of the 11 families. A total of 56 markers were from the USDA linkage map; 18 markers on BTA 6 and 16 markers on BTA 27. Data were analyzed using ANOVA in the granddaughter design, to identify significant marker-PS associations. Number of informative sons ranged from 38 to 285. Mean number of informative sons across all markers was 131; 115 for BTA 6 and 151 for BTA 27. Six markers, three each on BTA 6 and 27, had significant (P < 0.02) associations with PS. Suggestive of a major genetic component for PS, estimates of effects ranged from -0.45 to 0.28 % PS. Markers on BTA 9, 12, 14, 17, and 18 also exhibited significant associations with PS (P < 0.02), although this data was limited to two families. Estimates of effects for these markers ranged from -0.31 to 0.56 % PS. Distribution of the number of sons with alleles for significant markers was similar to the original bimodal distribution of PTA-PS. Evidence presented implies the existence of QTL linked to major genes affecting PS. Upon validation and fine-mapping, sires can be selected for PS based on the existence of specific marker information.

Key Words: Perinatal survival, Quantitative trait loci, Holstein dairy cattle

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A genome scan for chromosomal regions of bovine chromosome one (BTA1) influencing weaning weight (WT6), yearling weight (WT12) and postweaning average daily gain (PWADG) was performed using 112 half-sib progeny of 4 Japanese Black (Wagyu) sires and 98 microsatellite DNA markers. Identity-By-Descent (IBD) probabilities at specific chromosomal locations from multiple marker data were determined and a linear model containing the fixed effects of sex, parity and season of birth as well as sire as a covariate, was fitted to the IBD coefficients and phenotypic data. Data were analysed by generating an F-statistic by the regression of phenotype on the IBD probabilities of inheriting an allele from the sire. Permutation tests at chromosome-wide significance thresholds were carried out over 1,000 iterations at 1cM intervals while the bootstrap with resampling procedure was followed to estimate confidence intervals and average QTL locations. All these procedures were implemented in the QTLExpress computer programme with a web-based user interface (available at: http://qtl.cap.ed.ac.uk/). A significant QTL (P chromosome-wise threshold = 0.05) for PWADG was identified in Sires 2 and 3 located at 27cM and 29cM (95% confidence intervals of the QTL locations being 0-153cM and 0-125cM respectively). Another QTL for WT12 was identified at 113cM in Sire 2. No significant effect of WT6 was detected in any of the sires. Selection indices that include QTL with accurately estimated effects on carcass characteristics could reduce the amount of lengthy and costly data collection by providing a means of genetic evaluation early in the life cycle. Since PWADG is positively correlated with WT6 and WT12 in beef cattle, the identification of these QTL in Japanese Black Cattle holds a high prospect for the implementation of marker-assisted selection for the early attainment of slaughter weight in this breed.

Key Words: QTL, Japanese Black, Growth.

641 Different images of putative quantitative trait loci on BTA6 for correlated milk traits. G. Freyer1, P. Sorensen2, C. Kuehn1, and R. Weikard1, 1Research Institute for the Biology of Farm Animals, 2Danish Institute for Agricultural Science.

A number of publications based on various studies strongly suggest the existence of several putative quantitative trait loci (QTL) on the bovine chromosome 6 (BTA6) for the milk traits (Bovienhius and Schroten 2002). Further, they partly suggest equal QTL locations for different traits (e.g. Ron et al. 2001). The aim of our study was to investigate, whether previous findings of similar QTL positions for correlated milk traits are due to trait specific QTL or due to QTL with pleiotropic effects on several traits. For this reason, we applied a multivariate (co)variance component based QTL mapping method (Sorensen et al. 2003) to a data set involving five granddaughter families with 298 genotyped sons from the German Holstein cattle population. The marker map contained 16 microsatellite markers (according to Kuhn et al. 1999, extended) distributed across BTA6. The trait values (DYD and EBV) were provided by the VIT Verden. The multivariate-QTL approach (MTMQTL) is part of the DMU package, developed by the Danish Institute of Agricultural Sciences (DIAAS) and allows analysing several traits multivariately, and specifying five different genetic submodels. A chromosome-wise significance threshold was used, because BTA6 is known to harbor QTL for several milk traits. We received significant QTL findings for milk yield (between markers BM1329 and FBN12), for yields of protein and fat (FBN9 ... FBN13), and QTL for contents of fat and protein (BM1329 ... FBN12). The multivariate analysis resulted in a significant pleiotropic QTL finding for fat yield and protein yield. The estimates of variance contribution due to the QTL were 20% and 25%, respectively. For fat yield and fat content, a pleiotropic QTL seems to be likely, between FBN12 and TGLA37, but these results were not fully significant. Negatively correlated milk traits are likely affected by trait specific closely linked QTL on BTA6, e.g. 24 cM apart for protein yield and fat content, according to significant results. The confidence interval CI (95%) was computed as suggested by Darvasi and Soller (1997) and ranged from 8 to 13 cM, depending on the model, in significant cases.

Key Words: Milk traits, Multivariate QTL analysis, Pleiotropic QTL.

642 Using the internet for exchange of dairy genetic evaluations and research information for the dairy industry. A. H. Sanders*, F. A. Ross, and H. D. Norman, Animal Improvement Programs Laboratory, Agricultural Research Service, USDA.

The mission of the USDA Animal Improvement Programs Laboratory (AIPL) is to foster genetic improvement in dairy cattle. Practical improvement in production and profitability is achieved through the distribution of genetic evaluations used by the dairy industry to guide breeding decisions. Since 1997, evaluations have been distributed via the internet through the AIPL website (http://aipl.arsusda.gov) and FTP site (ftp://aipl.arsusda.gov). Data used to calculate evaluations is received via the FTP site from dairy record processing centers (DRPC), breed associations, and other industry cooperators. Between quarterly evaluations, 11.2 million individual animal updates, and 150,000 pedigree updates come from DRPC and breed organizations, respectively. Over 80 interactive tools assist cooperators and AIPL staff with data quality control, and access is customized by user group. Genetic evaluations are also available to the public via the website through 22 interactive queries. More than 20 quarterly or yearly reports are also available. Complete documentation of evaluation procedures is stored in the AIPL website. The user-accessible directory includes 377 Mb of data and information in 12,000 files. A full function search engine assists with site navigation. File metadata also facilitates indexing by outside engines. In 1997, the National Agricultural Statistics Service reported that 20% of all farms with over $100,000 annual sales had internet access. In 2001 that figure was up to 75%. In the second half of 2002, over 170,000 requests for bull evaluations and 67,000 requests for cow evaluations were submitted to the AIPL website. Evaluation access quadruples during the week following evaluation release. Links accessed within the AIPL website account for 74% of all website requests. Outside requests are from links on other sites 12% of the time, others coming from other parts of the website. Additional website enhancements include Spanish language availability and improved indexing. Planned improvements include more-dynamic database query tools, and user account control for industry cooperators.

Key Words: Internet, Information technology, Dairy genetics.

643 Effectiveness of presenting a national beef breeding management educational program via the internet. K. D. Bullock1, D. R. Strohbehn2, E. J. Pollak3, B. L. Golden4, J. K. Bertrand5, and D. E. Wilson2, 1University of Kentucky, Lexington, Kentucky, 2Iowa State University, Ames, Iowa, 3Cornell University, Ithaca, New York, 4Colorado State University, Fort Collins, Colorado, 5University of Georgia, Athens, Georgia.

There is a great demand for beef cattle breeding and genetics information from cattle producers and animal sciences students, however, with shrinking budgets at many Universities there is often a void in expertise. A national educational program was developed to provide resource materials and train Extension beef cattle specialists, other Extension personnel, beef science instructors, graduate students, breed association representatives and breed stud company representatives in all phases of beef cattle breeding management. Seven one-hour sessions were developed that covered the following topics: basic genetic principles; using Expected Progeny Differences (EPD); future EPD; multi-breed evaluations; economically relevant traits; incorporating genomics in genetic evaluations; and applying the technologies available. Each session was developed and presented by experts in the respective fields. A web-based system was used to deliver the program. The presenter and recipient participated from their remote location. After each session the presentation and audio files were available for downloading and a CD of all sessions was distributed to participants. Additionally, at the completion of the series a survey was administered to evaluate the content, method of delivery, and impact of the educational program. A total of 120 participants enrolled and 82% of the enrolled participants returned a completed survey. This represented 42% faculty, 6% graduate students, 36% county/area Extension agents, and
17% other. Forty-one percent planned to use the presentations to deliver educational programs to producers, 74% planned to develop their own slides from the material for producer educational programs, 32% planned to use the material to teach undergraduate courses and 68% planned to use the information for consulting clients. On a one to five scale from “Horrible” to “Excellent” the delivery method was rated 3.9 and the content was rated 4.1. Sixty-six percent thought the level of the content was “About Right”. The estimated impact was 6800 contacts, which does not reflect the 69% that did not complete the survey or those that plan to utilize the CD. In conclusion, this genetic management series delivered via a web-based system was effective in educating a large national audience at a minimal cost.

Key Words: Beef cattle, Education, Breeding

644 Use of a dairy whole farm nutrient balance education tool (Dairy WFN BET) to teach dairy producers and their advisers about nutrient management concepts at the whole-farm level. J. H. Harrison*, 1 T. Nemnich 1, J. Gillies 2, and C. A. Rotz 2, 1 Washington State University, 2 NRCS, USDA/ARS, University Park, PA.

All dairies in the state of Washington were required by law to have an approved nutrient management plan by July 2002. By December 2003, these nutrient management plans must be certified that the planned practices and structures have been implemented. In early 2003, we conducted a series of nutrient management workshops to assist dairy producers and their advisers better understand the factors affecting the whole farm balance of nitrogen. The goal was to encourage active use of their nutrient management plans as a part of their overall farm management. A spreadsheet based education tool was developed in Excel® to demonstrate whole farm concepts related to nutrient balance with a focus on nitrogen. The goals in developing the tool were: 1) to have it viewed on a single page (worksheet), 2) to require inputs readily available on most dairies, and 3) to be consistent with a planning program developed by NRCS to write nutrient management plans for dairies in Washington. The inputs required to simulate a farm were: herd milk production, number of milking cows, dry cows, heifers, dairy cows, and beef cattle, CP content of lactating cow rations, fertilizer import, land in forage crops, yield and CP content of forage crops, soil organic matter content, estimated losses of manure nitrogen based on storage system and manure application method, and nitrogen loss due to denitrification. Output of the analysis included the manure nitrogen available to crops and the whole farm balance of nitrogen. Specific management strategies were demonstrated with the education tool, which included diet reduction of CP, level of milk production, custom raising of heifers, crop yield, and manure application method.

Key Words: Environment, Nutrient management, Extension education

645 Development of an educational program to promote the performance of dairy farms in North-East of Iran. A. Naserian and T. Vafaa*, Ferdowsi University of Mashhad, Khorasan, Iran.

Khorasan state is second top of milk production in Iran, which produce more than one million ton milk annually.Holstein is the dominant breed which is kept. Extension Department of Agriculture Ministry, in order to promotion of performance of dairy farms strongly recommended to herd owners employee dairy graduated person. The short course was developed in response to the desire of dairy owners to increase the skills of their employees. Extension personnel consulted with dairy producers during meetings to identify training needs. Dairy specialist from university trained these skills. The objective of present study was to evaluate the effect of dairy graduated student manager and short course training in performance of dairy herds in Khorasan. Data were collected from different farms with different sizes, between 1996-2002. Dairy farms were divided between two main class a) Farms with dairy graduated students managers (T1=DGSM), b) without dairy graduated students managers (T2=W D G S M). Each class consisted of four herd sizes (40-60, 60-80, 90-110, 120-160). Data were analyzed using General Linear model. The design was completely randomized (unequal replicates) in a 2×4 factorial experiment. The results showed that herd size (P<0.0001) and the content was rated 4.1. Sixty-six percent thought the level of the content was “About Right”. The estimated impact was 6800 contacts, which does not reflect the 69% that did not complete the survey or those that plan to utilize the CD. In conclusion, this genetic management series delivered via a web-based system was effective in educating a large national audience at a minimal cost.

Key Words: Beef cattle, Education, Breeding

646 The south Texas “Cow Camp” program. R. L. Stanko 1, J. Ford 2, F. Escobedo 2, R. Mercado 2, B. Wymore 2, J. McManus 1, J. Lopez 2, R. Garza 2, H. Buehring 2, and J. C. Paschal 1, 1 Texas A&M University-Kingsville, Kingsville, TX, 2 Texas A&M University-Central Texas, South Texas, 3 Texas A&M University Cooperative Extension Service.

Building leadership for the future in the beef industry was the idea behind Cow Camp, a program developed and initiated in 1997 as a collaborative effort by south Texas Extension agents and Texas A&M University - Kingsville. The objectives of Cow Camp are to educate and build leadership skills of high school age youth interested in the beef cattle industry. Cow Camp was designed to provide an integrated, nutraceutically balanced, three-day beef cattle program which included university experience. The camp consists of classroom, live animal laboratory, range and wildlife habitat evaluation, computer interactive, and tour sessions. Sessions provide knowledge, background, and experience in the cow-calf, feedlot, packing, marketing, breeding and selection, reproductive management, and herd health segments of the beef cattle industry. Camp instructors include faculty, Extension agents and specialists, industry professionals, and regional beef cattle producers. Campers (n=94) were selected through an application process which has resulted in 19 ± 3 students selected per yr during the past six yr. Youth have ranged in age from 14 to 18 yr (mean = 16 yr) and have originated from 44 Texas counties. A variety of race, experience, and geographical region has enhanced the experiential learning at Cow Camp. Most campers (98%) have owned cattle themselves as a result of other beef production youth activities (4-H or FFA). The remainder of campers and their parents (2%) owned no cattle. The majority (97%) of campers planned on attending college and 90% planned on majoring in an agriculture field. Success indicators include: 1) number of program participants, 2) continued support of the sponsors and donors, and 3) enhanced (P< .05) comprehension of beef cattle management and the beef cattle industry as determined by pre- and post-camp exams. This program has been successful for six consecutive years and could serve as a model for other youth livestock programs.

Key Words: Beef cattle, Education, Breeding


A Spanish language milker’s school for Idaho dairy employees was developed in response to the request of dairy producers for educational opportunities for their employees. University of Idaho Cooperative Extension personnel consulted a dairy advisory board, consisting of producers and members of allied industry, to identify critical topic areas. The program consisted of 4.5 h of classroom teaching, and was held in Caldwell, Twin Falls, Preston, and Blackfoot, Idaho. Topics included udder anatomy, cow preparation and sanitation, milk letdown, milk removal and milking unit handling, mastitis, prevention of antibiotic residues in bulk tank milk, milking systems, and the role of the dairy industry in Idaho’s economy. All material was presented in Spanish. A 30-question test (true or false, fill in the blank, and multiple choice) covering various aspects of milking management was given to participants at the beginning and conclusion of the program. Fifty-six students completed the pre-

General knowledge exams have been conducted as a part of the activities at the Eastern States New England 4-H Horse Show, the conclusion of a year of work for most New England 4-Hers. Until now, the exams were graded and ribbons awarded based on score. In 2002, an extension specialist and an extension educator wanted to develop an exam that may determine strengths and weaknesses of the youth from states participating in an event. They planned to use these results to enhance program planning statewide. One hundred multiple-choice questions were placed into 10 categories with 10 questions in each category. Questions were randomized so that each category was dispersed throughout the exam. The test was administered to approximately 100 4-Hers. Exams were photocopied and the copies scored immediately at the show. The original exams were scored by Scan-Tron and data were evaluated. Information on name, birth date, number of years attending the event, discipline (hunt seat, saddle seat, western, or junior leaders), and state was gathered. An average score for each category was calculated. The final result for each category calculated as percentage correct revealed how the strength or weakness of the state was in that area of the exam. This information was distributed to each state leader with the recommendation that the information be dispersed throughout the state. It was hoped that these results could then be used to help determine topics to include when developing statewide events, such as a state workshop day. The use of a randomized, categorized exam should be considered when feedback on strengths and weaknesses is desired. This system may also offer a way to determine a 4-Her’s progress over time. This method, due to its simplicity and potential benefit to coaches, extension educators, extension specialists and 4-H youth, might also have potential for inclusion in hippology contests.

Key Words: Exam, Youth, Program planning

649 Arkansas 4-H dairy and meat goat conferences. J. A. Pennington*, University of Arkansas Cooperative Extension Service, Little Rock.

The Arkansas 4-H Dairy Goat Conference was initiated in 1994 at the request of dairy goat producers in the State. Topics included primarily management practices related to fitting and showing dairy goats which were presented at county fairs on Saturday in the spring. The next year, the conference moved to the Arkansas 4-H Center and topics were related to routine feeding and management in the morning and fitting and showing in the afternoon. In 1998, topics concerning meat goats were added, and the conference evolved into the Arkansas 4-H Goat Conference. In 2000 the conferences were split, and both dairy and meat goat conferences were conducted with the locations alternating yearly between northwest Arkansas and the 4-H Center in central Arkansas. Present topics include feeding, health, facilities, parasites, marketing and routine management plus fitting and showing. Youth are usually separated from adults for some sessions. Speakers are primarily Extension agents, industry personnel, and a scientist from Langston University. Participants in the conferences vary each year but are approximately 1/3 youth, 1/2 adults from industry and parents of youth, plus educators and speakers. Each year, a planning committee composed of goat breeders reviews comments from the previous year as they plan the program. Evaluations averaged 4.6 on a 5.0 scale last year and comments were positive, indicating that the conferences were well received by attendees.

Key Words: Dairy goat, Meat goat, Youth

650 Reducing catastrophic injury through helmet safety awareness. J. A. Nadeau1, E. A. McCabe-Alger1, and A. Bialczak2, University of Connecticut, Dept. of Animal Science, University of Connecticut, Dept. of Extension.

The Connecticut Helmet Safety Program was developed to increase awareness of helmet safety throughout New England, especially Connecticut. This program was funded by USDA Farm Safety funds. According to recent medical examiner reports, 60% or more of horse related deaths result from head injuries. Helmets can reduce this risk by 70-80%. The program began with development of a peer-reviewed brochure and a web site. The brochure highlighted important facts about helmet safety and was distributed at various horse-related events throughout the year. A web site was developed that features information on helmet safety, proper fitting and care of helmets, types of helmets available, and links to other horse related sites such as the University of Connecticut Animal Science department and horse specialist web pages. Additionally, age appropriate techniques of promoting helmet safety awareness were developed. The program developers also attended various equine events throughout the year, presenting information about helmet safety throughout distribution of brochures, showing the video “Every Time, Every Ride,” and sponsoring a drawing for helmets, “Every Time, Every Ride” videos and other prizes. In the future the program will target equine groups who have historically failed to adopt helmets as a necessary safety feature. The Connecticut Helmet Safety Program offers many ideas on how to promote helmet safety awareness to all horse owners. This program can be used as a model for use in other states. Training others to effectively disseminate information on behalf of program developers such as extension specialists and extension educators can enhance the scope and impact of important programs.

Key Words: Helmet, Safety, Program planning

651 Fish farmer certification: In-depth classes for producers of catfish or freshwater prawns. G. J. Burtle*, University of Georgia, Tifton, GA/USA.

Interest in alternatives to conventional farm crops is creating a demand for detailed instruction in fish farm management. Catfish culture and freshwater prawn culture are the most popular aquacultural enterprises in Georgia. Instructional programs were developed to teach catfish culture over three days and freshwater prawn culture over three days in order to provide information in-depth and allow for hands-on learning during each session. A certificate of completion was offered for successful completion of each course. Letters describing course content were provided as material for business plan documentation. The catfish course consisted of five Saturday sessions from January to June. The freshwater prawn course began on a Thursday in October, in order to demonstrate harvesting, and included Saturdays in November and December. The first session was devoted to economics of production and processing, harvesting and marketing topics. Lectures in subsequent sessions covered facility design and construction, nutrition, water quality, animal health, hatchery, and nursery topics. Laboratory activities included economic spreadsheet use, water analysis, fish processing, disease recognition, and hatchery techniques. These sessions were fee-based to limit participation to those in earnest and extension personnel were given substantially discounted rates. Enrollment was allowed on a session-by-session basis. The courses drew 14 students for catfish training and 17 students for prawn training. Students have utilized their training to start processing operations, develop investment proposals, construct fish farms, or determine that they were not prepared to enter the business. Extension personnel comprised 25.8% of the students and were willing to invest the time to learn more about aquacultural enterprises.

Key Words: Aquaculture, Catfish, Freshwater prawn

652 Comparison of IgG concentrations and total protein concentration in the blood plasma of newborn dairy calves. D. T. Vines*, R. Rodgers, A. B. Bodine, and W. C. Bridges, Clemson University, Clemson, SC, USA.

Previous studies at other laboratories suggest a relatively high regression coefficient for plasma IgG and protein when measured by a hand held refractometer. Jugular blood samples were collected from 2-4 day
post-partum Holstein and Jersey calves at the Clemson University Dairy. Plasma was collected following centrifugation and stored at -20°C until assayed. Protein values were determined by placing one drop (50 µL) on a refractometer window (Model RHC-200 ATC clinical refractometer, Westover Scientific) and reading value at g/100mL. IgG values were determined by a sandwich ELISA procedure using a monoclonal antibody against bovine IgG (Sigma Chem). Plasma samples were diluted at 1:2000 with PBS containing 0.2% ovalbumin. The data obtained were analyzed by regression procedure for correlation and by regression analysis. Mean values (n=148) for IgG was 1947 mg/100mL (S.E.=±4.7). Mean value (n=148) for protein was 6.13g/100mL (S.E.=±0.07). Mean IgG values (n=97) for Holsteins was 1889 (S.E.=±55.8) and for Jersey (n=51) was 2059 (S.E.=±86.2). Mean protein values (n=97) for Holsteins was 6.06 (S.E.=±0.09) and for Jerseys (n=51), 6.20 (S.E.=±0.13).

Data analysis by the above statistical procedures revealed an r value of 0.26 with extensive skewness at 2000 mg/100mL IgG. Within an assay there appeared to be a good positive correlation; increased protein similarly increased IgG. However, assay to assay variation was too great to result in an overall significant correlation between protein and IgG. In addition, comparison of refractometer protein readings to a standard protein analysis procedure could possibly suggest an insensitivity of the refractometer to major protein changes in plasma.

**Key Words:** IgG, Dairy calves, Refractometer

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### Growth & Development

#### 681 Effects of conjugated linoleic acid (CLA) and trans-18:1 fatty acids (TFA) on energetic metabolites and subcutaneous adipose tissue fatty acid composition.


Cornell University, Ithaca, NY

Finishing beef cattle (n=30, 359 to 60 kg BW), which were studied in an immune trial were also utilized in this experiment. Cattle were fed isonenergetic diets (steam-flaked sorghum based) supplemented (top dressed) with rumen protected (RP) palm oil (559 g/d; EnerGIt [EII]; control), RP TFA (594 g/d) or RP CLA (609 g/d) for 35d. Each treatment provided 475 g lipid/d and RP TFA consisted of 17.2% itallicizatrans-6, 8.7% trans-9, 8.8% itallicizatrans-10, 5.8% trans-11 and 7.3% itallicizatrans-12 C18:1 and the RP CLA contained 6.5% cis-9, trans-11, 5.4 % c/t-8, c/t-10, 8.25% c/t-11, c/t-13 and 7.9% itallicizatrans-10, cis-12 CLA. All bull calves were weighed and blood collected on d 0, 7, 13, 21, 28 and 35. Subcutaneous adipose biopsies were taken from the tail head on d 35. Overall, CLA supplementation decreased DMI (P = 0.04; 7.6, 7.4 and 6.1 kg/d for EII, TFA and CLA, respectively) and did not effect G:F or ADG. CLA supplementation tended (P = 0.10) to increase NEFA concentrations (196, 213 and 258 µmol/L) for EII, TFA and CLA, respectively) and this was not dependent upon time. Supplementing CLA reduced (P=0.04) plasma glucose levels (5.4%) compared to EII and there was not a trend x time interaction. Compared to EII cattle fed TFA had increased (P<0.01) concentrations of trans-6 (120%), trans-9 (113%), itallicizatrans-11 (30%) and trans-12 (62%) C18:1 fatty acids, but did not change itallicizatrans-10 C18:1 (54 mg/g fat) and also increased cis-9, trans-11 CLA (10 %). Irrespective of treatment the content of itallicizatrans-10 was 3.8 fold more than itallicizatrans-11 C18:1. CLA supplementation did not alter the trans-C18:1 profile but increased itallicizicic-9, trans-11 and trans- 10, cis-12 CLA content by 8 and 50% respectively. There was no treatment effect on total unsaturated fatty acid content (54%) or on theDeltaα-desaturase index (42.5%) or any of the specific Aα-desaturase ratios. These data indicate the Δα-desaturase system contributes to the cis-9, trans-11 CLA content in beef adipose tissue.

**Key Words:** CLA, Δα-desaturase

#### 682 Effect of conjugated linoleic acid on DNA fragmentation in cultured adipocytes.

K. M. Hargrave and J. L. Miner, University of Nebraska.

Dietary conjugated linoleic acid (CLA) causes body fat loss and DNA fragmentation in adipose tissue of mice. DNA fragmentation is an indication that CLA may cause apoptosis, either in preadipocytes or adipocytes. We recently reported that CLA promoted DNA fragmentation in cultured preadipocytes. The present study was designed to determine if mature 3T3-L1 adipocytes are susceptible to this effect of CLA. 3T3-L1 preadipocytes were seeded into 12-well plates with DMEM plus 10% cell serum, grown to confluence, and stimulated to differentiate with dexamethasone, IBMX, insulin, and fetal bovine serum. Differentiated cells were maintained in DMEM plus 10% fetal bovine serum for 7 to 9 d and then 0, 50, 100, or 200 µM linoleic acid (LA) or trans-10, cis-12 CLA, complexed to albumin (6.6:1), or 50, 500, or 1 mM staurosporine. Media were changed every 2 d. Cells were collected on d 2, 4, and 6 of treatment. Attached and detached cell number, DNA fragmentation, cellular triglyceride content, and glycerol content of media were determined. CLA did not increase DNA fragmentation compared to either the control or LA on any day. CLA, at the 50 and 100 µM doses, reduced (P<0.01) cell number on d 2 but not on d 4 or 6. LA and CLA did not alter cellular triglyceride content on any day. CLA also had no effect on glycerol content of the media. However, 200 µM LA increased (P<0.05) glycerol in the media on d 2 (790 vs 1370 µg for control vs 200 µM LA, respectively). Staurosporine reduced (P<0.05) total DNA on each day by 20 to 90% and appeared to increase DNA fragmentation on d 2. Additionally, 50 and 500 nM staurosporine reduced (P<0.05) cellular triglyceride content on d 2 by 24 and 65%, respectively, and increased the glycerol content of the media on each day, compared to the control. In conclusion, CLA did not cause an increase in DNA fragmentation in mature 3T3-L1 adipocytes. This indicates that the DNA fragmentation observed in fat pads of mice fed CLA may be attributed to preadipocytes and not to adipocytes.

**Key Words:** Conjugated linoleic acid, Adipocytes, DNA Fragmentation

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#### 683 IGF-I infusion alters gene expression profile of prepubertal bovine mammary parenchyma.


Insulin-like growth factor-I (IGF-I) stimulates proliferation of bovine mammary epithelial cells in vitro and in vivo. Our objective was to identify key genes that mediate the IGF-I mitogenic response in prepubertal mammary parenchyma. IGF-I was infused via the rumen canal into two quarters of six prepubertal Holstein heifers at 10 µg/quarter per d; other quarters received saline plus BSA. After 7 d, heifers were killed and mammary parenchymal tissue was collected. IGF-I increased the percentage of epithelial cells in the S-phase by 30%, as reported in a separate abstract. To date, gene expression profiles of total parenchyma mRNA from each cow were examined in DNA microarray using a bovine-specific cDNA microarray system containing 796 unique expressed sequence tags and 539 amplicons representing known genes. A loop design was used with cDNA from each quarter of each cow labeled with Cy3 or Cy5 dyes prior to microarray hybridization. Gene expression data were normalized for dye intensity using control genes. Significance levels of differential gene expression among treatments were assessed using a mixed model approach with the procedures LOESS and MIXED of SAS. IGF-I increased expression of several genes. Of particular interest, IGF-I upregulated nuclear receptor coactivator 6 interacting protein, an activator of the STAT3 pathway; beta-1,4-N-acetylgalosaminyltransferase IV, which influences cell cycle progression and susceptibility to apoptotic stimuli; MHC Ovar-DR-alpha, which interacts with the STAT1 pathway; and nickel-specific induction protein (Cap43), a marker for rapidly proliferating breast cancer cells. Expression of these 4 genes was increased 70 to 100% (P<0.008). We are currently evaluating the other 4 animals in the study, verifyng changes with real-time PCR, and employing laser capture microdissection to measure expression profiles of epithelial and stromal cell types separately. We conclude that IGF-I infusion into prepubertal bovine mammary glands induces changes in expression of genes affecting STAT signaling, mammary cell apoptosis, and cell cycling.

**Key Words:** IGF-I, Microarray, Mammary development

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**684** Leptin intramammary infusion alters the gene expression profile of prepubertal bovine mammary parenchyma. B. E. Etchebane,

Increased body fatness in prepubertal heifers is associated with impaired mammosogenesis. Leptin, a hormone produced by adipocytes, reduces proliferation of bovine mammary epithelial cells in vitro and in vivo. Our objective was to identify key genes mediating this inhibition. Leptin was infused via the streak canal into 2 quarters of 6 prepubertal Holstein heifers at 100 μg/quarter per d; control quarters received saline plus BSA or saline plus IGF-I. After 7 d, heifers were killed and mammary parenchymal tissue was collected. Leptin decreased the percentage of epithelial cells in the S-phase by 48% in IGF-I-treated and 19% in saline-treated quarters, as reported in a separate abstract. To date, the gene expression profile of total parenchymal mRNA from each quarter of 2 animals has been examined using a bovine-specific cDNA microarray containing 796 unique expressed sequence tags and 539 amlicons representing known genes. A loop design was used with cDNA from each quarter of each cow labeled with Cy3 or Cy5 dyes prior to microarray hybridization. Gene expression data were normalized for dye intensity biases using control genes. Significance levels of differential gene expression among treatments were assessed using a mixed model approach with the procedures LOESS and MIXED of SAS. Leptin upregulated 50 genes at P < 0.01; at least 30 of these had clear links to pathways mediating cell proliferation. The upregulated genes included 3 promoters of apoptotic dysfunction, 2 CCATF enhancer binding beta protein, and ribosomal protein S3A; 3 cell cycle regulators: nucleoprotein p62, ubiquitin-like protein NEDD, and protein kinase CDK9; several transcription factor regulators; and several cellular reorganization proteins, all with fold changes from 1.5 to 4.5 (P < 0.008). We are currently evaluating the other 4 animals in the study, verifying changes with real-time PCR, and employing laser capture microdissection to measure expression profiles of epithelial and stromal cell types separately. We conclude that leptin infusion into prepubertal bovine mammary parenchyma induces changes in expression of genes regulating apoptosis, cell cycling and transcriptional machinery. These molecular changes might help explain the impaired mammosogenesis of fat heifers.

Key Words: Leptin, Mammary development, Microarray

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**685** Intramammary infusion of leptin decreases proliferation of mammary epithelial cells in prepubertal heifers. B. E. Etchebane,
J.S. Liesman, M. S. Weber Nielsen, and M. J. VanderHaar, Michigan State University.

Excessive body fatness is associated with impaired mammosogenesis in prepubertal heifers. Leptin, a hormone produced by adipocytes, reduces IGF-I-stimulated proliferation of bovine mammary epithelial cells in vitro. Our objective was to determine if leptin also reduces proliferation of mammary epithelial cells in vivo before puberty. Recombinant ovine leptin (≥98% purity) was infused via the streak canal into two quarters of six prepubertal Holstein heifers at 100 μg/quarter per d with or without rhIGF-1 at 10 μg/quarter per d. The N-terminus of rLeptin was homologous to native oLeptin. Contralateral quarters were used as controls and received saline plus BSA with or without IGF-1.

After 7 d of treatment, bromodeoxyuridine (BrdU) was infused intravenously at 5 mg/kg BW, and heifers were killed 2 h later. Samples from three parenchymal regions (proximal, intermediate, and distal to the teat) were collected, fixed, sliced, and incubated with BrdU monoclonal antibody to identify cells in the S-phase of the cell cycle. Total number of epithelial cells and BrdU-labeled cells were quantified in three microscopic fields from each slide section so that 2700 cells were counted in each quarter. Leptin infusion decreased BrdU-labeling 48% in IGF-I-treated quarters (4.1 vs 7.9%, P < 0.01), and 19% (5.0 vs 6.2%, P = 0.01) in saline-treated quarters. Treatment effects were likely not associated with an immune response as we used sterile technique, mammary tissue was visually normal, and endotoxin was not detected in the infusates using a commercial kit sensitive to 0.006 ng/ml. We conclude that intramammary infusion of leptin inhibits proliferation of mammary epithelial cells in prepubertal heifers and completely blocks the stimulatory effect of IGF-I on mammary epithelial cells. These results suggest that leptin may mediate the inhibitory effects of high-energy intake on mammary gland development in heifers. If so, perhaps we can prevent nutritional impairment of mammosogenesis by simply managing body condition of young heifers.

Key Words: Heifer, Mammary development, Leptin

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**686** Compensatory growth during late gestation and its effects on metabolic status and health of transition heifers. M. S. Laubach,
D. B. Carlson, W. L. Keller, and C. S. Park, North Dakota State University, Fargo ND/USA.

Ten pregnant Holstein heifers averaging 499 kg of body weight and 60 d of gestation were divided into two treatments to determine if a stair-step gestational nutrition regimen affects metabolic status and lactation potential during the transition period. The control group was fed a diet containing 14.0% crude protein and 22.4 Mcal of ME per d for the entire 210 d of the trial. During the restriction period, the treatment group was fed a diet containing 18.5% crude protein and 14.5 Mcal of ME per d until d 180 of gestation; the diet was changed to 14.0% crude protein and 29.0 Mcal of ME per d for the realimentation period. Control heifers were restricted to less than 0.1 kg per d of gain during the restriction period. During realimentation, treatment heifers were allowed to gain 0.91 to 2.26 kg per d. Heifers were weighed for three consecutive days at the start, at 180 d of gestation, and within one wk before calving; BW was not different at initiation, at 180 d of gestation, or one week before parturition. Blood was drawn on d 14, 11, 9, 7, 5, 4, 3, 2, and 1 before parturition; within 3 h of calving; and on d 1, 2, 3, 4, 5, 7, 9, 11, and 14 after parturition to monitor glucose, insulin, triglycerides, NEFA, and the immune status. Glucose, insulin, triglycerides, and NEFA were not different between groups before or after parturition. Total leukocytes were significantly higher (P = 0.05) in the treatment group before parturition; however, after parturition there was no difference between groups. Milk production was not different (control, 8,571 kg; treatment, 8,453 kg). Milk fat percentage was increased in the treatment group (4.2% vs 4.1%, P = 0.05); however, milk protein percentage was the same in both groups (2.9%). The results suggest that compensatory growth during the last trimester of gestation does not affect the metabolic status of prepartum heifers or subsequent milk production.

Key Words: Heifer, Transition, Blood metabolites

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**Production, Management, & the Environment**

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**653** A system to characterize feeding behavior of dairy cows and feeding behavior of periparturient and mid-lactation cows. M. A. DeGroot* and P. D. French, Oregon State University, Corvallis.

The objectives of the following research were to develop a system to describe feeding behavior of group housed dairy cows and characterize feeding behavior of periparturient and mid-lactation cows. In experiment 1, 8 periparturient Holstein and Jersey cows were used to determine feeding behavior for the three weeks before and after parturition. Cows were group housed and fed individually via Calan doors. Behind each door was a feed tub that rested on a digital scale, equipped with an objective to identify genes mediating connectivity to a computer and a software program collected data, time, and weight events. Variables measured were meals/day, total meal duration/day, individual meal duration, daily DMI, DMI/meal, and meal efficiency (kg DM/min). Data were analyzed using the MIXED procedure of SAS. From 21 to 1 d prepartum, total meal duration decreased linearly (P<0.01) from 284 to 136 min/d, individual meal duration decreased linearly (P<0.07) from 32 to 17 min/d, DMI decreased linearly from 11.5 to 7.3 kg/d, and meal DM decreased linearly (P<0.01) 1.4 to 0.9 kg. From 1 to 21 d postpartum, total meal duration and individual meal duration increased linearly (P<0.05) from 100 to 278 min/d and 12 to 26 min/meal, respectively. Total meal duration was positively correlated with prepartum DMI (r=0.62) and postpartum DMI (r=0.80). Meals (10.2 meals/d) and efficiency (0.06 kg DM/min) were 38% lower in the 32 to 17 min/d group compared to the 32 to 17 min/d group during both prepartum and postpartum periods. In experiment 2, 8 Holstein and Jersey cows were used to characterize feeding behavior of mid-lactation cows (17334 days in milk). Overall, cows consumed 8.5 meals/d, total meal duration was 250 min/d, and efficiency was 0.09 kg DM/min. Daily DMI, DMI/meal,
and efficiency were greater (P<0.01) for Holsteins compared to Jerseys. Jerseys consumed more (P<0.05) meals/day than Holsteins. Results indicate that periparturient DMI is affected by the amount of time spent at the feed bunk. Therefore, strategies that increase individual meal duration may increase DMI during this critical period.

**Key Words:** Periparturient, Feeding behavior, Meals

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654 Effect of supplementing intensely grazed late gestation and early lactation dairy cows with chromium-L-methionine. M. A. Bryan1, M. T. Socha2, and D. J. Tomlinson2, 1Central Southland Veterinary Services Limited, Winton, Southland, New Zealand, 2Zinpro Corporation, Eden Prairie, Minnesota, USA.

Two hundred and thirty-two cows were assigned to a study to determine the effect of feeding 0 or 6.25 mg chromium/d from MicrOplex® chromium-L-methionine (Zinpro Corporation, Eden Prairie, MN) on lactation and reproductive performance. Cows received treatments from 6 weeks precalving through 21 weeks postpartum. Pre-calving, treatments were incorporated into a pelleted grain mixture and group-fed. Post-calving, cows received treatments via an individual oral drench once a day. Grazed herbage was the primary diet constituent for lactating cattle. Trial evaluators were blinded to treatment assignment until collection and analysis of data was completed. Blood was collected from a predetermined group of cows prior to and immediately after calving. Approximately every 6 weeks during the treatment period and at two timespoints following the treatment period, milk yield was recorded and samples collected for determination of composition. Chromium supplementation tended to reduce (P≤0.15) yield of 3.5% fat-corrected milk (FCM) and milk solids during the treatment period and tended to reduce 3.5% FCM yield over the entire lactation (P≤0.15). There was no effect of treatment on milk solids yield over the entire lactation. Chromium supplementation reduced plasma non-esterified fatty acid (NEFA) concentration (P<0.05). There was no effect of treatment (P>0.15) on plasma β-hydroxybutyrate or glucose concentrations. Chromium supplementation tended to reduce (P<0.15) percentage of cows open 48 days after the planned start of mating and days from calving to conception. Results indicate that chromium-L-methionine supplementation of intensely grazed, late gestation and early lactation dairy cattle tended to reduce lactation performance, reduced plasma NEFA concentrations and tended to improve fertility.

**Key Words:** Chromium, Lactating dairy cattle, Reproduction

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Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high concentrate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high conjugate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high conjugate wheat and corn diets when low levels of corn silage serve as the only roughage. Subclinical acidosis can be a problem on high conjugate wheat and corn diets when low levels of corn silage serve as the only roughage.


The objectives of this research were to determine the effect of an anionic supplement (AniMate®) on prepartum feed intake, periparturient plasma metabolites, and subsequent milk yield. Twenty-eight Holsteins and 20 Jerseys were blocked by expected calving date and assigned at random to one of two treatments beginning 28 days prior to expected calving date. Main effects were breed (Holstein or Jersey) and dietary cation-anion difference (DCAD; ±13 or ±23 meq/100 g DM). Negative DCAD was achieved through the addition of AniMate® (-712 meq/100 g DM) to the prepartum diet. Cows were individually fed a TMR once daily beginning 21 days prepartum and received a common TMR from parturition to 21 days postpartum. Data were analyzed as repeated measures using the MIXED procedure of SAS®. Prepartum and postpartum body weight and body condition score was similar for DCAD level. Three Jerseys receiving the positive DCAD diet were treated for milk fever after parturition. Urine pH was lower for cows receiving negative DCAD (6.2 vs 8.2; P < 0.05). Prepartum DMU was similar for DCAD level and postpartum DMU was greater for cows that received negative DCAD (16.0 vs 14.9 kg/d; P < 0.05). Holsteins that consumed negative DCAD produced more energy correct milk (46.0 vs 41.7 kg/d; P < 0.05) compared to Holsteins that consumed positive DCAD. Prepartum DCAD did not affect energy correct milk yield of Jersey cows. Plasma Ca was greater for cows receiving negative DCAD (7.7 vs 6.7 mg/dL; P < 0.05). Prepartum DCAD did not affect plasma β-hydroxybutyrate, glucose, or free fatty acids. In conclusion, negative prepartum DCAD increased postpartum DMU and energy corrected milk yield of Holstein cows through improved Ca balance after parturition.

**Key Words:** Cation-anion difference, Prepartum diet, Milk fever

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657 Effect of grazing growth rate on subsequent feedlot and carcass traits in cattle. J. J. Cleere1, A. D. Herring1, J. W. Holloway2, C. R. Long1, H. Lipke1, M. F. Mihm4, W. E. Pinchak5, F. M. Rouquette1, and B. G. Warrington3, 1Texas Agricultural Experiment Station, Overton, 2Texas A&M University, College Station, 3Texas Agricultural Experiment Station, Uvalde, 4Texas Tech University, Lubbock, 5Texas Agricultural Experiment Station, Vernon.

Braunvieh cross steers (n = 91) were assigned to various stocking rates at the Texas Agricultural Experiment Stations at Uvalde (UVL), Overton (OVT), and Vernon (VRN) to create different growth rates. Steers were stocked on TAM 90 annual ryegrass (RG) at UVL, Maton rye and RG at OVT, or TAM 202 wheat at VRN from January to May 2002. Cattle were placed on feed at the Texas Tech University Alltech research feedlot at termination of the grazing period to determine the influence of grazing growth rate (GGR) on feedlot and carcass traits. Steers were assigned to pens within location, stocking rate, and weight with 4 to 6 animals per pen. Animals were classified as very low (VL), low (LO), moderate (MD), highly moderate (MH), and high (HI) GGR groups based on ADG. Grazing period ADG was different between the VL, LO, MD, MH, and HI GGR groups (-0.01, 0.55, 0.77, 0.90, and 1.02 kg/d, respectively; P < 0.0001). The statistical model included GGR and location with initial grazing weight as a covariate. Initial feedlot weights were different between VL, LO, MD, MH, and HI steers (316, 366, 383, 397, and 406 kg, respectively; P < 0.01). Feedlot ADG was similar among the GGR groups with the exception of a difference (P = 0.02) between the LO and MD steers (VL = 1.73, LO = 1.81, MD = 1.65, MH = 1.72, HI = 1.68 kg/d). The VL steers had lighter hot carcass weights (HCW) than LO, MD, MH, and HI steers (302 vs. 338, 340, 354, 351 kg, respectively; P < 0.0001). The LO steers had lighter HCW than MH
and HI steers (P < 0.05) and MD steers had lighter HCW than MH and HI steers (P < 0.05). The VL steers were on feed longer than LO, MD, MH, and HI steers (113 vs. 111 d; P < 0.05). Adjusted fat thickness, kidney pelvic heart fat, marbling scores, and yield grades were similar among the GGR groups. The VL steers had smaller ribeye areas than the LO, MH, MD, and HI steers (Sat 79.9 vs. 89.1, 88.8, 88.1, and 90.0 cm², respectively; P < 0.01). Lower GGR steers had lighter HCW due to failure to compensate for differences in initial feedlot weight and GGR had a slight effect on carcass quality.

Key Words: Feedlot performance, Carcass, Beef cattle

659 Use of FEB-200® to increase productivity of cattle grazing fescue pasture. D. G. Ely1, D. K. Aaron1, J. Wyles1, and V. Akay2. 1University of Kentucky, Lexington, KY, 2Alltech, Inc., Nicholasville, KY.

Ninety-two Angus and Angus x Beefmaster cow/calf pairs were randomly allotted to nine, 10.5-ha KY 31 tall fescue endophyte-infected (>90%) pastures on May 1 in two consecutive years to evaluate the potential of FEB-200® (modified glucomannan, Alltech, Inc., Nicholasville, KY) to increase productivity. Three replicate pastures were randomly assigned each year to three treatments: CONT (control, no supplement); CS (corn supplement, 0.45 kg·hd⁻¹·d⁻¹ ground shelled corn); FEB (0.45 kg·hd⁻¹·d⁻¹ ground shelled corn + 4.4% FEB-200®). Initial cow and calf weights were taken on two consecutive days (May 1, 2). Cows averaged 5.2 yr, 511 kg, and 6.0 body condition score (BCS), and rectal temperatures of cows and weights of calves were taken at BCS, and rectal temperatures of cows and weights of calves were taken at various days (May 1, 2). Cows averaged 5.2 yr, 511 kg, and 6.0 body condition score (BCS) when the experimental period began each year. Interim weights, BCS, and rectal temperatures of cows and weights of calves were taken at 35-d intervals until weaning on September 17 (consecutive day weights, September 17, 18). Cow weight changes from May 1 to July 12 were not different. Cows consuming FEB gained more (P < 0.05) from July 12 to September 17 than CONT and CS cows (5.5 vs. -4.5 and -1.8 kg/hd). Changes in BCS were not different from May 1 to July 12. Cows in the FEB treatment maintained higher (P < 0.05) BCS than CONT and CS cows from July 12 to September 17. No differences in rectal temperatures were found. Overall (119 d), D. K. Aaron, J. Wyles, and V. Akay.

Key Words: Fescue, Cows, Calves


Eleven corn silage and nine haylage bunker silos from nine dairies located in New York state were evaluated to estimate the degree of variability occurring within bunker silos. Samples were collected on six dairies with a backhoe, on two dairies with a loader bucket, and on one dairy with a face remover. Sample collection was designed to reflect the feed that would be obtained if a feeder obtained a loader bucket of feed from a region (upper, middle, or lower) of the silo as compared to a bucket obtained from the entire height of the silo face. Silos above (n = 15) approximately four meters in height were split into thirds for sampling, while those less (n = 4) than approximately four meters were split into halves. Experimental feed within each section was thoroughly mixed and sampled for subsequent analyses. Within each silo, deviations from the minimum analytical result for DM, ADF, NDF, CP, and VFA were determined.

Haylage varied more than corn silage, although there were examples of extreme variation in DM in both crops. In some situations a feeder could be delivering an entirely different ration from one load of feed to the next if care is not taken in forage obtaining from the silo. Dairy feed personnel need to be aware of this variation, and of the difference it can make to the final ration delivered to the cow. Techniques to minimize forage variation, such as obtaining each bucket of feed from the height of the silo face or the premixing of forages obtained from across the entire face of the silo, should be part of feeding standard operating procedures on dairies.

Key Words: Forage variability, Bunker silos

661 Performance of market cows consuming hay and various levels of rice bran. D. W. Sanson*, S. M. DeRouen2, and D. H. Foster3, 1LSU Ag. Center, Rosepine Research Station, Rosepine, 2LSU Ag. Center, Hill Farm Research Station, Homer, 3U.S. Market News Service, Baton Rouge.

Ninety thin cows were purchased from area sale barns each of two years to evaluate the effects of different levels of rice bran in the diet. Cows were purchased during 3 to 4 weeks in late October and early November each year. After purchase, cows were transported to the Rosepine Research Station where they were weighed and scored for condition, treated for internal parasites, and identified with an ear tag. In Year 1, cows were fed one of four rice bran based supplements. Cows were fed 1.1, 2.3, 3.4, or 4.5 kg of rice bran daily in addition to hay free-choice. Supplements were formulated with cottonseed meal so that the supplements provided equal levels of protein. There were 2 replicates of each of the four treatments and the trial lasted 110 d. In Year 2, cows were fed rice bran at either 2.3 kg, 3.4 kg, or free-choice in addition to hay free-choice. There were 2 replicates of each of the three treatments and the trial lasted for 105 d. Cows were weighed on two consecutive days and scored for condition at the beginning and end of each trial.

Key Words: Rice, Cows, Bunker silos
On the last day of each trial, cows were transported to a local auction barn and sold. In Trial 1, cows that received the 3.4 or 4.5 kg of rice bran plus cottonseed meal gained (P < 0.05) more weight than cows that received 1.1 or 2.3 kg of rice bran plus cottonseed meal. Body condition score also tended to be higher for cows that received the higher levels of rice bran. There was no difference (P > 0.05) between weight gain of cows that received 3.4 kg of rice bran and those that received 4.5 kg of rice bran. There was no difference (P > 0.05) among treatments in the purchase price or the sale price. Average purchase price of the cows was $34.98 ± .4 per cwt and average sale price was $49.93 ± .9 per cwt. There was no effect (P > 0.05) of level of rice bran supplementation on weight gain or on the score change in Trial 2. Cows fed rice bran free choice had an average consumption of 5.2 kg of rice bran per head per day. Neither purchase price nor sell price was affected (P > 0.05) by supplemental treatment in Trial 2. The average purchase price was $35.80 ± .9 per cwt and the average sell price was $47.33 ± 1.5.

**Key Words:** Beef cow, Rice bran, Supplementation

662 Effects of calving date and weaning age on cow and calf production in the Northern Great Plains. E. E. Gringras*, R. E. Short, and R. K. Heitschmidt, USDA-ARS, Fort Keogh LARRL, Miles City, MT.

A 3-year study evaluated late winter (Feb), early spring (Apr), and late spring (Jun) calving systems (CS) on beef cow and calf performance. Crossbred cows were randomly assigned to 1 of 3 CS (avg n = CS-1, year-1 = 148) and 1 of 2 weaning times (Wean 1, 2) within each CS. Feb and Apr calves were weaned at 6-8 and Jun calves were weaned at 4-6 mo of age. Breeding by natural service occurred in a 32-d period that included estrus synchronization. Early weaned steers were housed in feedlots while half of the early weaned heifers grazed improved pastures and half were housed in feedlots. Early weaned calves were weighed on approximately the same day as late weaning. Weaning weight of calves adjusted to a constant date (October 19) was decreased (P < 0.01) as calving time became later (273, 229, and 181 kg for Feb, Apr, and Jun calves, respectively). Jun calves (203 kg) were lighter (P < 0.01) than Feb (224 kg) and Apr (221 kg) calves at 190 d of age. A CS x Wean interaction (P < 0.01) occurred for calf gains between Wean 1 and 2. Gains for early weaned calves averaged 0.71, 0.56, and 0.56 and for late weaned calves averaged 0.75, 0.47, and 0.56 kg d⁻¹ for Feb, Apr, and Jun, respectively. Between weanings, suckled cows gained less (Feb: Wean 1, 23.0 kg vs Wean 2, 6.0 kg) or lost more than non-suckled cows in all herds (P < 0.01). Cow weight change between Oct (Wean 1) and Dec (Wean 2) did not differ for Apr and Jun (-1.7 kg) non-suckled cows, but loss was greater for suckled Jun (-35.0 kg) than Apr (-15.4 kg) cows (CS x Wean interaction, P < 0.01). Time of weaning did not affect (P > 0.10) subsequent year’s cow or calf performance at weaning. Pregnancy rates (87.9%) were not affected (P > 0.10) by CS. Season of calving and weaning age have significant impacts on outputs from rangeland-based beef cattle operations.

**Key Words:** Beef cattle, Calving season, Rangelands


Forty crossbred steers (Brahman x English) were weaned at two ages, 1) early weaned (EW; n = 20), and 2) normal weaned (NW; n = 20). Calves averaged 89 and 300 d of age at the time of EW and NW, respectively. Early weaned calves were kept on-site and grazed on annual and perennial pastures until the time of normal weaning. During this time, EW calves were provided a commercial feed (16% CP) at 1.0% of BW daily. Upon NW, all calves were loaded onto a commercial livestock trailer and transported to the North Carolina State University Research Feedlot, Butner (1200 km). Upon arrival, calves were randomly allotted to 4 pens per weaning age treatment, such that each weaning treatment had measures of 6. As such two pens of steers calves. Individual calf BW and blood samples were collected at weaning, upon arrival to feedlot (d 1; 24-h following weaning), and d 3, 7, 14, 21, and 28 of the receiving period. Calves were offered a complete, corn silage-based receiving ration at rates to ensure ad libitum consumption. During the first 3 d, all calves were provided access to long stem grass hay. Feed intake by pen was measured daily. Blood samples were harvested from blood samples and analyzed for ceruloplasmin and haptoglobin concentrations. Early weaned calves were lighter (P = 0.03) at normal weaning than NW calves (223 vs 277 kg). By d 28, BW did not differ (244 vs 280 kg for EW and NW calves, respectively; P = 0.11). Overall, EW calves gained an average of 0.59 kg/d more (P = 0.02) than NW calves. Intake was similar (P = 0.36) between weaning ages (ADF: 5.3 and 4.9 kg DM for EW and NW, respectively). Feed efficiency was higher (P < 0.02) for EW than NW calves (FE = 6.4 vs 13.0). Ceruloplasmin concentrations increased in NW, but not EW calves, peaking on d 7 (27.6 and 34.2 mg/100 mL for EW and NW calves, respectively; P < 0.05). Haptoglobin concentrations increased in both groups and were highest (P < 0.05) in NW calves on d 3 (7.63 vs 14.86 Hpb/100 mL). These data suggest that early-weaned calves that are maintained on-site prior to shipping, are more stress-tolerant and productive during an initial 28-d feedlot receiving period.

**Key Words:** Calves, Weaning, Stress

664 Fertility and greenhouse gas emissions in dairy cows. P. C. Garnsly*, University of Nottingham, Loughborough, UK.

Dairy cows are estimated to account for 20% of methane and ammonia emissions worldwide. The aim of this study was to quantify the effects of fertility on gas emissions. Improved fertility increases mean annual milk yield per cow because a greater proportion of milk is produced in early lactation and the proportion of cows in their first lactation is smaller. Increased milk yield means higher feed intakes and production per cow. On the other hand, improving fertility means fewer replacements are needed, thereby reducing emissions. A model constructed to calculate combined emissions from cows and their replacements. Heat detection (HD) and conception rate (CR) were used in a decision tree to calculate pregnancy probabilities for a Markov chain that determined calving intervals, herd structure and replacement rate. NRC equations were used to calculate nutrient intakes, which determined methane and ammonia emissions. Annual milk yield was set at 10,000 liters for a cow in second lactation, with a 15% reduction for first lactation and a 10% increase for third and subsequent lactations; days to first service was set at 75 and TMR feeding was used for all cows and heifers. Using values of HD 40% and CR 30%, methane and ammonia emissions per 100 cows (plus replacements) were 19.3 and 5.1 t/yr respectively, equivalent to 20.6 and 5.4 g/l milk. A modest improvement in fertility (HD 50%; CR 50%) decreased emissions to 17.4 and 4.5 t/yr (17.0 and 4.4 g/l). Good fertility levels (HD 70%; CR 60%) gave emissions of 16.8 and 4.3 t/yr (15.5 and 4.0 g/l). At the low level of fertility (HD 40%; CR 30%), replacements accounted for 30% of herd emissions; at good fertility levels (HD 70%; CR 60%), replacements accounted for 10% of herd emissions. These results demonstrate the impact of fertility on greenhouse gas emissions from dairy herds. Moving from low to high fertility status can reduce herd methane and ammonia emissions by 13 and 16% respectively, which equates to a 25% reduction per liter of milk.

**Key Words:** Dairy cows, Fertility, Environmental emissions

665 Early detection of a change in pregnancy rate with control charts. A. de Vries*, University of Florida.

The objective of this study was to estimate the average time to detection of a true change in pregnancy rate monitored with statistical process control charts. Pregnancy rate is an important measure of the success of a reproductive program. An unexpected true change needs to be detected soon, but the rate of false alarms should be kept at an acceptable level. The performance of control charts, measured as the average time to signal (ATS), is the time between false alarms when only normal variation is present (ATS0) or the time to first detection of a true change in pregnancy rate (ATS1). A stochastic dynamic simulation model was used to simulate daily performance of cows over time. Default estrous detection efficiency (EDF) was 65% and default conception rate (CR) was about 0.40. Pregnancy checks resolved all inseminations 42 days after breeding. Five scenarios were simulated (n=400 runs): no change (scenario A), decrease in EDF to 55% (B), decrease in EDF to 35% (C), 25% decrease in CR (D), and both a 25% decrease in CR and decrease in EDF to 45% (E). Period lengths were 1, 3, 7, and 21 d. Herd sizes were 190 and 1000 cows. Control charts used were a Shewhart chart, a binomial cusum chart, and a non-parametric cusum chart. Control limits were set such that the ATS0 were near 365 or 730 d. Additionally, traditional 3-sigma limits were used for the Shewhart chart. Three-sigma limits on the control charts were set to 90% confidence levels. More than a 25% decrease in CR and decrease in EDF to 45% (E). Period lengths were 1, 3, 7, and 21 d. Herd sizes were 190 and 1000 cows. Control charts used were a Shewhart chart, a binomial cusum chart, and a non-parametric cusum chart. Control limits were set such that the ATS0 were near 365 or 730 d. Additionally, traditional 3-sigma limits were used for the Shewhart chart. Three-sigma limits on the control charts were set to 90% confidence levels. More than a 25% decrease in CR and decrease in
period lengths decreased ATS_0 significantly, but not ATS_1. Binomial cumulus charts with period lengths of 3 days detected true changes in pregnancy rate in general earlier than any other design or chart. For the 100-cow herd, ATS_1 (ATS_0 = 365 d) were 273 (B), 104 (C), 212 (D), and 106 (E) d. ATS_1 (ATS_0 = 730 d) were 422 (B), 127 (C), 332 (D), and 127 (E) d. For the 1000-cow herd, ATS_1 (ATS_0 = 365 d) were 130 (B), 53 (C), 78 (D), and 53 (E) d. ATS_1 (ATS_0 = 730 d) were 172 (B), 57 (C), 93 (D), and 57 (E) d. Binomial cumulus charts should be considered when early detection of a true change in pregnancy rate is important.

Key Words: Statistical process control, Monitoring, Pregnancy rate

666 Weaning at the onset of the breeding season fails to improve hind performance traits in Red Deer. R. D. Rankel, S. A. Mozek, D. A. Neuenhoff, and A. W. Lewis, Texas A&M University Agricultural Research & Extension Center, Overton, Texas USA.

Suckling stimulus suppresses rebreeding performance in beef cows. This experiment was designed to determine if performance of Red Deer females was similarly altered. Twenty two lactating Red Deer cows were randomly assigned to be weaned (W; n=11) or suckled (S; n=11) from September 25 (time of introduction of the breeding male) through November 20 (end of breeding season) with half of each group in one of two breeding pastures. Body weight, body condition score and a blood sample for progesterone analysis by RIA were collected at weekly intervals from September 4 through November 20. Body weights of the fawns were collected from September 25 (1st weaning date) through November 20 (2nd weaning date). All hinds were maintained on Coastal Bermudagrass pastures and supplemented with .91 kg/hind/d of 2:1 ground corn:soybean meal and Coastal bermudagrass hay as needed. Weaned fawns grazed Coastal bermudagrass pastures overseeded with ryegrass and were supplemented with .45 kg/fawn/d of 2:1 corn:soybean meal. The fertile males were equipped with marking harnesses and the females were examined daily for estrus activity. Pregnancy was determined by ultrasonography 45 d after ending the breeding season. Weaning of the fawns on September 25 failed to improve ADG (W = -.11 ± .02 kg/d; S = -.12 ± .02 kg/d) or body condition (W = .02 ± .24; S = -.18 ± .24 units) of the hinds during the breeding season (P > .10). Pregnancy rates were identical (100%) in W and S hinds. Days from beginning stag exposure to conception were 15.4 ± 3.5 d in W compared with 21.6 ± 3.5 d in S (P = .23). Fawn ADG during the 56 d period of the breeding season was not different between W (.972 ± .012 kg/d) and S (.974 ± .011 kg/d). The hinds with all fawns gaining at similar rates. Early weaning failed to improve performance in the Red Deer female with 100% of each group conceiving during the 56 d breeding season. This may be related to the strong seasonality and possible male effect from the stag.

Key Words: Red Deer, Suckling, Reproduction

Ruminant Nutrition: Metabolism - modeling


The maximum efficiency of microbial growth in the rumen is a function of dilution rate (DR). The Beef NRC calculates microbial efficiency (MOEFF) based on the maintenance rate of the bacteria, the digestion rate of a feedstuff, and the theoretic maximum yield of the bacteria. The purpose of this study was to compare the experimentally determined MOEFF to the Beef NRC model prediction and a prediction calculated using particular passage rate (PPR). Four ruminally fistulated and duodenally cannulated crossbred beef steers (591 ± 39 kg) were used in a 4x4 Latin square design. Treatment diets were pelleted, contained 77 % ground corn, 15 % cottonseed hulls, 0.4 % urea, and differed in source of supplemental protein. The diets contained 1) 7.4 % soybean meal (SBM); 2) 5.4 % fishmeal (FM); 3) 3.8 % bloodmeal (BM); or 4) 7.4 % corn gluten meal (CGM). Treatments were formulated to be isonitrogenous and isocaloric. Treatments had no affect (P > .05) on dry matter (DMI) or nitrogen (N) intake, apparent total tract dry matter digestibility (DMD), true DMD, PPR, MOEFF (expressed as g bacterial N/kg organic matter truly fermented), ammonia-N, or VFA concentrations. The experimentally determined PPR was used to calculate MOEFF, which was not significantly (P > .05) different from the measured MOEFF. The Beef NRC predicted MOEFF was greater (P < .07) than the measured MOEFF. Using PPR to predict MOEFF more accurately estimated MOEFF than did the Beef NRC model.

Key Words: Microbial efficiency, Dilution rate, Beef NRC

668 Effect of RDP and roughage level on microbial efficiency in continuous culture. C. A. Willis* and M. S. Kerley, University of Missouri-Columbia.

Feeding strategies can manipulate the rumen environment to control volatile fatty acid (VFA) production and potentially alleviate the need for roughage in the diet. Six diets were evaluated using a continuous culture system to determine the effects of high or low rumen degradable protein (RDP) level with or without roughage on VFA production, digestibility, and microbial efficiency. All diets were corn-based, either able protein (RDP) level with or without roughage on VFA production, diet efficiency calculated. The high RDP treatments resulted in higher VFA concentrations as compared to their low RDP counterparts (P < .01). Microbial efficiencies were greater for high RDP treatments versus low RDP treatments (P < .01). Diets that did not contain the 15% hay had significantly improved microbial efficiencies (P < .01). RDP level can be used to control organic acid production which could potentially reduce problems associated with feeding a 0% roughage diet. Removing roughage from the diet unexpectedly improved microbial efficiency.

Key Words: Microbial efficiency, RDP, No-roughage

669 Measuring ruminal pool size and duodenal flow of protozoal N using real-time PCR. J. T. Sylvester*, S. K. R. Kannati, M. L. M. Lima, J. L. Firkins, J. M. Morrison, 1The Ohio State University, Columbus, OH, USA, 2Universidad Federal de Goiás, Goiânia, GO, Brasil.

Studies evaluating the effects of protozoal ecology on ruminal N recycling and microbial N flow have been limited by availability of a protozoal marker. Current procedures have been either too laborious, not specific to protozoa, or have needed by-difference calculations using multiple markers with their own potential errors. The current objectives are 1) to evaluate a molecular-based assay using the 18S rDNA gene as a protozoal specific marker and 2) to report rumen N pool measurements and protozoal N flow predictions from two cows fed low (LF; 16%) or high (HF; 21%) forage NDF. Rumen pool size was determined from the average of two evacuations; duodenal DM flow, by INDF; and liquid dilution rate (LDR), from a pulsed dose of Li Co-EDTA. Rumen and duodenal samples were composited over 4 d. Rumen samples were quantitatively fractionated for protozoal enumeration and for enrichment of protozoa followed by DNA extraction. Ciliate protozoal specific PCR primers were used to amplify a 1.5-kb fragment of the 18S rDNA gene by conventional PCR for each sample and quantified for use as a standard. A second set of internal primers was used to amplify an approximate 300-bp fragment using real-time PCR to quantify the rDNA copies (i.e., amplicons) present in each ml of sample. Rumen protozoal N pool predictions were determined gravimetrically (i.e., protozoa/ml x ruminal fluid volume) and by multiplying the pool size or duodenal flow of rDNA copies x N/copy ratio of enriched protozoa. The bacterial N pool size and duodenal flow were determined by subtracting protozoal purines from the total purines [protozoal N x (purine/N in enriched protozoa)]. More replications are needed for further verification of the molecular method.
Two in vitro experiments (Exp. 1 and Exp. 2) were conducted to determine the effects of urease-containing feed sources on ruminal urease activity and fermentation traits. In Exp. 1, the traditional titration and the spectrophotometric assays were prepared in assessing urease activity of different origin of soybean products. The result showed that mean variations of urease activity for high activity samples were similar between two assays, whereas the variation for low activity samples was smaller (P > 0.05) with spectrophotometric assay than titration assay. Using the latter assay, some feeds and rumen fluid samples available in the laboratory were ranged according to their urease activities: dehulled soybean > whole soybean > rumen fluid > soy hulls > alfalfa hay. In Exp. 2, the effects of addition of urease-containing feed source on ruminal urease activity and ruminal fermentation traits were investigated using an in vitro gas production experiment. Raw soybean seeds meal and deactiivated soybean seeds meal were mixed at ratio of 0%, 33%, 67% and 100%, and used as substrates of rumen fermentation. The incubation was lasted for 12 h. During incubation, urease activity for 0% raw soybean maintained smooth levels, while the activities for 33%, 67% and 100% raw soybean samples decreased with progressed incubation time. During the first 8 h incubation, urease activities at all time points were significantly different among four treatments (P < 0.001), suggesting a linear (P = 0.001) decrease in ruminal urease activity with incrementatal levels of raw soybean seeds. However, when incubation lasted up to 10 h, ruminal urease activities were almost kept equal levels for four treatments (P = 0.29). As raw soybean inclusion level increased, theoretically maximum gas production decreased (linear; P = 0.004) and gas producing rate increased (linear; P = 0.001). The inclusion of raw soybean seeds had no effect on digestibility of DM, pH values, NH₃-N concentrations and individual VFA profile (P > 0.06).

**Key Words:** Urease activity, Rumen fermentation, Raw soybean seeds

671 **Nutritional improvement of rice husks.** J. Vadiveloo, MARA University of Technology.

The objective of the study was to ascertain if the nutritional value of rice husks could be improved by chemical or biological means for feeding to ruminants. Ground and whole husks were treated with 4% urea or 4% NaOH solution for 21 days at room temperature. Samples were dried to constant weight at 60°C and analysed for total ash (TA), neutral detergent fibre (NDF), ash insoluble in neutral detergent solution (IA), crude protein (CP) and in vitro dry matter digestibility (IVD). Untreated husks served as a control. Ground and whole husks were fermented by the edible fungus, *Pleurotus sajor-caju* without a nitrogen supplement (U), with palm kernel cake (PKC) or rice bran (RB) at 200g supplement/kg substrate or urea (UR) at 100g supplement/kg substrate. Standard mineral solution was added to achieve a moisture content of 70%. After incubation for 10 days, the PKC treatment reduced NDF from 84% to 73%, IA from 7% to 5%, increased IVD from 16% to 29% but did not improve CP (5%). The RB treatment reduced NDF from 73% to 68%, IA from 6% to 5%, increased IVD from 23% to 34% and CP from 4% to 7%.

Pre-treatment with NaOH may not be practical because of cost and difficulties in handling. Solid-state fermentation retained organic matter and improved digestibility and protein content (U and RB treatments) or digestibility only (PKC treatment). Refinements in fermentation conditions may elicit further improvements in nutritional value.

**Key Words:** Rice husks, fermentation

672 **Does level of dietary protein inclusion influence the ruminal degradability of the protein.** L. R. Leggett* and M. S. Kerley, Department of Animal Science, University of Missouri, Columbia.

This experiment was designed to test the effect of undegradable protein (RUP) inclusion rate on ruminal degradable protein. Five ruminally and duodenally cannulated steers were used to measure site and extent of digestion. The five diets were basal (B) with no supplemental protein, basal + 2.4% blood meal (BM-L), basal + 4.8% blood meal (BM-H), basal + 4.3% soybean meal (SBM-L) and basal + 8.6% soybean meal (SBM-H). The BM-L and SBM-L diets were formulate to be isonitrogenous; likewise, BM-H and SBM-H were isonitrogenous. The experiment consisted of five, 10-d experimental periods, including a 7-d acclimation period followed by 3 d of sampling for each period. Steers were weighed at the beginning of each period and fed 1.9% of BW per day to minimize orts. Chromium oxide, ytterbium-labeled cracked corn and cobalt-EDTA markers were used to determine digestibility, solids dilution rate and liquid dilution rate, respectively. Ruminal and duodenal samples were taken every 6 h with sampling times advanced 2 h each day so that every 2 h were represented over a 24-h period. Ruminal ammonia concentration was higher (P < 0.05) for SBM-H due to increased degradable protein. Treatment did not affect microbial efficiency (g of N/kg OM truly digested) with averages of 13.6, 12.8, 15.4 and 22.1 for BM-L, BM-H, SBM-L and SBM-H, respectively. Proteolytic activity, VFA production, and digestibility were not affected (P > 0.05) by treatment. Solids dilution rate was not affected (P > 0.05) by level of protein, however, liquid dilution rate was lowest for BM-H. The % RUP of BM-L was not different (P > 0.05) from the % RUP of BM-H with values of 61.7 and 54.8% respectively. Likewise, the % RUP was not different (P > 0.05) for SBM-L at 47.7% than SBM-H at 45.9%.

We concluded that increasing dietary inclusion rate of RUP would not influence the RUP value of the protein source.

**Key Words:** Bloodmeal, Ruminal undegradable protein, Digestibility

673 **Dry matter and protein digestibility of alfalfa hay or silage in the rumen and intestine of steer measured by mobile nylon bag technique.** E. Khafipour, M. D. Mesgarani*, and F. E. Shahroudi, Ferdowsi University of Mashhad, Mashhad, IRAN.

The present study was carried out to evaluate DM and CP digestibility of alfalfa hay and alfalfa silage (treated with urea and/or sulfuric acid). Second cut alfalfa (about 27% DM) was harvested, left on the ground for 8 h before ensiling or 2 days for drying. The chopped alfalfa was ensiled with urea (0.0 and 1%, DM) and/or sulfuric acid (0.0 and 1.5%, DM) in a complete randomized design (T₁: alfalfa silage, T₂:T₃ = 1.5% acid, T₃: T₁ + 1% urea, T₄:T₅ = 1% urea + 1.5% acid, T₃: alfalfa hay). The ruminal and post ruminal disappearances of DM and CP were determined using the mobile nylon bag technique in four Holstein steers (400±15 kg) fitted with rumen fistula and T-shaped cannula. For each treatment, ten bags (3×6 cm, 1.2 g DM of each sample) incubated in the rumen for 12 h. Then, the bags were removed and washed in running cold water. The bags containing intact samples (10 bags for each treatment) were inserted into small intestine, via the cannula (one bag every 30 min), then removed from the voided feces, washed in cold running water. Finally, the bags were dried in a forced air oven (58°C, for 24 h) and weighed to determine DM disappearance. The Ruminal and intestinal disappearance results are shown in the Table. Both ruminal DM and protein digestibility of alfalfa were significantly influenced by the treatments (P < 0.05). It seems that urea and sulfuric acid may influence the undegradable parameters of alfalfa silage in both rumen and intestine. So, it has been concluded that they might be used as good preservatives in alfalfa silage.
A concordance coefficient to compare model predictions to observed data. N. R. St-Pierre*1, The Ohio State University, Columbus.

Mathematical models are frequently used to quantify complex systems. The validation of such models is done by comparing model predictions to observed data. Various statistical methods have been used to assess a model’s validity: the Pearson correlation coefficient, the paired t-test, the least-square analysis of slope (=1) and intercept (=0), and the coefficient of variation or the intraclass correlation coefficient. None of these can completely assess the desired reproducibility characteristics. The Pearson correlation coefficient only measures precision of a linear relationship, not accuracy. Both the paired t-test and least squares analysis can falsely reject (accept) the hypothesis of high agreement when the residual error is small (large). The coefficient of variation and the intraclass correlation coefficient assume a dependent and an independent variable. More importantly, they fail to recognize the duality (interchangeability) of predictions with observations. Both are transforms of measurements. Both have random errors from measurements and parameter estimates. And both have structural errors due to the simplification of the complex real world. The relevant question is not whether a model predicts observed data but whether the model and the observation method measure the same thing. This requires a joint assessment of precision and accuracy. A single standardized statistical called concordance correlation coefficient (CCC) is suggested. Let $Y_1$ be the observed values and $Y_2$ be the predictions. The concordance correlation coefficient $r^c = 1 \frac{E(Y_1 \cdot Y_2)^2}{E(Y_1^2) \cdot E(Y_2^2)} - Y_1, Y_2$ are uncorrelated $= 2$ $\sigma_1^2 + \sigma_2^2 = (\mu_1 - \mu_2)^2 = r_{12} \chi_{12}$, where $\mu_1 = E(Y_1), \mu_2 = E(Y_2), \sigma_1^2 = Var(Y_1), \sigma_2^2 = Var(Y_2)$, and $\sigma_{12} = Cov(Y_1, Y_2) = \sigma_1 \sigma_2 r_{12}$. The CCC is a product of two components: precision $(\mu_{12})$ and accuracy $(\chi_{12})$, where $\chi_{12} = 2 \sigma_1 \sigma_2 / (\sigma_1^2 + \sigma_2^2 + (\mu_1 - \mu_2)^2) = [u_{12} + 1/\nu_{12} + u_{12}^2] / 21^{-1}$, with $\nu_{12} = \sigma_1^2 / \sigma_2^2$ representing scale shift, and $u_{12} = (\mu_1 - \mu_2) / (\sigma_1 \sigma_2)^{1/2}$ representing location shift relative to the scale. Application to the NRC(2001) dataset of measured and predicted microbial N flow to the duodenum shows that measurements and predictions are concordant but lack precision.

**Key Words:** Concordance coefficient, Model validation
ABSTRACTS
ADSA Student Affiliate Division

687 Effect of Prepartum Dietary Carbohydrate Source and Monensin on Postpartum Immune Function.
H. R. Springer1*, G. A. Varga1, M. M. Pickett1, J. P. Goff2, J. R. Stabel2, and T. W. Cassidy1, 1The Pennsylvania State University, University Park, PA, 2USDA-ARS, National Animal Disease Center, Ames, IA.

Thirty two multiparous Holstein cows were used in a complete randomized block design to evaluate the effects of carbohydrate source and prepartum monensin supplementation on postpartum immune function. Immune function was assessed by in vitro antibody production and phenotyping using flow cytometry for CD3, CD4, CD8, B cells, monocytes, γδ T cell receptor (γδTCR), MHC-II, and IL-2 receptor. Two diets with (+) or without (-) supplemental monensin (0 or 330 mg/d) were evaluated in a 2 X 2 factorial arrangement. The prepartum CONV diet contained 70% forage and the NFFS diet contained nonforage fiber sources such that 28% of the forage was replaced with cottonseed hulls and soyhulls. Treatments were designated CONV+, CONV−, NFFS+, and NFFS−. The prepartum diets were formulated to contain 1.55 Mcal/kg NE3, 40% NDF, and 14% CP. Dietary treatments began at dry off and continued until parturition. Monensin was top dressed daily starting 28 d prior to expected calving date. Jugal blood samples for immune function were collected on day 1, 14, and 42 postpartum. In vitro antibody production was lower for cows supplemented with monensin compared to cows not receiving monensin (P ≤ 0.05; 1732.3, 2625.5 ± 279.0). Antibody production increased from d 1 to 42 (P ≤ 0.05; 831.5, 2463.4, 2820.9 ± 818.0). Percentage of cells positive for CD3, CD4, CD8, B-cells, γδTCR and IL-2 were not different across treatments (P ≥ 0.15). There was a treatment by day effect such that monensin treatment resulted in lower monocyte populations on d 1 (P ≤ 0.05; 6.2 vs. 2.9 ± 0.99). Day was significant for MHC-II populations which were higher for d 1 and 14 compared to d 42 (P ≤ 0.05; 31.7, 33.4, 23.3 ± 4.8). Based on this study if the prepartum ration is properly balanced, postpartum immune function should not be affected. Monensin supplementation may effect monocyte populations and antibody production postpartum.

Key Words: Immune function, Monensin, Transition Cow

688 Effect of Prepartum Dietary Carbohydrate Source and Monensin on Postpartum Immune Function.
H. R. Springer1*, M. M. Pickett1, J. P. Goff2, J. R. Stabel2, and T. W. Cassidy1, 1The Pennsylvania State University, University Park, PA, 2USDA-ARS, National Animal Disease Center, Ames, IA.

689 Growth and incidence of scouring in Holstein calves fed high fat (28%) milk replacer. H. E. Carpenter1*, J. S. Birney, and K. A. Koudele, Andrews University.

The replacement heifer calves at the Andrews University Dairy were switched from a diet of whole waste milk (3.06% protein, 3.35% fat) to MR (22% protein, 20% fat, or 2.8% protein, 2.5% fat on as-fed basis) due to concerns about the spread of Johnes disease and other pathogens. There was concern following the switch that the calves were not growing as well on the MR since it was not equivalent to whole milk in protein.
and fat. But there were also concerns that a higher-fat MR would increase the incidence of scouring especially in warm weather, and also reduce pre-weaning grain consumption. During the late summer and fall of 2002 forty-eight heifer calves were paired by birth weight and fed either the regular MR, or a high-fat (17% protein, 28% fat or 2.1% protein, 3.6% fat on as-fed basis) MR. The calves were housed outside in individual hutches and fed 2L MR twice a day until weaning at 7 weeks of age, when they were weighed again. They received free-choice water, grain and hay. Grain intake was tracked weekly and environmental temperatures were monitored daily. The frequency and duration of scouring and treatments were recorded daily. The weight gained from birth to weaning was significantly higher in the high-fat MR group (43.55 kg vs. 31.76 kg; p < 0.001). The % of birth weight gained by the high-fat MR group was also significantly higher (105% vs. 75%; p < 0.001). There were no significant differences in grain intake by either group (2.26 kg/d). The cost of feed intake was less in the high-fat MR group by $0.92 per calf per day. Although the environmental temperature ranged from 37.1°C to -7°C during the trial period, there were no significant differences in the incidence or duration of scouring (8 cases/group, treated for 3 d). The data from this pilot study suggests that high-fat MR can be cost-effective to feed to calves even during warmer months resulting in higher weight gains with no reduction in grain consumption, and with no increased incidence of scours.

Key Words: Calf raising, High fat milk replacer, Weight gain


Our objective was to compare growth between two intensified liquid feeding programs (E) and a conventional early weaning (C) program. At 3 d of age, female Holstein calves in individual hutches were assigned to C (milk replacer [MR; 22% CP, 20% fat] plus starter [18% CP], as fed) or E (MR [28% CP, 20% fat] plus starter [22% CP], as fed). Trial 1 used 12 calves on C (C1) and 11 calves on E (E1). For E1, calves were fed MR at 2% of body weight (BW) during wk 1 and 2.5% of BW during wk 2-5 (adjusted weekly). During wk 6, calves were fed half the amount offered during wk 5 and were weaned at the end of wk 6. In trial 2, 21 calves received each diet (C2 and E2). For E2, calves were fed MR powder at 2% of BW during wk 1 and 2.5% of wk 2 BW during wk 2-5. During wk 6, calves were fed half the daily amount offered during wk 2-5 and were weaned at the end of wk 6. In both trials, C calves were fed a constant amount of MR (1.25% of birth weight as powder) through wk 4, one-half of that amount during wk 5, and were weaned at the end of wk 5. All calves had ad libitum access to water and starter. Total MR consumed was greater (P<0.01) for E (16.4, 38.9, 16.3, and 40.0 kg DM for C1, E1, C2, and E2, respectively). Total starter intake through wk 8 were lower (P<0.01) for E (49.8, 22.4, 54.1, and 25.3 kg). In trial 1, BW (57.0 vs 47.0 kg) and heart girth (HG) were greater (P<0.01) for E at wk 4; at wk 8 body length (BL) was greater (P<0.01), and wither height (WH) and HG tended (P>0.10) to be greater, for E1. In trial 2, BW (63.5 vs 51.1 kg), BL, and HG were greater (P<0.01) for E2 at wk 4 and tended (P>0.10) to remain greater at wk 8. Average daily gain (ADG) was greater (P<0.01) for E in both trials through wk 4 (0.303 vs 0.709, 0.360, and 0.714 kg/d for C1, E1, C2, and E2, respectively) and through weaning (0.519, 0.747, 0.562, and 0.671 kg/d). The ADG through wk 8 was greater for E1 than for C1 (0.690 vs. 0.560 kg/d, P<0.01) and tended (P=0.08) to be greater for E2 than for C2 (0.671 vs. 0.591 kg/d). Intensified liquid feeding programs resulted in greater early gains of BW and frame.

Key Words: Calves, Growth, Milk replacer


The objective of this study was to determine the intake of cobalt (Co) that optimizes fiber digestion in a ruminant. Four ruminally fistulated cows were fed a diet of approximately 50% (BGS). Treatments were arranged according to a Latin square design in which each cow was fed a trace element salt that contained 0, .5, 4 , or 10 ppm of added Co. Squares were randomized to avoid a carry-over effect when the next concentration was applied. The Co concentrations were achieved by adding cobalt glucoheptonate to a basal mineralized salt. Cows were adapted to each treatment for 7 d, ruminal fluid was collected (approximately 4 h after feeding) and transported to the laboratory to be used as an inoculant for the Daisy Incubator (ANKOM Technology). To examine dry matter and fiber digestion, the forage used in the diet was collected, dried at 60 °C, ground through a 1 mm screen, weighed into small bags and placed into the incubator. Ground alfalfa hay (AA) was used as a reference standard. After 48 h, the incubation was ended; the bags were washed and dried at 100 °C for 4 h to determine dry matter disappearance (DMD). Duplicate incubations from each cow at each Co level were conducted. The content of neutral detergent fiber (NDF) in the dry residue was determined. The impact of cobalt level on in vitro rumen degradation of DM and NDF was evaluated using the SAS statistical package for a Latin square. Salt was fed free choice and intakes varied dramatically by cow. Preliminary evidence suggests Co intake had no effect on DMD or NDF disappearance (NDFD). Mean DMD was 58BGS and 528BGS fiber digestion.

Key Words: Cobalt, Fiber digestion, In vitro

692 The costs and returns associated with select Wood Model lactation lengths. E. A. Vaaler* and G. L. Hadley, University of Wisconsin-River Falls.

The objective of this study is to determine the costs (returns) associated with extended days open and longer lactation lengths using curves developed by the Wood Model. Production profitability is at the heart of dairy farms. Therefore, the importance of this study is enabling the producer to select the lactation length that captures the highest return. Curves were developed for five calving intervals (40, 44, 48, 52, 56 weeks) for each of the three lactations (1, 2, 3). Costs include breeding, housing, labor, and feeding, as well as, other costs associated with the lactation. Cost, revenue, and profit were determined on a per day basis. They were also determined using the University of Wisconsin-Extension and Center for Dairy Profitability Agricultural Financial Advisor (AgFA) farm financial records database. The Net Present Value (NPV) associated with each series of lactation was calculated. To account for the different time frames, each lactation series was converted to infinity by dividing the NPV to an equivalent annuity. By applying a profit function to a Wood Model of various lactation lengths, we found that the cost of an average day open increases as lactation length increases. The return to the farm decreases as lactation length increases. Therefore, if a farm’s lactation curve is similar to those generated by the Wood Model, these results mean that a farm should decrease lactation length (calving interval) to increase return.

Dairy Production Undergraduate Paper Presentations


Twinning has a dramatic negative effect on subsequent health and reproductive performance of dairy cattle. Double ovulation is the primary cause of twinning. A study was conducted to evaluate the effect of seasonality on the incidence of double ovulation in lactating dairy cows. The study design was to evaluate the effect of seasonality on the incidence of double ovulation, utilized 590 non-pregnant, high producing (42 kg/day) Holstein dairy cows located at two different farms under similar management practices owned by a single entity. Observations took place in July-August (summer) and January (winter). There were 315 cows observed in summer and 275 cows observed in winter. The ovaries of each cow were examined once using a Cornometics 500V ultrasound machine to determine the number of corpora lutea present. Overall ovulation rate was not affected by location or lactation number (P>0.05), so data were pooled. Incidence of double ovulation was affected by days in milk (P=0.0382) and by rate of milk production (P=0.0061). In addition, season was found to have an effect (P=0.0113) on the incidence of double ovulation (22.2%) in this experiment. How-
ever, in this study the number of double ovulations was higher in the winter months (25.7%) versus the summer months (18.2%).

Key Words: Dairy cattle, Double ovulation, Seasonality

694 Are Dogs "Man’s Best Friend" or "Cattle’s Worst Enemy"?. Jessica Carrey*, Louisiana State University.

Abortions in dairy cattle represent a significant loss of potential income and present a frustrating challenge to dairy producers and veterinarians. Abortion in dairy cattle is defined as a loss of the fetus between 42 and 260 days of gestation. It has been estimated that each abortion costs dairy producers $500 to $900 depending on factors such as value of replacement heifers, feed and milk prices, and the stage of gestation when the abortion occurs. Genetic abnormalities, heat stress, and toxic agents such as mycotoxins have been implicated as factors which may cause abortion. The most frequent causes of abortions in dairy cattle are bacterial and viral infections. However, Neosporosis is a parasitic disease that can trigger spontaneous abortions in many species, including dairy cattle. This infection is caused by the coccidian protozoan parasite Neospora caninum. This organism is transmitted by dogs that ingest infected tissues from aborted fetuses and shed the parasite eggs, or Neospora oocysts, in their feces. Dairy cattle are exposed to this organism when they ingest feed contaminated with the dog feces. Neospora caninum was not identified until 1988, but its economic impact has already become extensive throughout the United States and the world. Although there is no treatment for Neosporosis, a vaccine has recently become available. Good management practices, including pest management, removal of aborted fetuses and placentas, and vaccination protocols, may prove to be beneficial in the prevention of this costly problem in the dairy industry.

Key Words: Neosporosis, Dog, Dairy cattle

695 Crossbreeding in the dairy industry: A new era in dairy production. L. B. Core*, University of Kentucky.

Crossbreeding is as controversial today as it was in the 1930’s when the first studies were conducted. Although, Holstein generally have a higher lactational performance, crossbreeding tend to offer other benefits to the producer. Lifetime yields, growth, health and reproductive traits are positively impacted by crossbreeding. An Illinois crossbreeding study reported that crossbred dairy cows had a 14.9% higher per cow income and 11.4% higher per cow per year income. A Canadian study reported equivalent lifetime milk yields, milk value and net returns for Crossbred and Holstein cows. Additionally, heterosis of 15 to 20% for lifetime traits was observed. Many studies indicate that a two breed rotational crossbreeding system is the most profitable. A three breed system has been examined, however evidence for its profitability is yet to be determined. The information cited does not prove the profitability of crossbreeding. More research is needed which includes current U.S. genetics, current production in dairy cows. However, it must be noted that milk production is the result of both genetics and environment. With that in mind, producers are exploring new ways that genetics can impact the dairy industry that is seeing a decline in herdlife. This decline is being partially blamed on the growing problem of a gradually more and more inbred national dairy population. One possible solution is crossbreeding. Crossbreeding has been used for hundreds of years in other areas of agriculture. In the dairy industry, only recently have studies begun to look again at this using crossbreeding. In fact, a recent study by the USDA on Holstein sires crossed with Ayrshires, Brown Swiss, Guernseys, and Jerseys, showed heterosis effects to vary between 2.47 to 5.37d to the renewed interest in this age-old technique. These factors include a shift from volume based milk pricing to component based milk pricing, and increased concerns about inbreeding, efficiency and fertility. It will also examine uses of crossbreeding internationally and explore how dairy producers in the United States, especially large commercial producers, can utilize those results.

Key Words: Crossbreeding


Organic agriculture has emerged as a developing market for dairy farmers. Both supply and demand for “certified organic” food products have risen dramatically over the past 20 years. Hundreds of certifying agencies that developed all had slight variations in their certification standards will greatly affect this industry as it grows in the future.

Key Words: Organic, Standards


The modern dairy producer has multiple management techniques that can be used to stimulate milk production. Changing milking frequency from 2X to 3X, supplementation with bST, and now photoperiod manipulation, are examples of tools that can be used to stimulate production. A natural photoperiod consists of 13 or fewer hours of light/day. A long day photoperiod (LDPP) is 18 hours of light/day, followed by 6 hours of dark. LDPP has been shown to increase milk production by up to 3.3 kg/day. In most studies, milk composition has not been altered, but minor decreases in fat concentration in milk have been documented with LDPP. Continual lighting is not recommended, as a dark period is required to maintain the ability of the animal to track day length and consequently regulate bodily functions. In order to observe milk yield increases, a footcandle illumination of 20 footcandle illumination per 50 feet of barn length is suggested. While the mechanism behind the increased milk yield with LDPP is not clear, LDPP affects the melatonin concentrations in the blood. Melatonin regulates plasma IGF-1 and serum prolactin concentrations. Research points to IGF-1 as the most probable cause of increased production with LDPP. Producers can combine bST supplementation and LDPP for an additional production increase. Additional fat corrected milk production increases from 1.9 kg/day with LDPP, to 5.7 kg/day over control when LDPP is combined with bST. Photoperiodic manipulation has the potential to be an important tool for dairy producers. While there are fixed costs to implement LDPP, and power usage increases, most producers find LDPP to be a profitable management tool. No additional effort is required on a daily basis to gain the effects of LDPP, no injections need to be administered, and there is no additional labor involved.

Key Words: Photoperiod
with health claims, or they can opt for “real” milk with its great taste and many nutritional benefits.

Key Words: Forward contracting, Milk pricing, Risk management tool

703 Wazzu’s famous variety. J. DeVoe*. Washington State University.

Cougars Gold is a unique cheese made only by Washington State University Creamery in Pullman, WA. This cheese was developed in the 1930’s with a unique bacterial strain giving it its own particular taste. To this day the same strain is cultured every three days, derived from the same clone that was selected over seventy years ago. Cougars Gold is a sharp, white cheddar with a taste that resembles Swiss or Gouda and is aged for at least one year. This cheese is packaged in a can, because of research in the 1930’s for a more ideal packing medium. Cougars Gold is the only known cheese in the USA that is canned, therefore making it Washington State’s own unique cheese. The scarcity of Cougars Gold also adds to its uniqueness. The only way to get this cheese is either to make a trip to Pullman or to have it mail ordered. It is not shipped in mass quantity and anyone ordering it can only order twenty cans at a time. Therefore, not only is this cheese unique, but it’s supply is restricted. The WSU Creamery makes this cheese year round and produces a little less than 150,000 cans of Cougars Gold a year. To add to its singleness, Cougars Gold helps to support student employment in the WSU Creamery. Furthermore, the facility provides opportunities for students to work with and learn about cheese. For example, the Food Science Human Nutrition club works with the cheese for a fund-raiser, students from the food science department hold classes and graduate and undergraduate students hold research studies at the Creamery. Therefore, a can of Cougars Gold is not just a plain old can of cheese; it is unique and represents many years of support, education and quality.

Key Words: Cougars Gold, Cheese


To better compete in the changing dairy industry, many small dairy producers are considering diversification. One diversification strategy that is growing in popularity is on-farm processing of fluid milk, cheeses, and other dairy products. There are currently 13 registered on-farm creameries in the state of Virginia. Many of these farms are family run and owned. These operations produce their own milk from small milking herds and turn the raw product into a “cow to consumer” product. The start up cost for the typical Virginia on-farm processing operation varies from $1 million to $1.5 million. Examples of products manufactured at these creameries include several flavors of milk with varying fat content, specialty cheeses, yogurts, and chip dips. On-farm processed dairy products in vitamins and minerals, low in fat, and cholesterol free. It contains no lactose, which makes it a safe and nutritional alternative for lactose intolerant individuals. Research has shown that soy foods may help to prevent heart disease and some forms of cancer. This beneficial effect is possible due to isoflavones, a phytoestrogen found in soybeans. While soy milk has numerous potential health benefits, it is not “nature’s most nearly perfect food.” Soy milk has been reported to be unpalatable. Sensory experts have reported off flavors, bitter taste, chalky mouth feel, and a bad aftertaste. With milk consumption declining, and even mist, phage peptide inhibition could allow sufficient time for cheese production and efficiency can increase. Considering the simplicity of introducing a phage to a cheese plant by clothing, cheese whey, and even mist, phage peptide inhibition could allow sufficient time for cheese fermentation without risk of phage infection.

Key Words: Phage Peptide, Bacteriophage, Cheese Fermentation

702 Will the “Real” Milk Please Stand Up? L. Ward, Louisiana State University.

In October, 1999, the FDA stated that “it recognizes the health benefits of daily consumption of soy protein. Specifically, consuming 25 grams of soy protein daily can help reduce the risk of heart disease.” This announcement paved the way for the soy product market. One product that has been gaining in popularity is soy milk. Soy milk is high in protein, rich in vitamins and minerals, low in fat, and cholesterol free. It contains no lactose, which makes it a safe and nutritious alternative for lactose intolerant individuals. Research has shown that soy foods may help to prevent heart disease and some forms of cancer. This beneficial effect is possible due to isoflavones, a phytoestrogen found in soybeans. While soy milk has numerous potential health benefits, it is not “nature’s most nearly perfect food.” Soy milk has been reported to be unpalatable. Sensory experts have reported off flavors, bitter taste, chalky mouth feel, and a bad aftertaste. With milk consumption declining, and even mist, phage peptide inhibition could allow sufficient time for cheese production and efficiency can increase. Considering the simplicity of introducing a phage to a cheese plant by clothing, cheese whey, and even mist, phage peptide inhibition could allow sufficient time for cheese fermentation without risk of phage infection.

Key Words: Phage Peptide, Bacteriophage, Cheese Fermentation
Innovative applications of membrane filtration. 
C. Machado*, California Polytechnic State University, San Luis Obispo.

Membrane filtration research is currently aimed at the standardization of milk, enhancing functional properties of milk proteins, fractionating whey proteins, and improving milk quality. Membrane filtration requires little energy and does not destroy any product during treatment. The pore size of the filter determines the type and size of the molecules to be retained by the filter. Alteration of the pore size yields a customized permeate and retentate. With the use of membrane filtration there could be an improvement in the quality of existing dairy foods, a creation of new and innovative products, and progress could be made in processing efficiency and profitability. Permeates gathered from filtration could be used as a value-added ingredient, fortifying foods, from sports drinks to infant formulas. The permeate could add a boost to the existing nutritional identity of fluid milk or create an entirely new product using milk’s functional or nutritional components. Filtration could become a key element in the production of cheese. It could extract valuable proteins prior to making cheese, greatly decreasing the amount of protein lost to acid whey during cheesemaking. Milk could be considered a collection of individual components with different nutritional values, such as protein, fat, casein, lactose, vitamins, and minerals. Federal standards have not been implemented to support this technology to date, but membrane filtration allows for promising economic benefits compared to the more traditional methods of concentrating, fractionating, and separating milk components.

Key Words: Membrane filtration, Milk components, Dairy processing
ABSTRACTS
POSTERS, Monday, June 23, 2003

* Author Presenting Paper

Physiology: Control of the estrous cycle and pregnancy

M1 Induced twinning by artificial insemination and embryo transfer fails to increase pregnancy rates but increases total fetus numbers in beef cows. G. C. Lamb1,3, R. C. Wasson1, D. R. Brown1, and C. R. Dahlen2. 1North Central Research and Outreach Center, University of Minnesota, Grand Rapids 55744, 2North West Research and Outreach Center, University of Minnesota, Crookston, 56716.

We determined whether induced twinning would increase fertility and twinning rates, and to elucidate factors responsible for altering twinning rates in suckled beef cows. Two hundred ninety-seven suckled beef cows were estrous synchronized with 7-11 Synch (i.e., melengestrol acetate [0.5 mg/head/d] from d -18 to d -11, PGF2α on d -11, GnRH on d -7, and PGF2α on d 0). Forty-eight hours later (d +2) all cows received a second 100 µg injection of GnRH and were assigned randomly to one of three treatments: 1) Fixed-time artificial insemination on day +2, (AI; n = 99); 2) a direct transfer embryo placed in the uterine horn ipsilateral to the ovary containing a corpus luteum (CL) on d +9, (ET; n =99); and, 3) a fixed-time AI on d +2 and an embryo on d +9 (TWIN; n =99). Blood samples were collected on d -29, -18, 0, +2, +7 to determine concentrations of progesterone. Ultrasonography was used to monitor follicle diameter on d +2, CL diameter on d +9 and to determine the presence of embryos on d 35. Only 34% of all cows were cycling by d -18, pregnancy rates were greater (P < 0.05) for TWIN (48%) and AI (40%) than for ET (33%) treated cows. Of the 48 pregnant cows in the TWIN treatment 19 were twin pregnancies (40%), whereas there was one twin pregnancy in the AI treatment and 0 twin pregnancies in the ET treatment. As a result, TWIN cows had more fetuses (P = 0.01) as a percentage of all treated cows (68%) than AI (47%) or ET (33%) treated cows. On d -18, A greater percentage of primiparous cows (57%) were cycling than multiparous cows (26%), resulting in greater (P < 0.05) overall pregnancy rates in primiparous (54%) than multiparous (40%) cows. Days postpartum on d 0 were greater (P < 0.01) for primiparous (79 ± 2 d) than multiparous (68 ± 1 d) cows. In the TWIN treatment, the correlation coefficient between concentrations of progesterone on d -7 and CL volume was 0.499 (P < 0.001), whereas the correlation coefficient between CL volume and the incidence of twins was 0.299 (P < 0.01). Embryo grade or stage of development failed to affect twinning rates. We concluded that transferring an embryo into a cow after timed-AI increased twinning rates, but failed to increase overall pregnancy rates compared to a fixed timed-AI.

Key Words: Twinning, Beef cows, Artificial insemination

M2 Effect of administration of GnRH on day 5 or day 5 and 11 post-insemination on pregnancy rates and serum progesterone concentrations in dairy cows during different seasons. A. E. Sweetman*, L. I. Nordbladh, and C. S. Whisnant, North Carolina State University, Raleigh, NC.

Heat stress has been shown to reduce reproductive performance in lactating dairy cows. One effect of heat stress is to decrease serum progesterone (P4) concentrations. Lower serum P4 may be associated with decreased pregnancy rate. Previous research suggested that administration of hCG on day 5 post-insemination or use of GnRH at day 11 post-insemination could increase serum P4 and improve pregnancy rates in cattle. The objective of the current experiments was to compare the response to supplemental GnRH in heat stress and cool environments. Lactating Holstein cows were bred at a timed AI after a use of the Ovsynch protocol in either summer (heat stress) or winter. Controls (CON n = 35) received no further treatment. GnRH (100 µg, Fertagyl, Intervet) was administered either on day 5 (D5 n = 42) or day 5 and 11 (D5+11 n = 39) post-insemination and blood samples were collected and rectal temperatures were measured every other day beginning 3 days after AI. Concentrations of P4 were compared between treatments using the GLM procedure of SAS for repeated measures. Pregnancy rates were compared using Chi square. The results from summer follow. Summer THI (70.2) indicated mild heat stress. Serum P4 levels were higher in D5 cows (P < 0.01) on days 9, 11, and 13 and were higher than P4 concentrations in CON cows (P < 0.01) on days 17 and 19 in D5+11 cows. Rectal temperatures did not differ between groups. Pregnancy rates as assessed using ultrasonography on day 30 post AI were higher (P < 0.05) in D5 (35.2 ± 2.4%) compared with CON (18.5 ± 1.3%) and D5+11 (20 ± 1.7%). In experiment 2, a similar protocol was performed except during winter when heat stress conditions did not exist (THI = 44.8). Serum P4 concentrations were higher in GnRH treated cows than in CON as in summer. However pregnancy rates did not differ between groups (CON 37.2 ± 2.7%; D5 39.3 ± 2.9%; D5+11 34.4 ± 2.2%;) unlike the results in summer. These results suggest that administration
of GnRH can increase serum P4 concentrations in lactating dairy cows during both heat stress and cooler conditions but that pregnancy rates were increased only during heat stress.

**Key Words:** Heat stress, GnRH, Progesterone


This study evaluated the effect of GnRH or hCG injection on day 5 after AI on conception rates in lactating dairy cows during the summer. Lactating Holstein cows, 158, producing 26±9 kg milk/d and 213±112 DIM, were randomly assigned to one of three treatment groups: G1 (N=52), control; G2 (N=55), 100 mcg i.m. of gonadorelin (Cystorelin®); and G3 (N=51), 2500 UI hCG i.m. (Vetecor®). Experiment was conducted during the summer in Brazil. Rectal temperature was checked at the moment of AI, and blood samples were collected on days 5, 7 and 12 after AI to evaluate serum progesterone (P4) concentrations. Pregnancy was determined between 42 and 49 d after AI. Data were analyzed by the MIXED procedure of SAS, and were included in the model the effects of treatment, parity, milk production, rectal temperature at the moment of AI and interactions. Treatment with GnRH and hCG increased conception rates in both treatment groups (P < 0.01). Serum P4 concentrations (ng/ml) for G1, G2, and G3 were, respectively, on day 5, 2.71, 2.45, and 3.23; on day 7, 4.79, 4.15, and 5.75; and on day 12 after AI, 5.21, 6.91, and 8.50. Due to the proportional increases in serum P4 concentrations from d 5 to 7 after AI, it is likely that treatments did not have luteotropic effects on the existing CL, but due to the higher increase in serum P4 on day 12, probably induced formation of a new CL. The average rectal temperature of cows at the time of AI was 39.7°C. Treatment with GnRH and hCG increased conception rates in cows with rectal temperature below 39.7°C (10.1, N=26; 36.8, N=27; and 32.8%, N=21; P < 0.01), but had no effect on conception in cows with temperature above 39.7°C (15.2, N=26; 17.8, N=28; and 24.4%, N=30; P > 0.15). These data suggest that GnRH and hCG increase conception rates in lactating cows by increasing serum P4 concentrations. The positive effects of treatments were not detected in cows with high rectal temperature probably because of the deleterious effects of thermal stress on fertilization and early embryo development.

**Key Words:** hCG, GnRH, Conception

M4 The effects of supplemental GnRH administration following Ovsynch on pregnancy rates of lactating dairy cattle during the summer and fall seasons. T. Dickerson*, K. Graves, J. White, S. Bowers, L. Evans, B. Gandy, S. Schmidt, and S. Willard, Mississippi State University.

High environmental temperatures are negatively correlated with reproductive efficiency in dairy cattle, as evidenced by lower conception rates. Studies were conducted in the summer and fall seasons respectively to evaluate the efficacy of supplemental GnRH injections post-breeding on pregnancy rates in lactating dairy cattle. Lactating dairy cows in Study 1-Summer (n=43) and Study 2-Fall (n=79) were synchronized using the Ovsynch protocol, bred (TAI) and assigned to one of three post-TAI GnRH treatment groups: Control (CON), D 5 & 11 (GnRH-5/11), and D 11 (GnRH-11). Blood samples were collected throughout the trials for evaluation of serum progesterone (P4) in relation to GnRH treatment. CL area and numbers were determined by ultrasonography on D 5, 11, and 17 post-TAI in cows in Study 1-Summer and D 5, 11, and 17 post-TAI in cows in Study 2-Fall (n=12/treatment). Rectal temperatures (RT) were collected throughout both studies, and ambient temperature-humidity index (THI) recorded daily. Study 1: Overall THI (24-h) was 74 (mild heat stress), with no differences (P > 0.10) in RT between treatment groups. On D11 post-TAI, GnRH-5/11 cows had higher (P < 0.05) serum P4 than CON and GnRH-11 cows. GnRH-5/11 cows had higher (P < 0.05) serum P4 than either the CON or GnRH-11 cows. Overall CL area did not differ (P > 0.10) among treatment groups, yet GnRH-5/11 cows had higher (P < 0.05) CL numbers on D 11 and 17 post-TAI than either the CON or GnRH-11 cows. Pregnancy rates did not differ (P > 0.10) with respect to treatment. Study 2: Overall THI (24-h) was 50 (no heat stress), with no differences (P > 0.10) in RT between treatment groups. On D11 post-TAI, GnRH-5/11 cows had higher (P < 0.05) serum P4 than CON cows, but did not differ (P > 0.10) from GnRH-11 cows. On D17 post-TAI, serum P4 did not differ (P > 0.10) among treatment groups. Overall CL area did not differ (P > 0.10) among treatment groups, yet GnRH-5/11 cows had higher (P < 0.05) CL numbers on D 17 post-TAI than either the CON or GnRH-11 cows. Pregnancy rates did not differ (P > 0.10) with respect to treatment. In summary for both trials, supplemental GnRH post-TAI increased serum P4 and CL numbers but did not increase pregnancy rate.

**Key Words:** Dairy cattle, GnRH, Progesterone

M5 Effect of bovine somatotropin and breed of recipient on pregnancy rates following timed embryo transfer with in vitro produced embryos. J. Block*, R. L. Monson2, J. J. Rutledge2, R. M. Rivera1, F. F. Paula-Lopes1, O. M. Ocon1, H. Rosson1, Y. M. Al-Katanani1, and P. J. Hansen1, 1University of Florida, Gainesville, FL, 2University of Wisconsin-Madison, Madison, WI.

Administration of bovine somatotropin (bST) improves pregnancy rates following timed artificial insemination in lactating dairy cows. Two experiments tested whether bST administration to non-lactating recipients improves pregnancy rates following transfer of in vitro produced (IVP) embryos. In exp. 1, Bradford cows were synchronized using the Ovsynch protocol. On d -1 (d 0 = anticipated ovulation), recipients were treated with bST or not. Embryos were transferred to all recipients having a palpable corpus luteum on d 7. Pregnancy was diagnosed on d 30 and 90. In exp. 2, recipients of 3 breed types [Angus (A), Holstein (H), and Brahman or Brahman crosses (B)] were given bST or not on d 0. Pregnancy was diagnosed between d 42 and 49. Other procedures were as for exp. 1. There was no difference in pregnancy rates between control and bST recipients in exp. 1 (d 30, 4/14 = 28.6% vs. 2/13 = 15.4%; d 90, 3/15 = 20.0% vs. 1/14 = 7.1%) or 2 (7/36 = 19.4% vs. 5/24 = 20.8%). In neither experiment did bST affect body condition, ovulation synchronization rate (determined by plasma progesterone (P4) concentrations on d 0 and 7), or plasma P4 on the day of transfer. In exp. 2, synchronization rate and plasma P4 concentrations were similar across breeds, but pregnancy rates were lower (p < 0.05) for B (0/15 = 0.0%) than for H (8/35 = 22.9%) and A (4/10 = 40.0%) recipients. In both experiments, there was no significant trend for recipients with ≤ 2.5 ng/ml plasma P4 on d 7 to have lower pregnancy rates than those with plasma P4 > 2.5 ng/ml. Results indicate that breed of recipient but not bST administration affects pregnancy rates in non-lactating recipients following timed embryo transfer with IVP embryos. (Support: USDA IFAPF #2001-52101-11318, USDA TSTAR 2001-34135-11556, and The Babcock Inst. for International Dairy Res. & Dev., UW-Madison).

**Key Words:** Bovine somatotropin, IVP embryos, Timed embryo transfer


This trial was designed to compare synchronization protocols in lactating crossbred cows in a grazing based dairy system. This study was conducted between December (2001) and February (2002) in Brazil. Cows producing 13.8±4.0 kg milk/d and 99.8±73.6 DIM, were randomly assigned to one of the four groups: G1) Control (N=51), which consisted of AI 12h after heat detection (HD); G2) CIDR® in (Eazi-Breed CIDR®) + GnRH (Cystorelin®, 50mcg, i.m.) - 6d # CIDR out + PFG2α (Luteolytic®, 25mg, i.m.) # 1A - 12h after HD (N=50); G3) CIDR® in + GnRH - 6d # CIDR out + PFG2α - 24h - ECP (ECP®, 1mg, i.m.) - 48h # AI (N=52); G4) CIDR® in + GnRH - 6d # CIDR out + PFG2α - 36h # GnRH - 12h - AI (N=53). Cycling status was determined by two ultrasound examinations at days #10 and 0 (first GnRH). Data were analyzed by CATMOD procedure of SAS and were included in the model groups, parity, milk production, BCS at day of first GnRH, DIM and interactions. Interaction between parity and group was detected (P < 0.05) for the TAI protocols. Pregnancy rate (PR) in TAI for primiparous (PC) and multiparous cows (MC) were 25.0% (7/28) and 50.6% (12/24) for G3 compared to 37.9% (11/29) and 16.7% (4/24) for G4, respectively. Conception rate (CR) to first service for PC and MC (P4), were 62.5% (10/16) and 47.3% (9/19), respectively, compared to 43.7% (7/16) and 52.6% (10/19) for G2, respectively. In G3 and G4 the CR in cows effectively synchronized, for PC and MC (P < 0.01) were
M7 Effect of incorporation of a low dose of estradiol cypionate (ECP) into a timed artificial insemination protocol on estrous behavior and conception rates in beef cattle. A. Ahmadzadeh*, D. G. Falk*, R. Manzo*, C. B. Sellers*, and J. C. Dalton*. University of Idaho, Moscow, *Southwest Research and Extension Center, Caldwell, ID.

Timed artificial insemination (Ovsynch; OVS) is a convenient method to facilitate artificial insemination, however GnRH administered during the follicular phase, as occurs in Ovsynch, causes a premature decline in estradiol secretion. It was hypothesized that administration of estradiol cypionate (ECP) coupled with the second GnRH injection would improve conception rate. The objective was to determine the effect of low dose ECP incorporation into OVS on expression of estrus and conception rates in beef cattle. One hundred eighty-two British cross-bred beef cows (55-60 d postpartum) received (i.m.) injection of 25 mg PGF2α (± 180 J. Anim. Sci. Vol. 81, Suppl. 1/J. Dairy Sci. Vol. 86, Suppl. 1) and synchronized ovulation (CIDR) using timed artificial insemination (TAI) with the MGA Select protocol. Crossbred beef heifers (n = 131) were randomly assigned to one of three treatments, control, MGA Select, and MGA Select with timed artificial insemination (MSTAI). Treatment 1, control group, (n = 43) was fed melengestrol acetate (MGA) for 14 days (0.5 mg. ld-1 d-1) and injected (i.m.) with PG (25 mg of Lutalyse) 19 days after the last day of MGA feeding. Treatment 2, MGA Select, (n = 44) was fed MGA for 14 days (0.5 mg. ld-1 d-1), injected (i.m.) with GnRH (100 g of Fertagyl) 12 days after the last day of MGA feeding and injected (i.m.) with PG (25 mg of Lutalyse) 19 days after the last day of MGA feeding. Treatment 3, MSTAI, (n = 44) was treated the same as MGA Select group except TAI occurred 60 hours post PG injection. Estrus detection via “Heat watch” began the day of PG and continued through 84 h for control and MGA Select groups. The estrus response was similar (P > 0.05) for the control, and treatment 2. Peak estrus period for both groups was observed to be between 48 and 60 h after PG, 53% of control and 64% of treatment 2 groups exhibited estrus (P > 0.05). Control and treatment 2 number of non-responders, those not exhibiting estrus, did not differ (P > 0.05). Comparison of conception rates for control and treatment 2 did not differ (P > 0.05). Additionally, comparison of first service pregnancy rates for treatment 2 to treatment 3 did not differ at (P > 0.05).

This research suggests the use of MGA Select can be equally effective in synchronizing estrus in beef heifers as the 19-d MGA-PG protocol. Use of TAI can be used for beef heifers in conjunction with the MGA Select protocol to achieve similar first service pregnancy rates as MGA Select when used in conjunction with estrus detection.

Key Words: Timed AI, MGA select, heifer

M9 Melengestrol acetate (MGA) pretreatment or estradiol cypionate (ECP) in short duration synchronization systems to improve synchrony of estrus and ovulation in yearling beef heifers. S. K. Johnson* and J. S. Stevenson, Kansas State University.

The objective of this experiment was to determine if MGA pretreatment or ECP after PG2α would improve synchrony of estrus, ovulation, and AI pregnancy rates in heifers. Yearling Angus and Angus crossbred heifers at a commercial heifer-development facility were assigned randomly to four treatments: 1) two injections of PGF2α, 14 d apart (2XPGF, n=97), 2) same as 2XPGF plus 0.5 mg of ECP 24 h after the 2nd PGF2α injection (d 0; PECP; n=98), EAI through 72 h after PGF2α, then timed AI (TAI) and GnRH to all non-detected heifers at 74 h; 3) GnRH on d -7 and PGF2α on d 0 and EAI (SS: n=97); 4) 0.5 mg of MGA from d -17 through d -11, PGF2α on d -11, GnRH on d -7 and PGF2α on d 0, EAI through 72 h after PGF2α. TAI and GnRH to all non-detected heifers at 74 h (7-11Synch, n=189). Doses administered were: i.m. 100 µg of GnRH and 25 mg of PGF2α. Pregnancy was diagnosed by ultrasonography 30 to 34 d after AI. From 0 to 72 h after PGF2α, average interval to estrus was greater (P<0.01) for 2XPGF than PECP but did not differ for SS or 7-11Synch. 56.4 ± 1.7; 49.6 ± 1.3; 47.6 ± 2.2; 49.0 ± 0.9 h, respectively. Proportion of heifers in estrus between 36 and 72 h was greater (P<0.01) for 7-11Synch (67%) than SS (49%) and tended to be greater (P<0.06) for PECP (70%) than 2XPGF (58%). Conception rate from 48 to 72 h was lower (P<0.01) for PECP but similar for SS and 7-11Synch: 48%, 71%, 75%, and 73% respectively. Conception rate of TAI heifers in PECP and 7-11Synch treatments was 5.9% (1/17) and 9.8% (4/41), respectively. Pregnancy rate (d 0 to 5) was greater (P<0.01) for EAI treatments than TAI treatments: 60%, 55%, 54%, and 41%, for 2XPGF, SS, 7-11Synch, and PECP, respectively. MGA pretreatment and ECP after PGF2α improved synchrony of estrus, but ECP reduced conception rates. Pregnancy rate after 3 d of AI in 7-11Synch heifers was similar to 5 d of AI in SS heifers.

Key Words: Ovulation synchronization, Progestin, Estrogen


The objective of this study was to evaluate the efficiency of synchronization protocols to improve pregnancy rate by improve in conception. Lactating Holstein cows (n=195), producing 30.4±1.3 kg milk/d with 90.2±3.1 DIM at the time of synchronized AI, were randomly assigned to one of five treatment groups: G1 (N = 39; CIDR; # 7d # CIDR out + PGF2α (Lutalyse®); 25mg, i.m.) # 24h # ECP (ECPα®; mg, i.m.); G2 (N = 39; CIDR; 2.5d # CIDR out + PGF2α - 24h # ECP - 44h # AI; G3 (N = 38; CIDR; # 7d # CIDR out + PGF2α - 24h # ECP - 5d # CIDR out + PGF2α - 48h - GnRH (Cystorelin®; 100mg, i.m.) # 12h # AI; G4 (N = 37; CIDR; # 7 # CIDR out + PGF2α - 48h - GnRH - 24h # CIDR; G5 (N = 32; 44%); 58% and 32% vs. 40% in the synchronized groups G1, G2, G3, and G4, respectively. When data of the cows effectively synchronized (CL regression on synchronization (81, 89, 89, vs. 94%) or pregnancy rates (35, 50, 58% vs. 65%) conception than the control group. The conception on the second AI were not affected by treatments (P = 0.49). G1 (N = 23; 26%); G2 (N = 28; 30%), G3 (N = 29; 36%) and G4 (N = 31; 42%) had higher (P<0.05) conception rates in heifers at a commercial heifer-development facility were assigned randomly to four treatments: 1) two injections of PGF2α, 14 d apart (2XPGF, n=97), 2) same as 2XPGF plus 0.5 mg of ECP 24 h after the 2nd PGF2α injection (d 0; PECP; n=98), EAI through 72 h after PGF2α, then timed AI (TAI) and GnRH to all non-detected heifers at 74 h; 3) GnRH on d -7 and PGF2α on d 0 and EAI (SS: n=97); 4) 0.5 mg of MGA from d -17 through d -11, PGF2α on d -11, GnRH on d -7 and PGF2α on d 0, EAI through 72 h after PGF2α. TAI and GnRH to all non-detected heifers at 74 h (7-11Synch, n=189). Doses administered were: i.m. 100 µg of GnRH and 25 mg of PGF2α. Pregnancy was diagnosed by ultrasonography 30 to 34 d after AI. From 0 to 72 h after PGF2α, average interval to estrus was greater (P<0.01) for 2XPGF than PECP but did not differ for SS or 7-11Synch. 56.4 ± 1.7; 49.6 ± 1.3; 47.6 ± 2.2; 49.0 ± 0.9 h, respectively. Proportion of heifers in estrus between 36 and 72 h was greater (P<0.01) for 7-11Synch (67%) than SS (49%) and tended to be greater (P<0.06) for PECP (70%) than 2XPGF (58%). Conception rate from 48 to 72 h was lower (P<0.01) for PECP but similar for SS and 7-11Synch: 48%, 71%, 75%, and 73% respectively. Conception rate of TAI heifers in PECP and 7-11Synch treatments was 5.9% (1/17) and 9.8% (4/41), respectively. Pregnancy rate (d 0 to 5) was greater (P<0.01) for EAI treatments than TAI treatments: 60%, 55%, 54%, and 41%, for 2XPGF, SS, 7-11Synch, and PECP, respectively. MGA pretreatment and ECP after PGF2α improved synchrony of estrus, but ECP reduced conception rates. Pregnancy rate after 3 d of AI in 7-11Synch heifers was similar to 5 d of AI in SS heifers.

Key Words: Ovulation synchronization, Progestin, Estrogen
The objective was to measure concentration of E2 in milk samples (E2 conc; pg/2gm) taken at specified times from dairy cows treated (T) with ECP. Sterile Solution (ECP; 2mg E2 cypionate/mL) compared to E2 conc in samples taken contemporaneously from control (C) cows. Unless specified, four-quarter composite (am+pm) samples were taken from each cow on consecutive days. Cows were randomly selected/assigned to one of five groups: (1) late lactation cows sampled for 5d (LL; n=15); (2) fresh cows C sampled for 7d (FC-C; 3-5d post partum; n=15); (3) fresh cows T with 2mL ECP i.m., sampled for 7d (FC-T; n=15); (4) breeding cows C (BC-C; 40-60d PP; n=16); and (5) breeding cows T with 0.5mL ECP i.m. (BC-T; n=17). To obtain BC for gp 4 and 5, cows were T with 5mL Lutalyse* Sterile Solution, and then sampled for 4d (am and pm, not composited). Cows in estrus by the 8th milking were assigned randomly to the BC-C and BC-T gp, and sampled post-T for 3d (am and pm, composited) and of 75 LL. 240 FC and 506 BC samples were assayed for E2 conc using a validated RIA. Data were analyzed using ANOVA. For the LL gp, milk E2 conc (pg/2gm) varied between 27.5 and 37.4 for the 5d period. Mean E2 conc of the FC-C (8.7) and FC-T (19.5) were less (P<0.01) than E2 conc in the LL gp. Similarly, mean E2 conc of the BC-C (6.3) and BC-T (8.0) were less (P<0.01) than E2 conc in the LL gp. E2 conc vs d 14 (P<0.01) and d 42 post-AI (P<0.01) between BC-C and BC-T. E2 conc in the FC-T gp was greater (P<0.01) than E2 conc in FC-C gp. E2 conc did not vary greatly by d of milking within the LL or BC gp. In the FC-C gp, E2 ranged from 4.8 to 16.0 and for the FC-T gp from 10.6 to 28.5 over the 8d period. In the BC gp, E2 conc was not different (P>0.05) pre- and post-ECP T. These findings indicate E2 conc in FC controls were 25% of E2 conc during LL. By 1-2 mo into lactation, E2 conc had decreased to 15-20% of E2 conc in LL. A 2 mL, but not a 0.5 mL injection of ECP gave a transient increase in E2 conc. The E2 conc in milk following ECP injection was lower than E2 conc observed in LL cows.

Key Words: Estradiol, Milk, Comparisons

M12 Timed AI (TAI) with estradiol cypionate (ECP) or insemination at detected estrus in lactating dairy cows. R.L.A. Cern*, K. N. Galvao, S. O. Juchem, R. C. Chebel, and J.E.P. Santos, 1University of California Davis.

Holstein cows, 799, from 3 dairies were blocked according to parity, BCS, and milk yield and randomly assigned to one of two treatments consisting of either TAI (Heatsynch) or insemination at estrus detection (ED). Cows received two injections of PGF2α (Lutalyse, Pharmacia Animal Health) at 37±3 and 51 DIM. At 65 DIM, cows received an injection of GnRH (Cystorelin, Merial Ltda), followed 7 d later by PGF2α. Cows in the ED group were inseminated after observed in estrus during the 7 d after the last PGF2α. Cows in the Heatsynch group received an injection of 1 mg of ECP (Pharmacia Animal Health) 24 h after the last PGF2α and were inseminated if observed in estrus in the first 24 h or TAI 48 h after ECP. Pregnancy was diagnosed by ultrasound at 30 d after AI and confirmed 14 and 28 d later. Progesterone in plasma was measured at the second PGF2α, GnRH, third PGF2α, and at 48 h after the third PGF2α injections. Lactation performance was followed for the first 165 DIM. Continuous and binomial data were analyzed using the MIXED and the LOGISTIC procedures of SAS (2001), respectively. Milk yield during the first 4 months after treatment (41.5 kg/d) was similar for Heatsynch and ED (P=0.64), but cows in the Heatsynch had lower production during the first 45 d of ECP treatment (P=0.01). Conception rate was higher for cows in the Heatsynch than ED on d 30 (43.0 vs 35.6%; P=0.03) and 58 (37.5 vs 31.0%; P=0.03) after AI. Heatsynch cows displaying estrus 24 and 48 h after ECP treatment had higher conception at d 30 after AI than those not displaying estrus at the moment of TAI (48.5 vs 23.6%; P<0.01). Pregnancy rates were higher for cows in the Heatsynch than ED on d 30 (43.0 vs 26.8%; P=0.01) and 58 (37.5 vs 19.6%; P<0.01) after AI. Pregnancy loss between 30 and 58 d after AI was similar for Heatsynch and ED (11.0 and 12.4%; P=0.88). Conception rate in the second AI was not affected by treatment (P=0.14) and it averaged 26.7%. Timed AI with the Heatsynch protocol compared to AI following ED improved conception and pregnancy rates at first AI, and had no effect on pregnancy loss in lactating dairy cows.

Key Words: Timed AI, ECP, Dairy cows


Holstein dairy heifers (n=190) 13 to 14 mo of age were subjected to a 42 d AI breeding period in which heifers received AI after once daily evaluation of removed tail chalk. At AI breeding period onset (d 0), heifers were randomly assigned to receive synchronization of ovulation (100 μg GnRH, d 0; 25 mg PGF2α, d 6; 100 μg GnRH+TAI, d 8; PG; n=96), or synchronization of ovulation as per GPG heifers but with a CIDR device inserted from d 0 to 6 (CIDR; n=94). The proportion of heifers receiving AI before d 8 was greater (P<0.01) for GnRH (23.9%, 23/96) than for CIDR (0.0%, 0/94) heifers, and conception rate at 30 d post-AI did not differ between GnRH (29.1%, 28/96) and CIDR (31.9%, 30/94) heifers. No treatment x AI technician interaction was detected (P=0.68); however, AI technician affected (P<0.01) conception rate (Tech 1=10.6%; 5/47; Tech 2=4.2%; 2/48; Tech 3=53.7%, 51/95). Overall pregnancy loss from 30 to 75 d post-TAI was 6.9%, (4/58) and did not differ between treatments. To synchronize second AI service, heifers (n=167) receiving TAI to first service were randomly assigned to receive either no further treatment (Control; n=85) or CIDR device insertion from d 14 to d 42 post-AI (Resynch; n=82). Heifers received second AI service after removed tail chalk. Conception rate at d 42 post-AI was greater (P<0.05) for Resynch (46.9%, 23/49) than for Control (26.0%, 13/50) heifers. Proportion of heifers receiving AI from d 14 to 20 was 0.0% (0/43) for Resynch vs. 32.7% (47/147) for Control, whereas proportion of heifers receiving AI within 72h after CIDR removal was 39.43% (35/90) for Resynch vs 58.6% (51/89) for Control heifers. Inclusion of a CIDR device prevented heifers from receiving AI during the TAI protocol with no detrimental effect on conception rate, and resynchronization of estrus using a CIDR device resulted in tighter synchrony of return to estrus for second AI service. Supported by Hatch project WIS04431 to PMF.

Key Words: Dairy heifers, Synchronization of ovulation, Timed artificial insemination

M14 Administration of estradiol cypionate (ECP) or GnRH after the end of a CIDR-based fixed-time AI program in dairy heifers. A. Garcia*, I. D. Peeler, O. A. Peralta, and R. L. Nebel, Virginia Polytechnic Institute and State University, Blacksburg.

An experiment was conducted to investigate the effects of estradiol cypionate (ECP) administered at the time of a CIDR device insertion on synchronization of follicular wave emergence and to compare the effects of ECP or GnRH administered 24 or 48 h after CIDR removal respectively on ovulation rate, time of ovulation, diameter of the ovulatory follicle and pregnancy rate after fixed-time AI in dairy heifers. Holstein and Jersey heifers (n = 30) 14 to 16 mo of age received a CIDR intravaginal insert (Eazi-Breed; Pharmacia Upjohn Animal Health) and 1 mg ECP (Pharmacia Upjohn Animal Health) i.m. on d 0. On d 7, CIDR devices were removed and 25 mg dinoprost (Lutalyse; Pharmacia Upjohn Animal Health) i.m. was administered concurrently. After CIDR removal, heifers were randomly allocated to receive either a 0.5 mg ECP i.m. (ECP group; n = 15) 24 h later or 100 μg GnRH (Cystorelin, Merial Limited) i.m. (GnRH group; n = 15) 48 h later. Timed AI was performed 48 to 72 h after CIDR removal using frozen/thawed semen from sires of proven fertility. Ovarian ultrasonographic examinations were performed once a day from d 0 to 7 and twice daily from d 8 to ovulation. Categorical data was compared using chi-square analysis, and quantitative data by ANOVA. A new wave of follicular development was detected on average 3.7±0.9 d after CIDR insertion. Although heifers receiving ECP had a shorter (P<0.02) interval from CIDR removal to ovulation than GnRH heifers (35.8±12.4 and 71.6±10.1 in ECP and GnRH groups, respectively), the pregnancy rate was not different (P=1.0) among groups. A pregnancy rate of 73.3% was obtained after the first synchronization.
cycle for ECP, and GnRH treated heifers. An overall pregnancy rate of 93.3% was obtained after two or three synchronization cycles for ECP or GnRH groups, respectively. Ovulation rate (100%) and diameter of ovulatory follicle (13.0±1.8 and 14.0±1.9 mm) did not differ (P>0.05) between ECP, and GnRH groups, respectively. In conclusion, the results from the present experiment demonstrated that ECP administration 24 h after the end of a CIDR treatment resulted in pregnancy rates comparable to the ones obtained after administration of GnRH 48 h after CIDR removal.

**Key Words:** Estrus synchronization, Dairy heifers, Estradiol cypionate

M15 Effect of estradiol cypionate (ECP) and estradiol benzoate (EB) on synchronization of follicle wave and luteal function in dairy heifers. K. N.*, R. C. Chebel, A. C. Coscioni, J.E.P. Santos, R.L.A. Cerri, and S. O. Juchem, University of California - Davis.

Thirty post-pubertal Holstein heifers (13mo) were randomly assigned to one of four treatments: 1) Control (n=4); 2) 2.0mg of EB (N=6); 3) 1.0 mg of ECP (ECP1; N=10); and 4) 1.5mg of ECP (ECP1.5; N=10). Treatments were given by i.m. injections at 72 h after ovulation. Ovaries were scanned every 12h, and follicles ≥ 4.0mm and CL were tracked from the day before ovulation through the estrous cycle. Blood was collected daily from the day of ovulation to 7 d after the treatments for measurements of plasma progesterone and estradiol. Prostaglandin F2α was given on d 17 after ovulation. Continuous data and repeated measurements were analyzed by the GLM and MIXED procedures of SAS (2001). Respectively. Treatments were given at similar time after deviation of the dominant follicle (DF) of the first wave (FW1), and averaged 15.7h (P=0.83). Growth rate of the DF of the FW1 was retarded by all estradiol treatments (9.3 ± 0.6 vs. 7.5 ± 0.1 d), whereas less than ECP (P<0.001). Hours from ovulation to emergence of FW2 were reduced by EB (178.0 h; P=0.03), but not by ECP1 (212.4 h) or ECP1.5 (218.4 h) compared to controls (234.0 h). Emergence of FW2 after treatment was earlier for EB compared to ECP1 and ECP1.5 (104 vs 140.4 vs 218.4 h) compared to controls (234.0 h). Emergence of FW2 after treatment was earlier for EB compared to ECP1 and ECP1.5 (104 vs 140.4 vs 218.4 h) compared to controls (234.0 h).

**Key Words:** Estradiol cypionate, Estradiol benzoate, Follicle development

M16 Reproductive management of dairy heifers using synchronization of ovulation and fixed-time artificial insemination (TAI) or artificial insemination after removed tail chalk. H. Rivera*, H. Lopez, and P.M. Fricke, University of Wisconsin - Madison.

Holstein dairy heifers (n=352) between 13 and 14 mo of age were subjected to a 42 d AI breeding period in which heifers received AI after once daily evaluation of removed tail chalk. At AI breeding period onset (Day 0), heifers were randomly assigned to receive synchronization of ovulation and TAI (100 µg GnRH, Day 0; 25 mg PGF2α, Day 6; 100 µg GnRH+TAI, Day 8) followed by AI after removed tail chalk for the remainder of the AI breeding period (GPG; n=175), or AI after removed tail chalk for the duration of the AI breeding period (TC; n=177). Internal from AI breeding period onset to first AI service was greater (p<0.01) for TC (9.9 ± 0.6 vs. 7.5 ± 0.1 d), whereas conception rate at 30 d post AI was similar between treatments (46.5%, 80/172 vs. 38.3%, 67/175 for TC vs. GPG heifers, respectively). No treatment x AI technician interaction was detected (p=0.70); however, AI technician affected (p<0.01) conception rate (Tech 1=24.8%, 28/113; Tech 2=30.0%, 18/60; Tech 3=56.8%, 101/174). Pregnancy loss from 30 to 75 d post AI was 10.2% (15/147) and was similar between treatments. For GPG heifers, 17.7% (31/175) received AI before day 8 (Day 5 ± 0.2) and did not receive TAI. For GPG heifers receiving TAI, 90.9% (131/144) ovulated within 48 h after the second GnRH injection (double ovulation rate=4.9%, 7/144). Blood samples collected from GPG heifers at each injection were classified based on serum progesterone (P) concentrations as High (≥ 1.0 mg/ml) or Low (< 1.0 mg/ml). The proportion of GPG heifers with a functional CL (High P) at PGF2α was 91.6% (132/144), and 96.2% (137/132) of functional CL had regressed (Low P) by 48 h after PGF2α. We conclude that this protocol for fixed-time AI of dairy heifers can yield acceptable conception rates if estrus detection and AI is conducted between the first GnRH and PGF2α injections and the effect of AI technician is optimized. Supported by Hatch project W1504431 to PMF.

**Key Words:** Dairy heifers, Synchronization of ovulation, Timed artificial insemination

M17 Effect of a rapid resynchronization of nonpregnant cows with estradiol cypionate (ECP) and PGF2α on pregnancy rates (PR) and pregnancy loss (PL) in lactating dairy cows. R. C. Chebel*, R.L.A. Cerri, K. N. Galvao, S. O. Juchem, and J.E.P. Santos, University of California - Davis.

Nonpregnant Holstein cows inseminated 2 or more times between 28 and 34 d after the pre-enrolment AI were assigned to a rapid resynchronization (Quicksynch; N=159) or to the Heatsynch (N=183) protocol. Cows between 28 and 30 d after AI with a follicle larger than 10mm were assumed to be in first follicular wave of a new estrous cycle and assigned to the Quicksynch protocol, which consisted of injections of 25mg of PGF2α (Premarin Animal Health) followed 24h later by 1mg of ECP (Pharmacia Animal Health). Cows were inseminated if observed in estrus or at fixed time 48h after ECP. Cows between 28 to 30 after AI with follicles less than 10mm and cows between 31 and 34 d after AI were enrolled in Heatsynch group and received 100g of GnRH (Merial Ltda), followed 7 d by PGF2α, and ECP 24 h after the PGF2α. Insemination was performed as indicated for the Quicksynch group. Continuous and binomial data were analyzed using the GLM and the LOGISTIC procedures of SAS (2001), respectively. Lactation number, BCS, DIM and milk yield were similar for Quicksynch and Heatsynch cows (P>0.15). The proportion of cows inseminated at fixed time was similar for both protocols (85.0%). Cows in Quicksynch and Heatsynch had similar PR on day 28 (18.9 vs 24.0%; P=0.54) and 42 (17.6 vs 20.8%; P=0.77) after the resynchronized AI. Pregnancy loss between 28 and 42 d after AI was unaffected by treatment (Quicksynch<6.7 vs Heatsynch<14.0%; P=0.41). Cows inseminated during heat stress had lower PR (23.3 vs 11.8%; P=0.03) and higher PL (30.8 vs 6.7%; P=0.02) than those inseminated during the cool season. More Heatsynch than Quicksynch cows had a CL on the day of PGF2α (77.1 vs 62.3%; P<0.001), and presence of a CL increased PR (P<0.001) for both Heatsynch (27.7 vs 11.9%) and Quicksynch (25.3 vs 8.3%). Rapid resynchronization of nonpregnant cows with PGF2α and ECP between 28 and 30 d after the pre-enrolment AI resulted in similar PR and PL compared to the Heatsynch protocol, but PR was improved when a CL was present at the PGF2α injection.

**Key Words:** Resynchronization, ECP, Dairy cows

M18 Use of intravaginal progesterone-releasing devices (CIDR) to resynchronize postpartum dairy cows previously synchronized for anestrus. S. McDougall1, S. H. Loeffler2*, and R Tiddy3, 1Animal Health Centre, P.O. Box 21, Morrinville, New Zealand, 2Riverside Veterinary Services, Ashburton, New Zealand 8300, 3Pharmacia Animal Health, New Zealand.

Introduction: In New Zealand, a fixed breeding season begins about 3 months after calving has begun. At this time, any cow that is greater than 21 days in milk and has not shown a heat is considered to be anestrous (A). These cows may represent up to 20 percent or more of the breeding herd. A animals may be treated with an intravaginal progesterone-releasing device (CIDR) to induce cyclicity. Although about 85% of these animals will show estrus and be bred after CIDR removal, only about 40% of these cows will conceive to first AI. Of the remaining cows, almost half (43 percent) will not show estrus 14 to 28 d after first AI. To reduce the problem of these "phantom pregnant" cows, a resynchronization protocol was developed.

Objective: To determine the difference in pregnancy rates (PR) at 28 and 56 d post insemination (following an initial CIDR treatment) and the final PR of previously A cows at the end of the breeding period between a no resynch group, a resynchronization protocol using a low dose
(0.5 mg) of estradiol benzoate (EB) only, and a resynchronization group using GnRH and low-dose of EB.

**Material and Methods:** A cows (n = 971 in 8 herds) were initially treated (7 d prior to the start of the breeding season) with a CIDR for 6 d with injection of 1 mg of EB one day after device removal (day of estrus detection = Day 0). Cows detected in estrus between D 0 and 3 were randomly assigned to be treated with a) reinsertion of a used P-releasing device for a period of 8 days on D 15 with 0.5 mg of EB at time of reinsertion and again one day after removal (EB-low), b) as for a) except that 250 mg of GnRH was substituted for EB at CIDR reinsertion (GnRH-EB-low) or c) left as untreated controls (control).

Cows detected in estrus within 6 wks of commencement of the breeding program were submitted for AI. Bulls were then introduced to the herd for a further 13.5 weeks (stdev = 1.7, range = 11.3-16.9 wks). Enrolled cows were pregnancy tested twice (with a 6 wk interval) and the conceptions rate estimated.

**Results and Conclusions:** Fewer cows were pregnant by D 28 and 56 of the breeding program following GnRH-EB-low than EB-low and control, but the final pregnancy rate was higher following EB-low than control or GnRH-EB-low (95.0%, 89.7%, 88.6%, respectively; p < 0.05). It is considered that EB-low resynchronization enhances reproductive performance of anestrous cows compared to GnRH-EB-low resynchronization or no resynchronization under New Zealand conditions.

**Key Words:** Resynchronization, Intravaginal progesterone releasing device, Cattle

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Objective was to compare pregnancy rate (PR) to re-synchronizations based on uterine and ovarian status. Holstein non-pregnant cows (n = 877) were classified at ultrasound on d0 (30d after AI) as: diestrus (CL, follicle ≤ 12 mm), metestrus (edema, edema, CL, follicle < 12 mm), proestrus (tongue, follicle > 12 mm), cystic (tongue > 15 mm, no CL, no tone), or anestrus (foll. < 12 mm, no tone). Cows in diestrus were assigned to Ovsynch (n = 216), Quicksynch (PGF 2α [PG] d0, 1 mg ECP d1, and TAI d3; Jan.-May; n = 92), or Modified Quicksynch (PG d0, ECP d1, AI at pedometer d2-3, and cows with no activity begin Ovsynch on d4; Jun.-Dec; n = 110). Cows in metestrus were assigned to Ovsynch (n = 54), Heatsynch (n = 50) or GnRH+Ovsynch (GnRH on d0, GnRH d8, PG d15, GnRH d17, and TAI at 16h; n = 44). Cows in proestrus assigned to Ovsynch (n = 71) or GnRH+Ovsynch (n = 73). Cows with ovarian cyst assigned to Ovsynch (n = 75) or GnRH+Ovsynch (n = 78). Diagnosis (US) for pregnancy was at 30d after TAI. PR was evaluated using multiple logistic regression adjusting for season, parity, number services and inseminator. Cows were classified as: diestrus 47.7% (418/877), metestrus 16.9% (148/877), proestrus 16.4% (144/877), cystic 17.4% (153/877) and anestrus 1.6% (14/877). PRs for diestrus were: Quicksynch 21.7%, Modified Quicksynch 28.2% (32.9% [26/79] at pedometer, 16.0% [5/31] TAI), Ovsynch 34.7%; metestrus: Ovsynch 24.1%, Heatsynch 18%, GnRH+Ovsynch 31.8%; proestrus: Ovsynch 31.0%, GnRH+Ovsynch 27.4%; cystic: Ovsynch 20.0%, GnRH+Ovsynch 30.8%. Ovsynch for cows in diestrus was used as the referent. There were decreases in PR for: Quicksynch cows in diestrus (P < 0.02); Heatsynch (P < 0.02) and Ovsynch (P < 0.13) cows in metestrus; Ovsynch cows with ovarian cyst (P < 0.01). PR to re-synchronization can be improved by assigning TAI protocols according to uterine and ovarian status. Strategies to increase the number of cows in diestrus at US, reduce treatment time and costs are underway.

**Key Words:** Re-synchronization, Time insemination, Cattle

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**M20 Enhancing the efficiency of AI in dairy cattle through modified systematic breeding protocols utilizing heat detection and timed AI. J. C. Dalton, R. Manzo, A. Ahmadzadeh, Caldwell Research and Extension Center, Caldwell, ID, University of Idaho, Moscow, ID.**

The objective of this study was to compare the conception rates of lactating dairy cattle subjected to four different artificial insemination (AI) protocols. Two commercial dairies utilizing daily look up, tail chalk, and once daily AI participated in the study. Cows (N = 432) were administered GnRH (100 ug) on d-7 and received tail chalk daily. Cows detected in estrus according to chalk removal (rougheened tailhead hair) prior to d 0 received AI immediately. Cows not detected in estrus by d 0 were administered prostaglandin (PGF; 25 mg) and continued to receive tail chalk daily until d +2. All cows detected in estrus prior to and including d +2 were assigned randomly to one of three treatment groups: GnRH on d +2 and timed AI 16 h later (T2; n = 132), GnRH and timed AI 64 h after PGF (T3; n = 127), or timed AI 64 h after PGF (no GnRH) (T4; n = 127). Pregnancy was diagnosed 35-45 d after AI by rectal palpation. Median days in milk were 112, 120, 128, and 119 for T1, T2, T3, and T4, respectively. Mean milk yield was 39.2, 39.5, 39.0, and 38.2 kg/d for T1, T2, T3, and T4, respectively. Conception rates (adjusted proportion pregnant) were 25.4%, 29.8%, 21.2%, and 16.5% for T1, T2, T3, and T4, respectively. The conception rate (adjusted proportion pregnant) was higher for T1 and T2 compared to T4 (P < 0.06). The conception rate (adjusted proportion pregnant) was different between T3 and T4. Nearly 11% of all cattle enrolled exhibited spontaneous estrus, received immediate AI (T1), and achieved an acceptable conception rate. Consequently, dairy producers should consider including heat detection in all systematic breeding programs. Timed AI (without GnRH) 64 h after PGF administration (T4) is not recommended as this treatment resulted in an unacceptably low conception rate (adjusted proportion pregnant).

**Key Words:** Artificial insemination, Estrus, Conception rate

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**M21 Reproductive efficiency in cattle selected for ovulation and twinning rate. S. E. Echtenkamp, A. Sozzi, L. F. Archbald, J. Mchale, and W. W. Thatcher.**

Effect of ovulation rate on cow productivity was evaluated in the MARC Twinner herd by comparing ovulation rate (i.e., CL) at pregnancy diagnosis to calving results and progeny performance. Numbers of fetuses and CL were determined by scanning the uterus and ovaries transrectally with a 3.5 MHz, convex-array, real-time, ultrasound probe at 75 d after first d of the 1995 to 2002 spring and fall breeding seasons; females < 35 d of gestation were re-examined 35 d later. Progeny BW was measured at birth and 200 d of age. Effects of type of birth on progeny BW and survival were analyzed by GLM ANOVA with age of dam, sex of calf, dystocia, year, season, and uterine location in the model and on calf survival by Chi-square analysis. Incidence of fetal mortality (abortions) from ultrasound to calving was 6.0% for single, 12.2% for twin, and 50.0% for triplet pregnancies (P < 0.01; n = 890, 583, and 28 cows, respectively). Percentage of females calving did not differ (P > 0.1) between single ovulations occurring on the left vs right ovary (84.9 vs 82.8%), but twinning rate was greater (P < 0.01) for bilateral twin ovulations (63.1% twins and 20.9% singles) compared with unilateral twin ovulations on left (55.4% twins and 27.9% singles) or right (53.6% twins and 27.0% singles) ovary. Calb birth weight and survival were also greater (P < 0.01) for bilateral vs unilateral twins (38.5 ± 0.3 kg and 91.8 ± 1.1% vs 36.8 ± 0.3 kg and 82.3 ± 1.1%, respectively). Single-born calves were heavier (P < 0.01) than twin or triplet calves at birth (48.7 ± 0.1 vs 37.6 ± 0.1 or 30.5 ± 0.6 kg) and at 200 d of age (256.9 ± 1.4 vs 224.4 ± 1.4 or 210.6 ± 7.0 kg); whereas, number weaned and total 200 d BW per cow calving increased (P < 0.01) from single (0.89 ± 0.01 calf and 220.8 ± 2.5 kg) to twin (1.54 ± 0.01 calves and 343.6 ± 3.4 kg) to triplet (1.80 ± 0.08 calves and 378.3 ± 17.8 kg) birth. Bilateral twin ovulations produced the greatest increase in reproductive efficiency in cattle; whereas, increased pre- and postnatal mortality for triplet ovulations and births compromise such gains.

**Key Words:** Twins, Survival, Cow productivity

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**M22 CIDR-based protocols for synchronizing bovine embryo transfer recipients without estrus detection. M. G. Colazo, J. P. Kastelic, W. J. W. Archbald, and W. W. Thatcher.**

The objective was to compare two protocols to synchronize embryo transfer recipients without detecting estrus. On Day 0 (start of experiment), lactating beef cows (n = 76) were given a CIDR device (Bioniche Animal Health); 36 cows (CIDR group) were concurrently given injections of 1 mg estradiol cypionate (ECP); (Pharamcia Animal Health) and 50 mg progesterone (Progestrone 5%; Vtoquinol). On Day 1, the other
Effect of a single treatment with estradiol cypionate (ECP) on dominant follicle (DF) and superovulatory response in dairy heifers. R. C. Chebel*, A. C. Coscioni, K. N. D. Iyavu, R. L. A. Ceremony, S. O. Juchem, and J. E. Santos, Veterinary Medicine Teaching and Research Center, University of California - Davis.

Effect of a single treatment with estradiol cypionate (ECP) on dominant follicle (DF) and superovulatory response in dairy heifers Thirty-one postpubertal Holstein heifers (13mo) were randomly assigned to one of three treatments: Control (N=10); 1 mg of ECP im. on d 3 after ovulation (ECP; N=11); and DF aspiration (ADF; N=10) on d 5 after ovulation (ovulation: study d 0). Superovulatory treatment with FSH (400 mg) started on study d 6, concomitant with insertion of a CIDR. During the 6th and 7th FSH treatment, PGF2α was given and the CIDR removed after the last FSH. An injection of GnRH was given 24 h after CIDR removal and heifers were inseminated twice, 12 h apart, with the first insemination at 12 h after GnRH injection. Heifers were flushed on d 7 after the first AI and structures evaluated. Ultrasonographic examination of the ovaries was performed from study d 0 to 6, and blood samples were collected twice daily from study d 2 to 6 for measurements of progesterone and estradiol. Continuous and count data were analyzed by the GLM and GLIMMIX procedures of SAS (2001), respectively. The control heifer was the experimental unit for analyses. Number of CL on d 7 after AI was higher for ADF than ECP and Control (9.8 vs 5.9 vs 4.3; P<0.01). Number of structures collected was higher for ADF than ECP and Control (8.7 vs 4.7 vs 3.6; P<0.01), but ADF also resulted in higher number of degenerated embryos than ECP and Control (3.1 vs 1.1 vs 1.4; P<0.01). Control heifers had more unfertilized oocytes than ECP (1.5 vs 0.5; P<0.04). Number of grades 1 and 2 embryos was higher for ADF and ECP than control (3.7 vs 2.7 vs 0.6; P<0.01). Percentage of total structures collected as grades 1 and 2 embryos tended to be higher for ECP than control (64.8 vs 30.0%; P=0.10), but it did not differ from ADF (40%). Within ECP heifers, those with growth rate of the DF > 1 mm/d had higher number of structures collected (7.0 vs 2.0; P<0.01) and more embryos grades 1 and 2 (3.8 vs 1.4; P<0.02) than heifers with DF growing more than 1 mm/d. Treatment with ECP 3 d prior to initiation of superovulation improved number of transferable embryos collected and response was higher when the DF regressed.

Key Words: Estradiol cypionate, Superovulation, Embryo quality


The relationship between numbers of small antral follicles and superovulation response in a select population of Holstein cows was examined in this study. Eight daughters of a cow (Integren Secret Sonata-ET) which has consistently responded to superovulation by producing large numbers of embryos (576 total embryos/ova and 400 transferable embryos in 27 collections) and four non-related herd mates were studied. Ovaries of all Sonata daughters in a single herd (n=32) were observed twice (15 day interval) using ultrasonography to obtain an estimate of the number of small follicles (3-5mm) present. Sonata daughters with greater than 25 small follicles/observation were assigned to a high group (n=4). Sonata daughters that had fewer small follicles (11-2) as compared to the number of small follicles (15-7) present on all of her daughters were assigned to a low group (n=4). Non-related herd mates (n=4) that were of similar age, stage of lactation, and milk production were assigned as controls. In experiment 1, ovaries of all cows in each group were observed using ultrasonography every twenty-four hours through two consecutive follicular waves. The number of small follicles/day (18.4, 13.4, and 11.0; high, low, and control groups, respectively) differed between the groups (P<0.0001). In experiment 2, all cows were superovulated three times to obtain a mean superovulation response. Five days following marker heat detection, all follicles >4 mm were ablated. Follicle stimulating hormone (Follitropin) was administered every twelve hours in decreasing doses over four days, beginning 24 hours after follicle ablation. Ova/embryos were collected nonsurgically, seven days after insemination. The number of corpora lutea at embryo recovery (12.3 ± 1.8, 10.6 ± 1.9, 7.4 ± 2.1; high, low, control, respectively), total ova/embryos (7.5 ± 1.7, 9.3 ± 1.8, 3.6 ± 2.0; high, low, control, respectively), transferable embryos (4.6 ± 1.4, 7.5 ± 1.4, 3.1 ± 1.6; high, low, control, respectively), and degenerate embryos (3.0 ± 1.1, 2.3 ± 1.1, 0.6 ± 1.2; high, low, control, respectively) recovered did not differ between groups (P>0.05). The number of small antral follicles present on the ovaries of selected sub-populations of Holstein cows was positively associated with the superovulation response.

Key Words: Cattle, Follicle, Superovulation


The adrenal gland may play a causative role in the formation of ovarian follicular cysts in cattle. Two experiments were conducted to determine if adrenal secretion of steroids differed between cows that formed follicular cysts versus normal cycling cows. In experiment 1, lactating Jersey and Holstein cows were diagnosed as having ovarian follicular cysts (follicle diameter ≥ 20 mm) via palpation of ovaries per rectum. Ovaries were examined by transrectal ultrasonography three times weekly to detect ovulations (OV; n=8) and/or new cyst formations (NCF; n=9). Venous blood samples were collected daily to quantify circulating concentrations of cortisol (CORT). The average CORT concentration (µg/dl) across the 10 day period prior to OV was not different from the concentration prior to NCF. In experiment 2, secretion of CORT and progesterone (P4) was examined in cows with ovarian follicular cysts (OFC;n=4) and control cows (CONTROL; n=4) in the follicular phase of the estrous cycle. An adrenocorticotropic hormone (ACTH) challenge (Cortrosyn, 0.06 mg, i.v.) was administered to cows with OFCs. CONTROL cows were treated with prostaglandin F2α (Lutalyse, 25 mg, i.m.) twice, 12 hours apart to induce luteolysis and the onset of the follicular phase. For CONTROL cows, the ACTH challenge was administered 36 hours after the first injection of prostaglandin F2α. Jugular venous blood samples were collected at -60, -30, 0, +10, +20, +30, +60, +90, +120, +180, +240, +300 and +360 minutes relative to ACTH administration. A rapid increase in both CORT and P4 was observed immediately following administration of ACTH in each treatment group (OFC and CONTROL). Peak concentrations of both steroids were achieved 30 minutes post ACTH administration. Mean concentrations of CORT and P4 did not differ between treatment groups (OFC vs. CONTROL) with respect to response and/or area under the curve. In summary, no differences in adrenal function were detected between normal cycling cows and cows with ovarian follicular cysts.

Key Words: Progesterone, Cortisol, Ovarian follicular cyst
M26 Effects of immunization of gilts against 17α-hydroxyprogesterone on follicular size distributions and follicular steroid synthesis. N. Post*, D. Kreider1, K. Cole1, M. Nihsen1, and C. Maxwell1, University of Arkansas.

The objective of this experiment was to evaluate the effects of immunization of gilts against 17α-hydroxyprogesterone on follicular size distributions and follicular steroid synthesis. Thirty-six crossbred gilts at 147 d of age were immunized against adjuvant (Control, n = 18) or 17α-hydroxyprogesterone (17OHP, n = 18). Gilts were given an initial 0.6 ml injection divided between two subcutaneous sites at the base of each ear, followed four weeks later by a single booster injection. Estrus was checked twice daily with a boar. At 16 to 17 d following first estrus gilts were sacrificed, tracts were recovered and uterine weight, uterine length, number of corpora lutea, and number of small (0-3 mm), medium (4-6 mm), and large (> 7 mm) follicles were determined. Serum binding of 17α-hydroxyprogesterone in 17OHP was greater than (P < 0.01) Control and increased with time (P < 0.01). Age at puberty was not affected by treatment (P = 0.28) and averaged 187.3 ± 0.4 and 183.9 ± 1.7 d for Control and 17OHP, respectively. Serum progesterone during the first 17 d of the estrous cycle was higher for 17OHP than Control (P = 0.09). Serum estradiol-17β was not affected by treatment (P = 0.84). Serum progesterone (P < 0.01) and estradiol-17β (P < 0.01) were affected by time. Uterine weight was increased (P = 0.12) in 17OHP vs. Control, while mean uterine length was numerically greater (P = 0.18) in 17OHP vs. Control (716.8 ± 47.8 vs. 625.3 ± 30.1 g and 214.8 ± 10.7 vs. 211.1 ± 11.2 cm, respectively). Ovulation rate at first estrus was higher in 17OHP than Control (15.8 ± 0.6 vs. 13.4 ± 0.4). Follicular fluid estradiol-17β did not differ between treatments (P > 0.62) for any follicular size class; however, testosterone was higher (P = 0.16) in medium follicles of 17OHP than Controls (133.1 ± 22.5 vs. 94.5 ± 13.6 ng/ml, respectively). These data suggest that immunization against 17OHP altered follicular growth and steroid synthesis.

Key Words: Gilts, Ovulation rate, Steroids

M27 A direct injection of vascular endothelial growth factor (VEGF) gene to the ovary promotes follicular development in miniature gilts. T. Shimizu, H. Sasada, and E. Sato*, Tohoku University, Sendai, Japan.

Ovarian follicular angiogenesis initiates early during follicular development and continues throughout follicular growth. In general, vascular endothelial growth factor (VEGF) is thought to be a central factor for regulation of thecal angiogenesis during follicular development. We investigated whether follicular development was promoted by inducing extraproduction of VEGF with direct ovarian injection of its gene in miniature gilts. Using a TAP Express KitTM, porcine VEGF gene was transformed into a transcriptionally active PCR fragment that is used for direct introduction into mammalian tissues according to the manufacturer’s instrument. Eleven prepubertal miniature pigs were used and divided in three groups. The first group was injected i.m. with 500 IU of eCG to induce follicular development, and the second was injected with saline as a control. The third group was directly injected with VEGF gene fragments into both ovaries, followed by administration i.m. with 500 IU of eCG 7 days later. Animals from each group were ovariectomized 72 h after eCG or saline injection. The number of the preovulatory follicles increased in the VEGF-treated ovaries compared to those of either the control or the eCG alone. No atretic follicles were observed in the ovaries treated with VEGF gene injection. In the ovaries injected with VEGF gene, the vascular density in medium follicles ranged between 3.0 and 4.9 mm in diameter increased approximately two folds as compared to those of the eCG alone. Follicles with a larger than 6.0 mm in diameter, which were appeared only in the gilts received the injection of VEGF gene, had significantly higher vascular density than those of other follicles. Our findings demonstrated that the direct injection of VEGF gene into the ovary induces the development of the vascular network in the thecal cell layers and can promote follicular development by reflection on resuse of the atretic follicles.

Key Words: Thecal angiogenesis, Follicular development, Atretic follicle

M28 Effects of the ovulatory response to the first GnRH injection on synchronization and pregnancy rates in lactating dairy cows. RM Santos*, JLM Vasconcelos, M Meneghetti2, EPBC Silva3, and P Wechsler1, 1FCAV - Unesp, Jaboticabal, 2FMVZ - Unesp, Botucatu.

Data from 2 trials were analyzed to evaluate the effect of ovulation to the first GnRH treatment in synchronization of ovulation protocols in lactating dairy cows. In trial 1, 136 lactating Holstein cows, with 23.7 ± 5.8 kg milk/d and 134.6 ± 73.6 DIM, were randomly assigned to one of 2 groups that differed in the dosage of GnRH: G1 (N=68), Ovsynch with 1.0 mg of gonadorelin (Fertagyl®); and G2 (N=68), Ovsynch with 2.5 mg de gonadorelin. In trial 2, 204 crossbred lactating cows, with 13.8 ± 4.9 kg milk/d and 99.8 ± 73.6 DIM, were randomly assigned to one of 2 groups: G1 (N=102), GnRH+CIDR in-6d-PGF2α+CIDR out-6h- GnRH-12h-AI; and G2 (N=102), GnRH+CIDR in-6d-PGF2α+CIDR out-24h-ECP-36h-AI. Data were analyzed by the CATMOD procedure of SAS with a mathematical model that included the effects of breed, cyclicity, milk production, parity and treatment. No effects of treatments were detected on trial 1. However, in trial 2 treatment influenced synchronization rate (P<0.10), but not pregnancy rate. Ovulatory response to the first GnRH injection averaged 55

Key Words: Synchronization, GnRH, Dairy cow


This study was conducted to determine the effect of pre- and post-ovulatory nutrition with or without supplemental progesterone (P4) on ovulation, embryonic survival, and pregnancy rates in multiparous ewes. Multiparous ewes (n=66) were randomly assigned to a 3 x 2 factorial and fed individually. Groups 1 and 2 received a diet 2 x maintenance 2 wk prior to mating (d 0), and 2 x 1 x maintenance, respectively, up to d 15 post mating with half of each group receiving P4 supplementation via a controlled internal drug releasing device (CIDR) starting 24 h post estrus (d 2). Group 3 received a diet 1 x maintenance 2 wk prior to and during breeding season with and without P4 supplementation via a CIDR starting 24 h after estrus. After d 15 post mating, all diets were 1 x maintenance. Ewes were bred via natural service after estrus was detected using a vasectomized ram and the HeatWatch® system. Progesterone therapy continued until d 23 after mating. Ovulation rate was determined (mid-ventral laparotomy) using five randomly selected ewes from each treatment ranging from d 4 to d 8 post breeding. Blood samples were collected (jugular venipuncture) from these 30 ewes every third day from d 2 to 29 at 1800 h. Plasma insulin and P4 concentrations were determined by RIA. Insulin was not affected (P > 0.20) by P4 treatment. Group 1 had a greater (P < 0.03) insulin concentration than 2 and 3. Progesterone was elevated (P < 0.01) for ewes receiving CIDR starting 12 h after insertion through d 11. Ewes in nutritional groups 1, 2, and 3 differed (P < 0.05) in P4 concentration (0.9, 1.6, and 2.4 ng/ml, respectively). Number of corpora lutea present was similar (P > 0.50) across CIDR and nutritional treatments. Additionally, no difference (P > 0.30) was observed across nutritional treatments for ewes ultra sounded as having zero, single, or twin lambs. However, ultrasound data indicated ewes receiving CIDR had a higher incidence of singles and lower twinning rates (P = 0.01). This was verified by ultrasound data from all ewes on the project for P4 therapy (P = 0.05). In summary, P4 therapy decreased the number of ewes with multiple fetuses. Nutrition did not influence ovulation rate or pregnancy rate.

Key Words: progesterone, ovulation, embryonic survival, pregnancy rate, insulin

M30 Effects of feeding supplemental safflower seed with human chorionic gonadotropin following AI on pregnancy rates in heifers. R. S. Walker*, P. D. Burns2, G. E. Sides3, and D. D. Zalesky1, 1San Juan Basin Research Center, Hesperus, CO, USA, 2Colorado State University, Fort Collins, CO, USA, 3Intervet, Inc., Millsboro, DE, USA.

The objective of this study was to determine the effects of supplementing 0.96 kg of whole safflower seed with an ICG injection post AI to
increase fertility in heifers. Primiparous crossbred beef heifers (n = 96) were divided into two breeding seasons, early breeding heifers (EBH, n = 48) and late breeding heifers (LHB, n = 48), and randomly assigned to one of two dietary supplement groups by weight and age for both EBH and LHB. Heifers were fed a control diet (CON) consisting of mixed alfalfa/grass hay and oat grain or a safflower seed diet (SAPP) consisting of the control diet plus safflower seed high in oleic (69.9%) acid. Diets were fed 35 d prior to AI and continued 20 d post AI. Diets were formulated to be isocaloric and isonitrogenous for both groups. Heifers in each supplement group for both EBH and LHB received either an injection of hCG (3,300 IU) or saline 5 d post AI. All heifers were synchronized with calf removal and prostaglandin F2 alpha (PGF2 alpha) > AI (66.7 vs 59.5%), but did not differ from saline treated heifers (P > 0.10) between Control and CIDR cows. Pregnancy rates by AI were not different (P = 0.28), between Control (18%) and CIDR (33%) cows. Overall pregnancy rates were higher (P < 0.10) in Control (97%) compared to CIDR (80%) cows. Concentrations of P4 on d -7, d 0, and d 11 did not influence (P > 0.10) overall pregnancy rates; however, progesterone concentrations were increased (P < 0.05) in CIDR cows on d 0 (5.6 vs 2.9 ng/ml, for CIDR vs. Control) and d 11 (7.1 vs 4.8 ng/ml, for CIDR vs. Control). Administration of a CIDR 7 d before calf removal and PGF2 alpha increased concentrations of P4 on d 0 and 11, and increased the proportion of cows exhibiting estrus. However, CIDR treatment did not improve conception and AI pregnancy rates and reduced overall pregnancy rates in this study.

Key Words: Postpartum, Beef cows, CIDR


The purpose of this study was to examine effects of glucose concentration, epidermal growth factor (EGF), and hormones (FSH, LH, and estradiol 17 beta) during bovine oocyte maturation on in vitro production of blastocysts. Oocytes from slaughterhouse ovaries were divided among the 12 factorial combinations of 3 glucose concentrations (0.5, 2.0, and 5.5 mM), presence or absence of 50 ng/ml of EGF, and presence or absence of LH, FSH, and E2 in CDM-1, a chemically defined medium similar to SOF. Oocytes were matured at 38.5°C in 5% CO2 in air for 23 h. After maturation, oocytes were fertilized at 1 X 10^6 sperm/ml in 6 replicates in F-CDM (0.5 mM glucose), and then cultured 2 days in CDM-1 (0.5 mM glucose) and 4 days in CDM-2 (2 mM glucose). Glucose concentration in maturation medium at 0.5, 2.0, and 5.5 mM had no effect on blastocyst rates per oocyte, 33%, 32%, and 31% respectively. However, 0.5 mM glucose resulted in a cleavage rate of 87%, higher than 81% seen for both 2 and 5.5 mM glucose (P=0.004). EGF and hormones independently enhanced cumulus expansion, but there was no synergism between them, and they had no affect on cleavage or blastocyst rates. Both cleavage (P=0.003) and blastocyst rates (P=0.02) were affected by which of 3 bulls was used for fertilization.

Key Words: Bovine, Embryo, Oocyte

M33 Post-thaw fertility of bovine semen aged within an AI straw for 8.5 hours. J. L. Edwards*, A. J. Roberts, J. A. Paterson, and R. N. Funston, Montana State University, Bozeman; USDA-ARS, Miles City, MT; University of Nebraska, Lincoln.

Objectives for this experiment were to determine effects of a 7-d pre-treatment with an intravaginal progesterone insert (CIDR) on estrous response and pregnancy rates in 3-year-old beef cows. J. L. Olson*, A. J. Roberts, J. A. Paterson, and R. N. Funston, 1Montana State University, Bozeman; USDA-ARS, Miles City, MT; 2University of Nebraska, Lincoln.

Objectives for this experiment were to determine effects of a 7-d pre-treatment with an intravaginal progesterone insert (CIDR) on estrous response and pregnancy rates in 3-year-old beef cows. J. L. Olson*, A. J. Roberts, J. A. Paterson, and R. N. Funston, 1Montana State University, Bozeman; USDA-ARS, Miles City, MT; 2University of Nebraska, Lincoln.

Objective was to evaluate fertility of frozen-thawed semen aged for 8.5 h. Estrus was visually assessed three times daily for at least 30 minutes each time. Jersey heifers (age: 13.9 ± 1.4 mo; weight: 272.8 ± 19.2 kg) observed standing to be mounted between 0700 and 1200 h were randomly assigned to be inseminated with a straw of frozen semen that had been thawed and maintained in a Cito Thaw Unit (34.4°C water bath) for 8.5 ± 0.04 min (Control; range 3-14 min) or 8.5 ± 0.68 h (Aged; range 6-10 h). Heifers observed in estrus after 1200 h were inseminated with control semen. All heifers were inseminated according to AM/PM rule. To age sperm, a straw of frozen semen was thawed immediately after visual detection of a heifer in estrus and then maintained in a Cito Thaw unit until insemination approximately 8.5 h later. Frozen semen was purchased from various AI organizations (n=6). Individual Jersey bulls (n=30) were randomly and evenly distributed across treatments. Establishment of pregnancy was determined by palpation per rectum at 45 to 65 d post-insemination. Animals were monitored throughout pregnancy and upon calving, sex of offspring was recorded. Data were analyzed using Chi-Square; variables of interest included proportion pregnant, calving, and sex of resulting offspring. Effects of inseminating Jersey heifers with sperm aged within an AI straw for 8.5 h post-thaw were minimal. Fifty percent of heifers inseminated with aged semen became pregnant and delivered a live calf at term (Table). Proportion of female offspring was similar. Ability to maintain frozen-thawed semen within an AI straw for 8.5 h in a 34.4°C water bath without significant reductions in fertility demonstrates that sperm can be held post-thaw for extended time periods and suggests potential for manipulation post-thaw for sexing or performing diagnostics.

**Treatment No. Bred Pregnant (%) Calved (%) Female (%)**

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<th>Female (%)</th>
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Key Words: Frozen semen, Aging, Artificial insemination

M34 Effects of presynchronization and/or post-breeding treatment with porcine LH or hCG on pregnancy rates in dairy cows. J. P. Kastelic*1 and J. D. Ambrose2, 1Agriculture and Agri-Food Canada, Lethbridge, AB, Canada; 2Alberta Agriculture Food and Rural Development, Edmonton, AB, Canada.

The objectives were to determine the effects of presynchronization with a PGF2 alpha analogue and/or post-breeding treatment with porcine LH (pLH) or hCG on pregnancy rates in dairy cows. In three experiments, an Ovsynch protocol was used to synchronize ovulation in...
lactating Holstein cows (range, 50 to 125 d postpartum). Cows were given im injections of 100 µg GnRH (Fertinlin; Vetoquinol) on Days -10 and -1 and 500 µg cloprostenol (Estrumate; Schering Plough) on Day -3, with fixed-time AI on Day 0. Pregnancy was diagnosed by palpation per rectum between 45 and 60 d after AI. In Experiment 1, cows were randomly allocated to either a standard Ovsynch protocol (n = 120) or to a presynchronization protocol (n = 80; 500 µg cloprostenol given twice, 14 d apart) followed by Ovsynch, with the first GnRH given 12 d after the second cloprostenol. Pregnancy rates were 35 and 49%, respectively (P < 0.06). In Experiment 2, cows were given im injections of 2 mL saline, 12.5 mg pLH (Lutropin-V; Bioniche Animal Health), or 2500 IU hCG (Chorionic; Intervet) 3 d after timed-AI (41, 41 and 39 cows, respectively). Pregnancy rates were 22, 33 and 37% (P = 0.32). Experiment 3 was a 2 x 3 factorial, with the factors being presynchronization and post-breeding treatment (as done in Experiments 1 and 2, respectively). Pregnancy data are presently available from 86 cows, with data collection ongoing on several farms. Pregnancy rates in the six treatment groups ranged from 40 to 55% (ns). Pregnancy rates were 42 and 50% without and with presynchronization, respectively, and were 42, 48 and 55% in cattle treated with saline, pLH and hCG, respectively (P < 0.06). In conclusion, pregnancy rates to timed-AI were improved by presynchronization. Post-breeding treatment with pLH or hCG 5 d after timed AI numerically improved pregnancy rate.

Key Words: Ovsynch, Fertility, Dairy cows

M35 Pregnancy outcome in dairy cows fed diets supplemented with flaxseed or sunflowerseed. J. D. Ambrose1, J. P. Kastelic2, R. Corbett3, P. A. Day4, J. A. Small5, and H. V. Petit4. 1Alberta Agriculture and Agri-Food Development, Edmonton, AB, 2Agriculture and Agri-Food Canada, Lethbridge, AB, 3Brandon, MB, 4Lennexville, QC, Canada.

The objectives were to determine if a diet enriched in α-linolenic acid (ALA; C18:3n-3) would enhance embryo survival and pregnancy rates in dairy cattle. Holstein cows were assigned to diets supplemented with rolled flaxseed or rolled sunflowerseed. Inclusion of rolled flaxseed in the diets of postpartum dairy cows improved fertility, especially enhanced early embryo survival.

Key Words: Pregnancy, Flaxseed, α-Linolenic acid


To accelerate genetic improvement of reproductive traits, both molecular and comparative genomic data are required. We are developing extensive sequence and mapping data for cDNAs expressed in female reproductive tissues. We have produced 25 cDNA libraries from different stages of estrus or gestation for embryo, anterior pituitary, hypothalamus, ovary, uterus, and term placenta. A total of 21,499 EST sequences from random clones have been submitted to Genbank. The average length across this dataset is >400 base pairs. As assessed by clustering analysis, these data represent 10,574 different genes. A BLAST analysis of these clusters indicates that 4652 are unique relative to porcine Genbank genes/ESTs (BLAST score >200). To facilitate selection of genes for comparative mapping, we have developed software to predict the cytogenetic location of pig ESTs. We identified pig EST matches (BLAST score >200) to human loci that have consistent cytogenetic and RH mapping locations, and then predicted the pig location of high-scoring ESTs based on mapping data and human:pig chromosome painting information. A total of 721 loci have been mapped across pig chromosomes, concentrating on pig chromosomes (1,4,6,7,8,15,X) where litter size or other reproductive QTL have been localized. More than 90% of these loci map to the chromosome predicted by comparative data. A WWW site (http://pigest.genome.iastate.edu) has been established for access to these sequences and the analysis data. This set of sequence and map data can be immediately used to study reproductive biology and look for genes controlling quantitative reproduction traits.

Key Words: Expressed sequence tags, Porcine reproduction, Comparative mapping

M37 Effect of semen packaged in 0.25 and 0.50 cc straws on conception rate of lactating dairy cows. N. Michael1, C. Marti, E. Roberts, and M. Pace, ABS Global, Inc.

Cost and efficiency of semen storage can be dramatically improved by packaging semen in 1/4 cc straws. However, it is not clear if fertility of lactating dairy cows would be different by using 1/4 cc straws compared to 1/2 cc straws. This study evaluated the effectiveness of straw packaging size (1/4 cc vs 1/2 cc straw) on conception rates in lactating dairy cows. At time of collection, semen from each A.I. sire (n = 8) was divided equally between 1/4 and 1/2 cc straws using a split collection technique. All straws were packaged and frozen using the ABS Global wind-tunnel freezing process. Numbers of sperm per straw were the same for 1/4 and 1/2 cc straws. Both straw types were equally divided by sire within each herd where herd owners chose the A.I. sires used in their herd; the number of sires used within the herds was one to four, for a total of 17 sire within herd comparisons. The fewest number of inseminations per herd x sire x straw type was 125. Cows (n = 6602) from eight herds located in Idaho and California were randomly inseminated by odd-even days of the month to receive A.I. in the uterine body from either sire (even day: n = 3373) or 1/4 cc (odd day: n = 3229) straws from seven professional A.I. technicians between September 2001 and October 2002. Straws were thawed in 35 ± 37°C water baths for a minimum of 30 seconds and then held thermo-neutral until A.I. Pregnancy diagnoses were performed between 35 and 42 days following A.I. by the herd veterinarian in cows that had not returned to estrus during this period. Cows that were detected in estrus and re-inseminated between A.I. and pregnancy diagnosis were defined as not pregnant. All inseminations and pregnancy diagnoses information were entered into Dairy Comp 305. Data were retrieved from Dairy Comp 305 from each herd, summarized by sire comparison within herd and entered into Excel. Data were analyzed using a paired t-test on the conception rate measured for each straw package type. Conception rates were significantly higher (P < 0.05) between 1/4 (31.1%) and 1/2 cc (31.3%) straws. In summary, comparison of multiple A.I. sires in multiple locations indicated that
fertility was not different from semen in 1/4 vs 1/2 cc straws packaged using the ABS Global wind-tunnel freezing process.

Key Words: Semen packaging, Conception rate, Dairy cows


Split-weaning (SW) of first parity sows decreases the weaning to estrous interval (WEI) and advances ovarian follicular development. However, follicles ovulating soon after weaning start development during lactation when sows are often in a catabolic state. We hypothesize that an extended interval between SW and final weaning will induce atresia in this wave of disadvantaged follicles, trigger a new wave of follicle development after weaning when sows will be less catabolic, marginally increase the WEI, but improve overall sow fertility. To test this hypothesis, first parity sows with standardized litters were randomly allocated to be either Control (C; n=45) or SW (all but the lightest 6 piglets removed) at d14 of lactation (n=45). Feed intake, litter growth and sow metabolic state were monitored during lactation. Ovarian follicular development was determined morphologically after euthanizing groups of C and SW sows (n=15) on d16, 18 and 20 of lactation. A baseline of follicular development was established in an additional group of 15 sows euthanized on d14 (C14). Fewer (5/15; P<0.05) C14 sows had follicles ≥3mm diameter compared to all other groups, indicating a critical and possibly coordinate interval of follicular development between d14 and 16 of lactation. SW increased (P<0.05) the total number of follicles ≥3mm, mean size of the largest 10 follicles, maximum follicle size, mean FSH and PRL volatage of follicles in the ≥5mm category. SW increased (P<0.05) plasma IGF-I at weaning (105±3 vs. 87±3 ng/mL) and decreased sow body mass loss during lactation (5.9±1.0 vs. 9.1±1.0 kg). Also, irrespective of treatment, plasma IGF-I was lower (P<0.05) at d14 and weaning, and the decrease in loin muscle depth during lactation was greater (P<0.05), in sows with follicles <3mm diameter at slaughter. Increased catabolism during lactation can therefore critically limit follicular development. Refinements in SW protocols, based on a better understanding of ovarian follicular development in SW sows, have the potential to improve the fertility of weaned, first parity, sows.

Key Words: sow, lactation, ovary

M39  Do calcium-mediated cellular signalling pathways, PGE2, estrogen or progesterone receptor antagonists, or bacterial toxins affect bovine placental function in vitro? C. Weems1, Y. Weems2, T. Welsh3, G. Carsten4, and R. Randle5. 1 Univ of. Hawaii, 2, 3, 4, 5 Texas A&M Univ.

The bovine placenta secretes little progesterone (P4) when the CL is functional (Conley and Ford, J. Anim Sci 65:500, 1987), while the placenta secretes half of the circulating P4 (Weems et al Prostaglandins 46:277, 1992) and PGE2 in cattle (Shemesh et al, PNAS 81:6403, 1983). Diced placental slices from 193-243 day Brahman and Angus cows were incubated in vitro at 39.5 C under 95% air:5% CO2 at PH 7.2 in 5 mL of M-199 for 1 hr in the absence of treatments and for 4 and 8 hr with the presence of treatments at a dose of 100ng/ml to determine regulation of placental function. Treatments were: vehicle; RU486; Compound 48/80; IP2; PGE2; CaCl2; cyclosporin A; lipopolysaccharide from Salmonella abortus, enteriditis, and typhimurium; monensin; ionomycin; arachidonic acid, mimosine; palmitic acid; androstenedione, estradiol-17β; A23187; RU-486; or MER-25. Jugal and uterine venous plasma and culture media were analyzed for P4, PGE2, and PGF2α by RIA. Hormone data in blood were analyzed by a one way ANOVA and were pooled. PGE2 and PGF2α in CL samples in Expt 1 were undetectable in controls of all three synchronize regimens. DETA-NONOate, SNAP, sodium nitroprusside, or ET-1. In Expt 2, estrus was synchronized with Lutalyse, a CIDR, or natural; CL were collected and weighed on d-14; and CL slices were diced and incubated in vitro with treatments. Treatments (100 ng/ml) were: vehicle, L-NAMe, L-NMMA, DETe, DETA, Synchrotron E, sodium nitroprusside, or ET-1. Tissues were incubated in M-199 for 1 hr without and for 4 and 8 hr with treatments. Media were analyzed for P4, PGE2, and PGF2α by RIA. Hormone data in Expts 1 and 2, were analyzed by a 2x2 factorial Design for ANOVA since breeds did not differ (P>0.05) among treatments. Concentrations of PGE2 in CL samples in Expt 1 were undetectable in 90 and 57 % of the samples at 4 and 8 hr, respectively and PGE2α increased (P<0.05) with time but did not differ (P>0.05) among treatments. Secretion of PGE2α by caruncles increased (P<0.05) with time and was not affected (P>0.05) by caruncles. Treatment (P<0.05) decreased secretion in controls of all 3 synchronize regimens. DETA, Synchrotron E, SNAP, sodium nitroprusside, (NO donors) and ET-1 increased (P<0.05) PGE2α secretion in the CIDR group (P<0.05), and no treatment increased (P>0.05) PGE2α secretion in any of the synchronize regimens. It is concluded that SMB and a CRD alters CL PGE2 secretion, Lutalyse lowers CL weights in the next estrous cycle, and NO or ET-1 given alone are not luteolytic agents. It is possible that NO could have indirect luteotropic effects via increasing PGE2 secretion by luteal tissue.

Key Words: Estrous synchronization, Progesterone, Prostaglandins

M41  Photoperiod and diet effects on heifer development. J. A. Small1, A. D. Kennedy2, and D. R. Ward3. 1Agriculture & Agri-Food Canada, Research Centre, Brandon, MB, Canada, 2University of Manitoba, Winnipeg, MB, Canada.

A 2x2 factorial arrangement of photoperiod (A vs W) and diet (C vs S) treatments was applied to spring-born crossbred beef heifers (n = 144) assigned at weaning (Sep 21; 0 wk) by body weight (247±19 kg) and age (191±12 d) to one of four pens in one of two similar open shed/drylot facilities. Supplemental light (350 lux, 1 m above ground) was used to extend photoperiod (natural + supplemental light) to 16 h for 12 wk starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W). Diets were formulated to achieve 60% mature body weight at 32 wk, through either constant starting on either Sep 27 (A), or Dec 20 (W).
than S (392 vs 381 ± 3.4 kg and 2.6 vs 3.3 ± 0.12 mm; P<0.05), but the proportion of heifers that had two estruses was greater for A than W (48.6% vs 30.9%; P<0.05). Prolactin, initially 16.3±1.6 ng/ml, was higher for A than W from 4 to 12 wk, and lower for A than W from 16 to 24 wk (12 wk; 10.1 vs 1.1 and 24 wk; 6.7 vs 20.0 ±1.8 ng/ml; P<0.05). Extended photoperiod in autumn advanced puberty independently of the effects of diet on growth, and acute change in photoperiod influenced prolactin, in heifers housed outdoors.

Key Words: Photoperiod, Prolactin

M42 Heat shock increases glutathione in bovine oocytes. R. R. Payton1, P. Coy2, R. Romar3, J. L. Lawrence3, and J. L. Edwards1, 1The University of Tennessee, Knoxville, USA, 2The University of Murcia, Murcia, Spain.

Heat shock increases glutathione (GSH) content in a variety of cell types including embryos. Objective of this study was to examine GSH content in bovine oocytes cultured at an elevated temperature during maturation. Cumulus-oocyte complexes were randomly allocated to one of three treatments and then cultured in the following manner: 38.5°C for 24 h (Control), 41°C for 6 h followed by 38.5°C for 18 h (HS 0-6), or 41°C for 12 h followed by 38.5°C for 12 h (HS 0-12). After 24 hours, oocytes pre-stimulated were denuded of cumulus by vortexing. Pools of oocytes (25-32/treatment group) were solubilized in 0.63 M phosphoric acid and frozen at -20°C until further analysis. Glutathione content was determined using a 5,5'-dithiobis(2-nitrobenzoic acid)-glutathione disulfide reductase recycling assay and was expressed as pmol oocyte. Intra-assay coefficient of variation was 7.7%. Data were analyzed using an incomplete block design using mixed models of SAS after testing for normality. The experiment was replicated on 5 occasions and included a total of 8 to 11 pools of oocytes per treatment (236-330 total oocytes/treatment). Culture of oocytes at 41°C during the first 12 h of maturation increased GSH content (4.4 versus 2.7 and 1.6 pmol/oocyte for HS 0-12, Control and HS 0-6, respectively; SEM=0.57; P=0.02). Increases in an antioxidant such as GSH, suggest heat-induced increases in free radicals. Cytosolic perturbations involving increased free radical production may be one of several mechanisms contributing to reduced developmental competence of heat-stressed oocytes. Supported in part by USDA Initiative for Future Agricultural and Food Systems Program, "Improving Fertility of Heat-Stressed Dairy Cattle"; Grant #2001-52101-11118.

Key Words: Heat shock, Oocyte, Glutathione

M43 Intramammary infusion of prostaglandin E2 (PGE) increases mammary development and milk yield of cows induced to lactate. J. M. Lukas1, W. J. Weber1, R. J. Collie1, J. L. Viviani1, M. F. McGrath1, and B. A. Crooker1, 1University of Minnesota, St. Paul, 2University of Arizona, 3Monsanto Agricultural Group, St. Louis, MO.

Intramammary injections of dexamethasone (0.05 mg/kg BW/d) were administered on d 21, 22 and 23 and 2X milking initiated on d 22. Cows were induced to lactate by twice daily subcutaneous (SQ) injections of bST (0.85 mg) or excipient and the quarters massaged to disperse infusate. Intramuscular injections of prostaglandin E2 (0.05 mg/kg BW/injection) for 7 d (-13 to -7 DIM) and or 1 SQ injection of POSILAC® (500 mg bST) at -13 and -3 DIM. An intramammary injection of dexamethasone (0.05 mg/kg BW/d) was administered at 0 DIM and 3X milking initiated at 1 DIM. Induced cows received bST at 7 and 17 DIM and at 14-d intervals thereafter. Calved cows received bST at 14-d intervals after 63 DIM. Milk samples collected at 2 and 12 weeks of lactation (WOL) from a subset of successfully induced (10 of 34) and calved (10 of 19) cows were analyzed for fatty acid content. Method (calved, induced) and WOL effects were assessed by PROC MIXED of SAS with P<0.05. Milk yield and composition of the subsets did not differ from their respective groups. During 2 and 12 WOL, milk yield of calved and induced cows averaged 40.6 and 22.4 kg/d. Milk from calved cows contained more cis-9 (3.5 vs. 3.0%, 3.5% vs. 3.0% and 5.9 vs. 5.6%) but fat (4.3%) and log SSC (5.6) did not differ from induced cows. On a weight (mg/g) and molar (% of total moles) basis, de novo fatty acid synthesis and incorporation of preformed fatty acids into milk fat were similar for calved and induced cows. Substrate to product ratios (a proxy of Δ9-deaturase capability) of C14:0/C16:0, C16:0/C18:1, C18:0/C18:1 and trans-11 C18:1/cis-9, trans-11 CLA were 16 to 28% less for induced cows. Total percentage of cis-9, trans-11 CLA did not differ but contents of trans-18:1 isomers were 17 to 20% less in induced cows. Although induced cows produced less milk and had an enhanced Δ9-deaturase system, overall milk fatty acid profiles were similar.

Key Words: Induced lactation, Mammary development, Milk yield


Milk composition change in cisternal and alveolar compartments at different milking intervals has been rarely studied. Interest is higher as a consequence of robotic milking and milking omission routines. Four Holstein cows (20.5 kg/d; 215 DIM) regularly milked daily at 0800 and 1800 were used to study the effects of different milking intervals on cisternal milk (CIS) and alveolar milk (ALV) in a 5 wk experiment. Experimental milkings were made at random and in duplicate at 4, 8, 12, 16, 20 and 24 h after a regular milking. A wash-out period of 2 d with regular milkings was allowed between experimental milkings. A teat cannula was used to drain CIS after an i.v. injection of an oxytocin receptor blocking agent (Atosiban; 10 μg/kg). Oxytocin was then injected to remove ALV. Samples of each milk fraction per quarter were analyzed for composition. Ratio of CIS:ALV varied according to milking interval and averaged 30:70. Milk fat content decreased in CIS and increased in ALV as milking interval increased (P<0.001). Minimum fat percentage in front and rear CIS (0.93%) was reached at the same milking interval (16 h). Milk fat content in ALV was constant during the first 16 h, increasing rapidly thereafter. Final fat content in ALV (6.95%) was higher than CIS initial (5.62%; P<0.05) and final (0.96%; P<0.001) values. Total

fat yield tended to increase for CIS with longer milking intervals, but increased markedly for ALV (P<0.001), indicating that fat globules do not pass freely from the alveoli to the cistern between milkings. Milk protein content increased in CIS (P<0.001) and tended to increase in ALV with longer milking intervals. Initial and final milk protein content did not differ between CIS and ALV. Total protein yield increased with milking interval in both fractions (P<0.05) and was greater in the rear quarters than in the front quarters (P<0.01) for both milk fractions. We concluded that effects of milking interval on milk composition can be explained by changes in alveolar and cisternal milk ratio.

Key Words: Milk composition, Alveolar milk, Cisternal milk

M46 Description of glucose transport in isolated bovine mammary epithelial cells by a 3-compartment model. C. T. Xiao*, V. M. Quinton, and J. P. Cant, University of Guelph, Ontario, Canada.

The carrier-mediated glucose transport in isolated bovine mammary epithelial cells displays moderate degrees of asymmetry and cooperative interactions between export and import sites when described by a fixed-site carrier model. The present study examines the hypothesis that these model features are due to compartmentalization of intracellular glucose. Net uptake of 3-O-methyl-D-[1-14C]glucose (3OMG) by isolated bovine mammary epithelial cells was measured at the beginning and the end of a course curve of 3OMG net uptake could be better fitted by a double exponential equation than a single or triple exponential equation.Compartmental analysis of the time course curve suggested that translocated 3OMG is distributed into two compartments with fractional glucose spaces of 32.6±5.7% and 67.4±5.7%, respectively. The results support the view that glucose transport in bovine mammary epithelial cells is a multi-step process consisting of two serial steps: fast, carrier-mediated, symmetric translocation of sugar across the cell plasma membrane into a small compartment, and subsequent slow exchange of post-translocated sugar between two intracellular compartments. A 3-compartment model of this system successfully simulated the observed time course of 3OMG net uptake (R² = 0.98) and the observed dependence of unidirectional entry rates of intracellular and extracellular 3OMG concentrations (R² = 0.99). Parameters of the fixed-site carrier model derived from the simulation results represented a significant degree of asymmetry and a moderate degree of negative cooperativity. The results indicate that compartmentalization of intracellular glucose exerts significant effects on glucose transport behavior and should be considered when modeling this process.

Key Words: Glucose transport, Bovine mammary epithelial cell, Model


Uptake of amino acids (AA) by the lactating mammary gland is critical for milk protein synthesis. Several transport systems are responsible for AA uptake by mammary epithelial cells. Understanding of the regulation of AA transport is limited, but may include regulation by mammary growth factors. We compared the kinetic properties of a sodium-independent AA transport system (for lysine) and a sodium-dependent AA transport system (for taurine) in mammary tissue from nontransgenic sows (control; n = 5) and transgenic sows (n = 5) that over-express insulin-like growth factor-I (IGF-I) in their mammary gland during lactation, under the direction of the α-lactalbumin promoter. Mammary tissue was collected on day 20 ± 1.8 and 21 ± 2.1 of lactation for control and transgenic sows. Tissue explants were incubated in isosmotic physiological buffer with the respective radiolabeled AA tracer and either sodium (350-51.1) or not. Kinetic parameters for lysine transport were not different between control and transgenic sows (Km = 2.1 ± 0.4 vs. 1.5 ± 0.2 μM; Vmax = 6.1 ± 0.7 vs. 7.5 ± 1.6 mmol/kg cell water/30 min). The Km of taurine transport was not different between control and transgenic sows (20 ± 3.1 vs. 30 ± 5.0 μM). However, the Vmax of taurine transport was significantly lower for control vs transgenic sows (70 ± 16 vs 118 ± 29 μmol/kg cell water/30 min; P < 0.05). Mammary over-expression of IGF-I by sow mammary tissue did not affect taurine uptake, a sodium-independent transport system, nor did it affect the affinity of the taurine transport system. However, the maximal rate of taurine transport was increased in sow mammary tissue of IGF-I transgenic sows, suggesting that the effect of IGF-I over-expression may occur through a regulation of cellular sodium transport systems. Funded in part by the USDA CSREES under project NRICGP 00-35206.

Key Words: Mammary gland, Amino acid transport, Growth factors


The postpartum acyclic period is prolonged in cows due to frequent suckling as compared to twice daily milking. In conventional milking systems twice daily (2X) milking is typical, while in automatic milking systems (AMS), three and more daily milkings are common in early lactation. This study tested whether increased milking frequency in AMS delays postpartum cyclic activity and pregnancy in dairy cows. Simmental cows (n=124) were studied during the postpartum period until the onset of the ovarian cycle and pregnancy. Calvings were evenly distributed throughout the one-year experimental period. Cows were housed in one barn, and 62 cows were milked voluntarily in the AMS (AC), while 62 cows were milked in the conventional milking parlor (PC) 2X. Other management was identical for both groups. Milk yields and number of milkings were recorded in both systems. The cow's time spent milking was analyzed for the first ovulation profile of each individual cow. The mean milking frequency during the first 3 weeks after parturition was higher in AC (3.030.02) than the 2X milking in PC. Individual milking frequency within AC for the first 3 weeks varied between 2.80±0.11 and 4.28±0.02 milkings. Milk yield in the first 6 weeks was higher (p<0.05) in AC compared to PC (30.00±1 vs. 22.70±2 kg/d). The day of the first and second ovulation did not differ between groups (27.61.5 and 36.41.4 vs. 27.51.1 and 36.11.3 in AC and PC, respectively). Within AC no relation was observed between milking frequency and duration of acyclic period. The first and second ovulation was earlier (p<0.05) in primiparous cows (24.00±1 and 34.11.3±d) as compared to multiparous cows (30.56±1 and 38.31±d). First ovulation was similar in AC (74.47±1 d) and PC (74.75±7 d). Increased milking frequency in AMS did not delay postpartum cyclic activity and pregnancy in dairy cows.

Key Words: Acyclic postpartum, Milking frequency, Automatic milking

M49 Change from conventional to automatic milking in cows with and without previous experience. D. Weiss* and R. M. Bruckmaier, Institute of Physiology, Technical University Munich, Germany.

Effects of a change from milking in a conventional parlor to an automatic milking system (AMS) on milk yield was investigated. Cows had either no experience in AMS milking (n=17) or were previously milked for at least one lactation in the AMS (n=9). Experienced cows (EC) were older (3.6±0.5 lactations) than unexperienced cows (UC: 1.8±0.3 lactations). EC were milked for 36.4±5.1 d after parturition in the parlor before changing to the AMS. EC obtained no training before changeover. Milk yields were recorded in the parlor for 10 d prior to changeover. Milk yield in the parlor was 26.3±2±3 kg/d in UC and 37±6±1.7 kg/d in EC. UC were trained intensively in the AMS area for 3 d before changeover, while still being milked in the parlor, and the first AMS milking was performed on the fourth day, i.e., after at least 8 visits to the AMS. Although offered concentrate, UC had to be pushed into the AMS milking stall for the first one to two visits. EC entered the AMS milking stall voluntarily. In UC the rate of voluntary visits were 0, 32, 48, 56, 81, 86, 91, 94, 93 and 97% during the first 10 d of AMS milking. UC, milk letdown was disturbed during the first visits and mean yield at the first milking in the AMS was lower than in the parlor (67±5±4.8% vs. p<0.05). In EC, milk letdown was disturbed and 33% of the yield at first AMS milking was 101±3% of the yield in the parlor. Rate of voluntary visits and the degree of disturbance of milk letdown in UC was independent of lactation stage and age of the animals. During the first 10 d of milking in the AMS the mean frequency was 2.67 and 2.88 milkings/d in UC and EC. Milk yield at the first 15 AMS milkings was lower in UC (36.8±4.7%) compared to the yield obtained in the parlor (p<0.05). In conclusion, cows with previous experience to AMS milking do not need an adaptation period after transient
parlor milking. Furthermore, milk yield is increased in these cows from the increased milking frequency. In contrast, unexperienced cows need intensive adaptation to the AMS.

Key Words: Automatic milking, Milk yield, Dairy cow

M50 Use of digital pictures to study udder morphology in dairy sheep. M. Rovai,1 Y. M. Berger1, Y. M. Berger1, G. Caja2, 1University of Wisconsin-Madison, 2Universitat Autonoma de Barcelona, Bellaterra, Spain.

Ewe udder shape and size are related to milk yield and milking time, and culling for undesirable udder traits can improve the efficiency of machine milking. Measurements from digital pictures of ewe udders may provide an easy and accurate method for measuring ewe udders. Udder traits were measured on 120 dairy ewes and from digital pictures of their udders taken at the time of the in vivo measurements. Measurements were taken at wk 5, 11, and 17 of lactation 4 hr before the pm milking. Ewes were milked 2X/d. Udder height, udder width, teat length, teat angle, and cistern height were measured in vivo using a ruler and protractor. Ewes were also assigned scores from the 9-point scoring system developed by De la Fuente et al. (1995) for teat size, teat angle, udder height, and udder shape. Following in vivo scores and measurements, digital pictures of the rear udder of each ewe were taken. While taking each picture, a ruler was held parallel to the ground in the same vertical plane as the back of the udder and a few cm below the bottom of the udder to serve as a calibration device for measurements on the digital pictures. Likewise a plumb bob was suspended vertically in back and in the middle of the udder while taking each picture to give a true vertical line as a reference for measuring teat angle. Measurements from the digital pictures were obtained using the public domain software, Image Tool from Texas University, available on the Internet. All digital measurements were significantly (P<0.0001) correlated with those measured in vivo. Correlations were 0.73 for udder height, 0.67 for udder width, 0.47 for teat length, 0.88 for teat angle, 0.68 for teat size score, 0.79 for teat angle score, 0.88 for udder height score, and 0.89 for udder shape score. Advantages of the digital picture method over in vivo measurements are that pictures can be taken faster than the in vivo measurements at the farm, they can be analyzed at your convenience, and they provide a permanent record for future use.

Key Words: Digital pictures, Dairy sheep, Udder traits

M51 Udder traits of dairy ewes on U.S. commercial farms and their effects on milk yield. M. Rovai,1 Y. M. Berger1, Y. M. Berger1, and G. Caja2, 1Univ. of Wisconsin-Madison, 2Univ. Autonoma de Barcelona, Spain.

Rapid scoring systems have been developed in Europe to categorize udder shapes of dairy ewes, and these scores are related to milk yield and milking time. These scoring systems were evaluated in U.S. ewes of dairy-meat crosses. Ewes were scored by one classifier 3 hr before the pm milking using a linear udder scoring system (De la Fuente et al., 1995) based on a 9-point scale per trait: udder depth, teat angle, and udder shape. Ewes also were scored for typeology (Gallego et al., 1983): 1 = horizontal teats, 2 = teats at 45 degrees, 3 = vertical teats, and 4 = misshaped udder. Ewes were from two commercial dairy sheep farms (A, n = 177; B, n = 166) and one university farm (C, n = 120). Ewes were milked 2X/d. Floccs differed in breed composition: A: East Friesian (EF) crosses (10 to 50% EF); B: EF crosses (10 to 75% EF); and C: EF (50 or 75% EF), 50% Lacaune (LC), and 25% EF-50% LC (EF-LC) crosses. Remainder of breeding was of non-dairy domestic breeds. Effects of parity and stage of lactation also were considered. Percentage of EF breeding had no effect on milk production or udder trait scores in farms A and B. In farm C, LC ewes had the most horizontal teats and faulty (type 4) udders than ewes in earlier lactation. Udders of type 2 were more frequent than other types in all flocks. Farm C also had a high percentage of ewes with ulcers of type 1 which may be related to LC ewes. Within all genotypes and farms, positive correlations were observed between udder depth scores and milk yield (0.20 to 0.46; P<0.05). High correlations were observed between udder shape and teat angle scores (0.80 to 0.93; P<0.0001).

Key Words: Dairy sheep, Udder traits, Linear scores

M52 Udder traits of U.S. dairy ewes and their effects on milking time and milk yield. M. Rovai,1 Y. M. Berger1, Y. M. Berger1, and G. Caja2, 1Univ. of Wisconsin-Madison, 2Univ. Autonoma de Barcelona, Spain.

Udder shape and size is related to milk yield and milking time in specialized dairy sheep breeds in Europe. This study determined if similar relationships exist among U.S. dairy-meat cross ewes. Ewes (n=120) of 4 breed groups: East Friesian, EF; 75% East Friesian, EF; 50% Lacaune; LC; and 25% East Friesian-50% Lacaune crosses, EF-LC; remainder breeding of each group was domestic non-dairy breeds were utilized. Ewes were milked 2X/d. Measurement of udder size (depth, height, width, and circumference), teat size (length and width), teat angle, and cistern height was done 6 hr after the am milking by one technician at wk 5, 11, and 17 of lactation. Cistern area by ultrasonography and kinetics of milk emission (lag time, volume the 1st minute, total volume, and milking time) also were measured. Cisternal scans were obtained by a portable ultrasound scanner with 3.5 MHz sectorial transducer. Milk yield was highest (P<0.0001) in EF-LC ewes, increased (P<0.0001) with age, and decreased (P<0.0001) through lactation. LC ewes had the shortest (P<0.01) teats (3cm) and highest (P<0.0001) test insertion (59). Cistern height and udder size were larger (P<0.05) in LC and EF-LC ewes than in the other two breed groups. EE and EF-LC dairy ewes had greater (P<0.001) cistern area (30 and 32 cm²) than ewes of the other two breeds. Udder and teat size increased (P<0.001) with parity. Udder size decreased (P<0.0001) through lactation while teat angle and cistern height increased (P<0.0001). Cistern area decreased through lactation (P<0.0001) and increased (P<0.0001) with parity. Total milking time was greatest (P<0.05) in EF-LC ewes, increased (P<0.05) with parity, and decreased (P<0.05) during lactation. Udder traits correlated with daily milk yield (r = 0.21 to 0.50; P<0.01) and milking kinetics (r = 0.15 to 0.38; P<0.05). Cisternal area correlated with daily milk yield (r = 0.63; P<0.0001), milk volume during the 1st minute (r = 0.34; P<0.0001), measures of teat size (r = 0.18 to 0.25; P<0.01), and udder height (r = 0.20; P<0.01).

Key Words: Dairy ewes, Udder traits, Milking kinetics

Animal Health

M53 Binding of IgM to non-apoptotic bovine blood neutrophils. S. N. Knight,1 M. Worku, and P. L. Matterson, NC Agricultural & Technical State University, Greensboro, NC.

Receptors for IgM have been identified on bovine neutrophils. The objective of this study was to evaluate the association of IgM binding with apoptosis of bovine blood neutrophils. A modified assay to detect apoptosis by comparing the effect of actinomycin-D (160 μM), sodium butyrate (160 μM), E.Coli lipopolysaccharide (LPS) (10ng/ml) treatments versus untreated isolated neutrophils in the presence or absence of purified bovine IgM was used. Whole blood was collected from healthy lactating Holstein cows (N=4) in 15 ml vacutainer blood collection tubes pretreated with 250 IU of heparin sodium. The blood was pooled, divided with 1X PBS, separated by gentle centrifugation and RBC were lysed with 0.83% ammonium chloride several times until a white pellet and clear supernatant was obtained. Viable, isolated PMN were verified by microscopic observation and counting, using Trypan Blue exclusion for viability (98.0%) and Wright stain differentials. Treated and control PMN were spotted onto poly-L-Lysine, subbed slides. After drying, slides were then assayed for the apoptosis using Promega’s Apoptosis Detection Kit which is based on the TUNEL method of labeling fragmented DNA of apoptotic cells with Flourescein. The percentage of cells incorporating green fluorescence was evaluated microscopically. Neutrophil isolation, Actinomycin D and Dexamethasone induced apoptosis. Bacterial endotoxin, Sodium butyrate and IgM binding showed the least amount of apoptosis. Treatment with IgM had no effect on apoptosis.
due to treatment. The Fc receptor for IgM may serve as a marker of non-apoptotic neutrophils.

Key Words: Neutrophils, Bovine, Apoptosis

M54 Dissociation of glucocorticoid and tumor necrosis factor-α (TNF-α) responses to repeated endotoxin (LPS) challenges: effects of individual versus group penning. S. Kah* and T.H. Elsasser, USDA, Agricultural Research Service, Beltsville, MD.

The development of effective intervention strategies to limit overproduction of proinflammatory cytokines during immune challenge depends on an accurate assessment of how animal-to-animal variability influences the interpretation of data and subsequent conclusions. Our objective was to determine the effect of two consecutive LPS challenges (LPS1 and LPS2, 5 d apart; 0.2 µg/kg BW, i.v., E.coli 055:B5,) on plasma TNF-α and cortisol (C) responses in heifers kept in individual or group pens before and during the challenge. Forty two heifers (309 ± 4 kg) fed a forage-concentrate diet (15% CP) were transported (6h) and then placed in outdoor individual hutches for 14 d, then all pigs were challenged orally with 106 CFU Salmonella enterica serotype Typhimurium. Samples of mesenteric lymph nodes draining the terminal jejunum and ileum were obtained from all animals at sacrifice 14 d after bacterial challenge (after 28 d on experimental diets).ymph nodes were disrupted mechanically to obtain single cell suspensions. Cells were prepared for flow cytometric analysis with primary antibodies to cell surface antigens, followed by FITC-labeled secondary antibodies. Primary antibodies recognizing CD4, CD8, B cell, and granulocyte/monocyte surface antigens were used. The proportion of lymphocyte-gated cells positive for CD4 (29.2 ± 2.7 and 31.6 ± 2.7), CD8 (24.0 ± 1.4 and 24.5 ± 1.4), and B cell (64.9 ± 5.3 and 56.7 ± 5.3) markers did not differ between pigs fed carbadox and control diets, respectively. Similarly, proportions of gated cells labeled with the granulocyte/monocyte marker did not differ between carbadox (85.4 ± 4.5) and control (86.3 ± 4.5) treatments. The results suggest that dietary carbadox, at levels commonly used for growth promotion in swine nursery diets, does not affect major immune cell populations in mesenteric lymph nodes following challenge with an enteric pathogen.

Key Words: Carboxad, Pig, Immune cells

M55 Effects of age at transport on health and development of neonatal dairy calves. T. A. Johnson*, S. D. Eicher*, Purdue University, West Lafayette, IN, USDA-ARS, West Lafayette, IN.

Stress associated with transportation at an early age can have immunological effects as well as effects on performance. The purpose of this study was to evaluate the effects of age at transport on immune development. Holstein calves (n=47) were randomly assigned to treatments by day of transport; 2-3 d (A), 4-5 d (B), or 6-8 d (C) within a completely randomized design. Colostrum was administered to each calf by day of transport; 2-3 d (A), 4-5 d (B), or 6-8 d (C) within a completely randomized design. The primary response to LPS challenge was measured as area under the time × concentration curve (AUC, ng/ml × h). Overall, mean plasma TNF-α and C responses were lower after LPS1 than LPS2 (respectively, 2.64 vs 4.57, P < 0.01 and 48.2 vs 54.8, P < 0.05). However, TNF-α responses were greater in IND than GRP heifers both after LPS1 (5.20 vs 3.92, P < 0.05) and LPS2 (3.95 vs 1.35, P < 0.01). There were no differences in C responses between IND and GRP heifers in both LPS1 and LPS2 (52.3 vs 50.8, P > 0.05); although initial plasma C concentrations at 0 h of LPS2 were higher in GRP than IND heifers (10.8 vs 3.1 ng/ml, P < 0.01). Results indicate that handling and management of heifers prior to and during acute phase response (APR) to LPS challenge affect both glucocorticoid and TNF-α responses during APR that compromises interpretation of the degree to which LPS tolerance develops.

Key Words: Cortisol, Endotoxin, Tumor necrosis factor-α


Carboxad is widely used in nursery pig diets for growth promotion, but the mechanism of action of this class of antibiotics has not been thoroughly elucidated. One action of carboxad could be to change pathogen load in the lower gut and thereby alter populations of immune cells in mesenteric lymph nodes of pigs. Weaned pigs were housed in an environmentally controlled nursery and fed diets containing no added antibiotic (n = 8) or carboxad at 55 ppm (n = 8). No other antimicrobials were included in the diets. Pigs were fed their respective treatment diets for 14 d, then all pigs were challenged orally with 106 CFU Salmonella enterica serotype Typhimurium. Samples of mesenteric lymph nodes draining the terminal jejunum and ileum were obtained from all animals at sacrifice 14 d after bacterial challenge (after 28 d on experimental diets). Lymph nodes were disrupted mechanically to obtain single cell suspensions. Cells were prepared for flow cytometric analysis with primary antibodies to cell surface antigens, followed by FITC-labeled secondary antibodies. Primary antibodies recognizing CD4, CD8, B cell, and granulocyte/monocyte surface antigens were used. The proportion of lymphocyte-gated cells positive for CD4 (29.2 ± 2.7 and 31.6 ± 2.7), CD8 (24.0 ± 1.4 and 24.5 ± 1.4), and B cell (64.9 ± 5.3 and 56.7 ± 5.3) markers did not differ between pigs fed carboxad and control diets, respectively. Similarly, proportions of gated cells labeled with the granulocyte/monocyte marker did not differ between carboxad (85.4 ± 4.5) and control (86.3 ± 4.5) treatments. The results suggest that dietary carboxad, at levels commonly used for growth promotion in swine nursery diets, does not affect major immune cell populations in mesenteric lymph nodes following challenge with an enteric pathogen.

Key Words: Carboxad, Pig, Immune cells

M57 Effects of conjugated linoleic acid (CLA) and trans-C18:1 fatty acids (TFA) on production variables and immune indices following castration in beef cattle. L. H. Baumgard*, C. E. Moore1, C. R. Baily1, M. BenAbdallah1, P. S. Cuneo1, S. Dial1, D. Luchini1, and G. C. Duff1, 1The University of Arizona, Tucson, 2BioProducts Inc., Fairlawn OH.

Feeding CLA alleviates the growth-suppressing effects (cachexia) caused by an activated immune system in rodent models. Larger animals often experience cachectic symptoms (decreased feed efficiency and reduced ADG) immediately (7-14 d) post-castration. Growing male beef cattle (n=30, 359 60 kg BW) were fed isoenergetic diets (steam-flaked sorghum based) supplemented (top dressed) with rumen protected (RP) palm oil (560 g/d; EnerGIFR; control), RP TFA (594 g/d) or RP CLA (609 g/d) from #7 to 28d related to castration. Each treatment provided 475 g lipid/d and RP TFA consisted of 17.2% trans-8, 8.7% trans-9, 8.8% trans-10, 5.8% trans-11 and 7.3% trans-12 cis-9,11,14 and the RP CLA contained 6.5% cis-9, trans-11, 5.4% c/t-8, c/t-10, 8.25% c/t-11, c/t-13 and 7.9% trans-10, cis-12 CLA. All calves were weighed on d #7, 0, 3, 6, 9, 12, 15, 21, 28 and blood collected on d #7, 0, 3, 6 and 9 relative to castration. On d 0 testicles were banded with latex tubing and on d 7, 0, 3, 6 and 9 relative to castration. Excess blood was banded with latex tubing and scrotums surgically removed on d 3 (post-banding). During wk 1 and 2 post-castration all animals had reduced DMI (7.8%), lost BW (ADG, -0.69 kg/d) and reduced feed efficiency (G:F, -0.15) and there was no treatment by wk interaction on these measurements. Overall (d 7 to 28), CLA supplementation decreased DMI (P = 0.04; 7.6, 7.4 and 6.1 kg/d for EII, TFA and CLA, respectively) and did not effect G:F (0.013) or ADG (0.17 kg/d). Compared to d 0, body temperature on d 3 and 6 were elevated (P < 0.05) by 0.54 and 0.19C. Castration had little effect on total white blood count, monocytes or eosinophils. but neutrophils were reduced (P<0.001) 23%, lymphocytes increased 10%, basophils increased 266% and the neutrophil/lymphocyte ratio decreased 29% (P<0.01). Treatment had no effect on aforementioned immune variables. Unique fatty acids evaluated in this trial were ineffective at

Key Words: Dairy calves, Transport, Stress
preventing the negative side effects on production immediately following castration.

Key Words: CLA, Castration, Beef cattle

M58 Suppression of Th1-like BoCD4+ T lymphocyte proliferative response by BoCD8+ T lymphocytes stimulated with staphylococcal enterotoxin C is induced by type II cytokines, Y. H. Park1, W. A. Ferens2, W. C. Davis3, J. S. Ahn1, N. H. Kwon1, and G. A. Bohach2, 1Seoul National University, Seoul, Korea, 2University of Idaho, Moscow, USA, 3Washington State University, Pullman, USA, 4National Veterinary Research and Quarantine Services, Anyang, Korea.

Staphylococcal isolates from bovine mastitis often produce superantigen (SAg) exotoxins. We previously demonstrated that the SAg staphylococcal enterotoxin C (SEC) leads to an inversion of the CD4:CD8 T cell ratio and generation of an atypical CD8+ T-cell subpopulation. In the present study, we examined T cell proliferation and apoptosis profiles of subpopulations of bovine peripheral blood mononuclear cells (PBMC) in cultures stimulated with SEC. DNA synthesis in cultures stimulated with SEC was low during the first four days and increased greatly on day 5. In contrast, DNA synthesis in concanavalin A (ConA) stimulated cultures increased continuously from day 1 through day 5. SEC stimulated cultures showed exceed apoptosis of CD4+ T cells at early stage and predominant proliferation of CD8+ T cells at late stage. Type II cytokines were predominantly transcribed at late stage of culture. While transcripation of type I cytokines reached peak, but low level compared with ConA stimulated PBMC. Our results suggest that SEC promotes Staphylococcus aureus survival by induction of a specific subset CD8+ T cells and suppression of CD4+ T cells may be via type II cytokines in CD8+ T cells.

Key Words: Staphylococcal enterotoxin C, Bovine T cells, Cytokine mRNA

M59 Increased levels of LPS-binding protein (LBP) in bovine blood and milk following bacterial lipopolysaccharide challenge. D. Bannerman*, M. Paapel, W. Hare, and E. J. Sohn, USDA-ARS, Beltsville, MD, 2University of Maryland, College Park, MD.

Approximately 40% of the clinical cases of mastitis that occur annually are caused by Gram-negative bacteria. The most common Gram-negative pathogens implicated in mastitis are Escherichia coli, Klebsiella pneumoniae, and various species of Enterobacter. A common denominator to all of these bacteria is the presence of endotoxin or lipopolysaccharide (LPS), which is found in the outer membrane of all Gram-negative bacteria. LPS is a highly pro-inflammatory molecule that is shed from the bacterial surface during bacterial replication or death. The bovine mammary gland is highly sensitive to LPS, and LPS has been implicated, in part, in the pathogenesis of Gram-negative mastitis. Recognition of LPS is a key event in the innate immune response to Gram-negative infection and is mediated by the accessory molecules CD14 and LPS-binding protein (LBP). Previous studies have demonstrated an increase in soluble CD14 in milk following intramammary challenge with LPS. The objective of the current study was to determine whether LBP levels increased in the blood and mammary gland following LPS challenge. The left and right quarters of five mid-lactating Holstein cows were challenged with either saline or LPS (100 µg), respectively, and milk and blood samples collected. Basal levels of plasma and milk LBP were 38 and 6 µg/ml, respectively. Plasma LBP levels increased as early as 8 h post-LPS challenge and reached maximal levels of 138 µg/ml by 24 h. Analysis of whey samples derived from LPS-treated quarters revealed an increase in milk LBP by 12 h. Similar to plasma, maximal levels of milk LBP (34 µg/ml) were detected 24 h following the initial LPS challenge. These data suggest a possible role for LBP in mediating mammary gland response to LPS.

Key Words: Mastitis, Endotoxin, LPS-binding protein

M60 Establishment of a bovine cell-culture system to study the genomic response of mammary epithelial cells to infection with Staphylococcus aureus. O. Wellnitz* and D. E. Kerr, University of Vermont, Burlington, VT.

A cell-culture system was developed to study changes in gene expression during mammary epithelial cell infection. Primary cell cultures from three healthy Holstein cows were prepared, passaged twice, and frozen in liquid nitrogen until infection experiments. Cryopreserved cells were thawed, grown in plastic culture flasks, then split once into 6-well plates. After 24 h cells were infected with 2x10⁶ cfu/well of Staphylococcus aureus. Sterile, mock-infected plates were included as controls. Three hours post-infection the extracellular bacteria were removed by changing the medium and addition of gentamicin (100µg/ml). Cells were grown for another 21 h after which medium and total RNA were harvested. Lactoferrin concentrations in conditioned medium, measured by ELISA, were 1.2±0.1µg/ml and 2.3±0.4µg/ml in sterile or infected cells, respectively (P=0.07). Lactoferrin mRNA expression, as detected by northern blot analysis, was 1.8±0.3 fold higher (P<0.05) in infected cells compared to sterile cells. Tumor necrosis factor alpha (TNFα) mRNA expression was detected by quantitative RT-PCR using SYBR Green. The TNFα response to the infection protocol was variable, being numerically increased 41, 22 and 2 fold as compared to the mock-infected cells (P>0.05). The analysis of lactoferrin and TNFα were chosen to detect an infection response, because bovine lactoferrin concentrations in milk often increase during mastitis and the cytokine TNFα is known to play an important role in inflammatory processes. The increase of lactoferrin expression in cells after infection establishes a direct connection between infection and epithelial cell lactoferrin production and reflects the increased milk lactoferrin concentrations seen in mastitis. The biological replication from simultaneous analysis of cells from different animals is an advantage over experiments with an immortalized cell line. The current model provides substantial quantities of RNA (> 100µg/plate) that will be useful for techniques such as microarray analysis.

Key Words: Mastitis, Cell culture, Gene expression


A bovine mastitis pathogen susceptibility monitoring program was initiated by Pharmacia Animal Health (PAH) in 2001 to monitor in vitro activity of ceflizox, pirlimycin, a lincomycin/neomycin combination, and a penicillin/novobiocin combination. Minimum inhibitory concentrations (MICs) were determined for 354 bacterial strains isolated from bovine mastitis cases at 6 veterinary diagnostic laboratories in the US and Canada. Isolates were forwarded to PAH for MIC determinations using a commercially available broth microdilution system that conforms to National Committee for Clinical Standards (NCCLS) guidelines. MIC₅₀ values were calculated from data obtained for the bacterial strains that were received. Ceflizox was the only compound tested which exhibited consistent activity against both gram-negative and gram-positive pathogens tested, with the exception of the enterococci. Penicillin/novobiocin showed excellent activity against the gram-positive organisms and was highly active when tested against the enterococci. Lincomycin/neomycin showed excellent activity against S. agalactiae, S. aureus and other Staphylococcus spp. Pirlimycin was also active against the staphylococci and lactococci. Minimum Inhibitory Concentrations (MIC₅₀) for Antimicrobial Agents Against Organisms Isolated from Cases of Bovine Mastitis.
M63 Effect of intramammary infection at calving caused by environmental pathogens on lactation performance, mastitis incidence, and somatic cell counts in lactating Holstein cows. S. O. Juchem1,**, G. C. Corbellini1, K. N. Galvao1, J. E. P. Santos1, and M. Villaseñor1, 1Veterinary Medicine Teaching and Research Center, University of California - Davis, 2Universidade Federal do Rio Grande do Sul - Brazil.

An aseptic milk sample collected from each cow was analyzed for the presence of environmental pathogens at the time of calving. The aseptic milk samples were collected on the first 3 d after calving from 1290 Holstein cows not displaying signs of clinical mastitis. Samples were cultured in blood agar and BHI medium for microbiological analyses at the Milk Quality Laboratory (VMTRC, Tulare). Results were grouped into 5 treatments: no growth (NG), coagulase negative Staphylococcus spp. (SS), non-agalactiae Streptococcus spp. (STC), and a mixed culture of SS and STC (MX). Data from monthly production and clinical mastitis (CM) cases were collected for the first 300 d in milk (DIM). Diagnosis of CM was performed at every milking by the herd personnel. Continuous and binomial data were analyzed using, respectively, the MIXED and the LOGISTIC procedures, and number of mastitis cases per cow by the GENMOD procedure of SAS (2001). Interval from calving to first CM was analyzed by the Survival Analysis procedure of MINITAB (2000). Results are shown according to the following order: NG, COL, SS, STC and MX. Yields (kg/d) of milk (37.3 vs 34.3; P<0.05) and 3.5% fat-corrected milk (37.6 vs 34.2; P<0.05) were lower for STC than NG, but they did not differ among the other groups. Fat and true protein production was higher for NG than STC cows (1.32 ± 1.2 and 1.19 vs 1.09 kg/d; P<0.05). Linear SCC scores (1.8 vs 2.4 vs 2.5 vs 3.3 vs 2.7; P<0.01) were higher for STC, but not different from MX. Cows in NG had lower incidence of CM during lactation (11.4 vs 31.3 vs 21.7 vs 43.2 vs 28.6%; P<0.01). The mean number of CM cases per cows during lactation was lower for NG than the other groups (0.04 vs 0.6 vs 0.26 vs 1.54 vs 0.55; P<0.01). The interval from calving to the first CM case was affected by bacterial isolate at calving (254 vs 134 vs 248 vs 201 vs 102 d; P<0.01). Intramammary infection with no signs of clinical mastitis in the first 3 d postpartum affects lactation performance, increases linear SCC and occurrence of CM.

Key Words: Mastitis, Milk culture, Dairy cows

M64 Safety and compatibility of Orbeseal® during the dry period and early lactation when used in conjunction with commercially-available intramammary dry cow therapies. R. Hassfurth1*, D. Earley2, and N. A. Evans2, 1Pfizer Veterinary Medicine, Terre Haute, IN USA, 2Pfizer Animal Health Group, New York, NY USA.

Orbeseal® is an internal teat sealant designed for use at dry-off. It is an inert viscous paste consisting of bismuth subnitrate in a paraffin base and is aseptically administered at dry off. The sealant mimics the natural keratin plug and provides immediate closure of the teat canal thus helping to prevent intramammary infections during the entire dry period. It is likely the US dairy industry will use Orbeseal® in combination with intramammary dry cow antibiotics. The current study examined the safety and compatibility of Orbeseal® when administered concurrently with any of 4 commercial dry cow antibiotics. Thirty cows were treated at dry off with Orbeseal® or a dry cow antibiotic in conjunction with Orbeseal® in each quarter. Systemic observations and gland assessments were made throughout the dry period and post-calving in order to evaluate product compatibility. Bismuth subnitrate is radiopaque, and radiographs of teats were taken throughout the dry period and at calving to evaluate the presence of the plug. At calving, foremilk was stripped and physical presence of Orbeseal® was determined. Milk production was measured for 20 days post-calving and composite milk samples were collected to investigate bismuth levels. Orbeseal® did not compromise gland health and was physically compatible with licensed dry cow antibiotic therapies. The radiographs and the physical presence of the seal at calving support evidence that Orbeseal® remains intact in the teat cistern until physically removed post calving. Treatment with Orbeseal® had no effects on early lactation milk production and no deleterious impact on antibiotic residues in milk. Collectively, these data demonstrate that Orbeseal® is a safe and reliable dry cow product when used alone or in conjunction with licensed dry cow antibiotics.

Key Words: Orbeseal®, Dry Cow, Teat Sealant

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**Table:**

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<th>Organism (No. tested)</th>
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<th>Penicillin/</th>
<th>Erythromycin/</th>
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<td>Novobiocin</td>
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<td>64.0</td>
<td>0.12</td>
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*Includes *Streptococcus* spp. (23), *Lactococcus* spp. (2); 3MIC90 not calculated for organisms with less than 10 isolates. †Includes *Pasteurella* spp. (2), *Citrobacter* sp. (1), and *Enterobacteriaceae* (1), *Serratia* sp. (1), *Pseudomonas* sp. (1)
M65 Test-day milk loss associated with elevated test-day somatic cell score. R. H. Miller*, H. D. Norman, G. R. Wiggans, and J. R. Wright, Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.

To determine usefulness of current and previous test-day somatic cell score (SCS) in predicting test-day milk yield, test-day records from Holstein first and second calvings between 1995 and 2002 were examined. Initial selection required that cows have at least the first four test days with recorded milk yield and SCS for both parities 1 and 2. Least-squares analyses were conducted for milk yield on test days 2 through 10 within herd and cow. The model included regressions on both current test-day SCS and mean SCS of all previous test days with separate estimates by parity; effects for parity and calving year also were included as well as a regression on days in milk on test day 1. Error degrees of freedom ranged from 143,748 to 214,526. Highest SCS was most often on test day 1 (20%) followed by test day 10 (14%). Ranges of regression coefficients (kilograms of milk per unit of SCS) are in the table. Effect of current SCS on test-day milk yield was much greater for parity 2 than for parity 1 but only slightly greater than effect of mean of previous test-day SCS on milk yield for parity 1. Milk loss from elevated SCS likely results both from mammary status on test day and from direct and maternal influences of elevated SCS earlier in lactation. Mastitis in early lactation appears to have a carryover effect on milk yield for the remainder of the lactation.

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Key Words: Test-day milk, Mastitis

Breeding & Genetics


Small farms characterize dairy production in Norway. The average herd size in 2002 was 15.3 cows. Although the herd size is increasing, the number of cows has been slowly decreasing over the last years. The Norwegian Dairy Cattle (NRF) population is currently about 300,000 cows. Phenotypic data on health, fertility traits, production (yield and beef), calving information and management has been reported to the Norwegian Dairy Herd Recording System (NDHRS) since 1978, and recordings are compulsory for members. In 2002 96% of the cows were part of the NDHRS. These cows represent the breeding population of NRF. Dams are considered as sire mothers if their total merit index, milk production and pedigree meet the requirements. Every year about 400 bull calves are purchased based on their pedigree information at approximately 3-4 months of age. In the period between 5-12 months of age, they are evaluated for growth rate, conformation and semen quality. The 120 best young bulls are then selected for progeny testing. Several functional traits (fertility, mastitis resistance, other diseases, calving ease and stillbirths) are included in the total merit index. To perform progeny testing for these traits, breeding values are based on 250-300 daughters. After progeny testing the best 10-12 sires are selected as elite sires. Selection is based on total merit index and also on number of sire lines represented and number of close relatives in use. To prevent inbreeding, a restriction is put on the use of sires. The optimum distribution between use of young bulls for progeny testing and elite sires is 40:60 in the NRF population. A computer program is distributed to all farmers that optimise use of young bulls and elite sires in the herd, and suggest the optimum mating combinations. Farmers can download the program freely, or get a breeding plan from the dairy advisor that runs this program on routine basis for the farmers. It is assumed that approximately 90% of the farmers use the breeding plan. Through this breeding scheme a small population is turned into a large breeding population.

Key Words: Genetic gain, Small population, Norwegian dairy cattle

M67 Identification of quantitative trait loci affecting birth and weaning weights in pigs. J. W. Holl*, J. P. Cassady1, and R. K. Johnson1, 1University of Nebraska, Lincoln, NE, 2North Carolina State University, Raleigh, NC.

A whole-genome scan was used to identify chromosomal regions and estimate quantitative trait loci (QTL) that affect individual pig birth weight (BWT) and weaning weight (WWT). A three-generation resource population was developed by crossing a randomly selected control line with recorded milk yield and SCS for both parities and 1 and 2, to create a whole-genome scan to identify chromosomal regions and number of close relatives in use. To prevent inbreeding, a restriction is put on the use of sires. The optimum distribution between use of young bulls for progeny testing and elite sires is 40:60 in the NRF population. A computer program is distributed to all farmers that optimise use of young bulls and elite sires in the herd, and suggest the optimum mating combinations. Farmers can download the program freely, or get a breeding plan from the dairy advisor that runs this program on routine basis for the farmers. It is assumed that approximately 90% of the farmers use the breeding plan. Through this breeding scheme a small population is turned into a large breeding population.

Key Words: Genetic gain, Small population, Norwegian dairy cattle

M68 Detecting quantitative trait loci for twinning and production traits in Holstein dairy cattle. J. Cruickshank*, M. R. Dentine1, P. J. Berger2, and B. W. Kirkpatrick1, 1University of Wisconsin-Madison, Madison, Wisconsin, 2Iowa State University, Ames, Iowa.

Twinning in dairy cattle has been associated with many negative health and reproductive events that cause economic loss to the producer. Reports have suggested that twinning rates are increasing and that there may be a positive relationship between milk production and twinning frequency. Quantitative trait loci (QTL) for twinning rate on bovine chromosomes 5, 7, 19, and 23 have been previously identified in other populations. The objectives of this study were to detect and confirm the existence and effects of these QTL and to look for QTL for milk yield, fat and protein yield and percent, somatic cell score (SCS), and productive life in those same chromosomal regions. Half-sib families of 25 North American Holstein sires with high twinning rate PTA comprised the population under investigation. This project utilized sire predicted transmitting ability (PTA) values for the production traits from USDA. Twinning rate PTA values were estimated from calving data. DNA extracted from semen samples was analyzed using 45 microsatellite markers across the four chromosomes. Marker heterozygosity of the patriarchs averaged 56%. Evidence of twinning QTL was found in multiple families on chromosomes 5 and 23 at a chromosome-wise p < 0.05. Similarly, evidence of QTL was found on chromosome 7 for milk; chromosomes 5, 7, and 19 for fat yield and fat percent; chromosome 7 for protein yield; chromosome 5 for protein percent; and chromosomes 5, 19, and 23 for SCS. Most of these families are related within three generations and will be combined into larger, multi-generation families for further analysis. For twinning QTL replicated in Holsteins, chromosomal positions will be more narrowly defined by haplotype analysis. Frequencies of haplotypes associated with twinning will be estimated in elite Holstein cow populations.

Key Words: QTL, Twinning, Cattle


Microsatellite, which contained tri repeats, have been isolated in Korean cattle (Hanwoo). The pooled Korean cattle genomic DNA, which was digested with Sau3AI and separated onto agarose gels, was recovered

for 3 sections (200 to 500 bp, 500 to 1000, 1000 to 2000). For the construction of the bovine genomic libraries, a PCR-enrichment procedure was employed resulting in 14 libraries. Selection process for the tri and tetra repeat sequences were performed using PCR with biotinylated oligo primers. After blue/white colony selection, the positive colonies were sequenced with an ABI 3730 automatic sequencer to identify the repeat sequence. A total of 14 genomic libraries were constructed for Korean cattle using 4 unrelated individuals. Clones, which were 8,198 from 14 Hanwoo genomic libraries for 3 repeat sequences, were identified and sequenced. The association test was conducted for weight traits using the isolated microsatellite.

Key Words: Microsatellite, Bovine, Weight

M70 Graphical approach to evaluate genetic estimates of calf survival. H. Schlessert, R. Shanks, J. Berger, and M. Healey, University of Illinois Urbana-Champaign, Iowa State University.

Identification of bulls with bimodal pattern of inheritance could allow for more selective and efficient genotyping. A bimodal pattern of inheritance for calf survival was identified in sons of Holstein bulls. This pattern of inheritance is indicative of an allele effect or a sire of mates effect. Large allelic effects could lead to bimodal pattern of inheritance for bulls heterozygous for quantitative trait loci affecting calf survival. However, caution is needed because unequal distribution of sire of mates may indicate nonrandom mating. Data on predicted transmitting ability (PTA) for the first and second parity of 12034 sons were collected from 1984 through 1997 from seven Midwestern states. Fifty-four bulls had at least 50 sons and were included in the analysis. The data set was further restricted to fifty-two bulls having at least 25 sons with first parity PTA for calf survival. Seventeen bulls were identified with a potential bimodal pattern of inheritance, through a graphical method. In order to graphically determine a bimodal pattern of inheritance, PTAs for first parity were multiplied by one thousand and truncated to form an integer score for each son. This created several sons with the same score as other sons. These scores were then plotted against number of sons with each score. The bimodal patterns were quantified by equating coefficients of variation between the two groups. The seventeen bulls were analyzed to determine the distribution of the sires of mates between groups. Sires of mates were nonrandomly distributed between groups for fifteen of the seventeen bull families.

Key Words: Mating distribution, Calf survival

M71 Analysis of health and fertility traits for proven and young sires in herds participating in a progeny test program using data from on-farm herd management software. N. R. Zwald, K. A. Weigel, and B. Welper, UW-Madison, 2Alta Genetics.

The objective of this study is to analyze health and fertility traits within a selected group of 126 Holstein herds using DC305, PCDART, or DHIELPLUS and enrolled in the same progeny test program. Herds range in size from 200 to 3300 cows and are located in the Northeast (VA, MA, NY, PA, OH), Midwest (WI, MN, IA, IL, MI), the West (CA, OR, WA, ID), and Texas. Herds have been tested to have accurate DNA results, and perform regular pregnancy exams. Service sires were analyzed for male fertility on a conception rate basis, with all AI services being considered. 301,777 services were analyzed on 95,321 animals for 36,46 service sires from 1/1/01-2/1/03. The model was response = HY + B + (sire service sires + service sire + type of sire (young sire vs. proven) + type of animal (heifer vs. cow) + dim. Overall conception rate was 26.2%, and conception rate on young sires was 22.9%, and was 29.2% on proven bulls. Conception rate on virgin heifers was 50.8% and was 23.3% on milking cows. The proportion of the total variance attributed to the service sire was 1.36%. The correlation between the results of this analysis and the ECRR ranking was 31%. This research shows that if pregnancy exam data was stored and could be used for fertility evaluations, the accuracy and heritability of both female and male measures of fertility would be increased. Disease incidence was also studied to determine possibilities for genetic evaluations for health traits. 60 of the 126 herds were recording some type of early metabolic disorder, 47 were recording clinical mastitis, and 44 were recording lameness or foot trimming events. Disease incidences on herds recording data were: 14.8% for mastitis and 11.0% for early metabolic disorders, which included ketosis (5.2%), Metritis (1.8%), displaced abomasums (1.8%), and retained placentas (2.3%). This suggests that efforts need to be made to improve the recording of health traits on farms before any national genetic evaluation for these traits is warranted, however groups of herds using similar sires with accurate identification and proper recording of health information could be used to test for genetic differences to disease resistance within progeny test situations.

Key Words: Kids, Relative growth rate, Half breed


The present study was conducted on 614 (145, Black Bengal; 310, 1/2 Jamunapari + 1/2 Black Bengal and 159, 1/2 Beetal + 1/2 Black Bengal) kids of 51 sires born during 1981-86 under All India Coordinated Research Project on Goats at this institute. Relative growth rate (RGR) in body weight was studied during 12-24, 24-36, 36-48, 12-36, 12-48 and 24-48 weeks of age. The variation in RGR during 12-24 weeks of age due to year of birth (P ≤ 0.01) was significant. While RGR during 24-36 weeks of age varied significantly due to season of birth and birth weight (P ≤ 0.01). During 36-48 weeks of age, the effect of birth weight (P ≤ 0.01) on RGR was significant. However, during 12-36 weeks of age it varied significantly due to season of birth (P ≤ 0.05) and birth weight (P ≤ 0.01). During 12-48 weeks of age, the effect of type of birth and parity of dams on RGR was significant (P ≤ 0.05). In general, the random effect of sire on RGR was not significant except during 24-36 weeks of age. Heritability estimate of RGR in post-weaning body weight (0.023 ± 0.025 to 0.216 ± 0.153) was low to moderate and RGR during 12-24 weeks had positive and significantly (P ≤ 0.01) phenotypic (0.293) association with RGR during 12-48 weeks of age.

Key Words: Kids, Relative growth rate, Half breed

M73 Genetic correlations among body condition score, dairy form and disease from the US. C. D. Dechow, G. W. Rogers, T. J. Lawlor, L. Klei, A. E. Freeman, and G. Azim, University of Tennessee, 2Holstein Association USA, Inc., 3Iowa State University.

The objectives of this study were to estimate genetic correlations among body condition score (BCS), dairy form (DF) and measures of cow health. Observations for BCS and DF were obtained from Holstein Association USA Inc. Body condition score and DF records were included to include those cows with valid BCS and that were classified between 24 and 60 days of age and between test 80 and 35 days in milk. A minimum of 10 cows per herd-classification visit (HV) and 20 daughters per sire were required. Only one record per cow was used in the analyses. Records were available for 183,044 cows after edits. Health data were obtained from several herds that participated in a Genex/CRU pilot health recording study and recorded all veterinary treatments. The diseases included in the analyses included displaced abomasums (DA), metabolic disease, foot diseases, uterine diseases and mastitis. Herd mates that calved during the same year and season of cows with one or more observations for disease, but that did not have a disease observation were assumed to be disease free. A minimum of 5 cows per herd-year-season (HYS) was required. The edited data set included 6247 cows, 221 of which had BCS and DF observations available. Genetic correlations among disease, BCS and DF were estimated with multiple trait sire models in ASREML. Models included age at calving nested within lactation group, 5th order polynomials of DIM nested within lactation group, fixed HV effects and random sire and error for BCS and DF. Models for disease traits included a fixed HYS effect, age at calving nested within lactation group, and random sire and error. Body condition score was significantly correlated with lower incidence of DA (0.84) and metabolic disease (-0.95), whereas DF was significantly correlated with higher incidences of DA (0.86) and metabolic disease (0.96). Cows that are genetically inclined to have high dairy form or low BCS may be more susceptible to DA and metabolic disease.

Key Words: Body condition score, Dairy form, Health
Legendre polynomials were adopted for drawing lactation curves. The objective of this study was to test statistically which order of polynomial can fit the lactation curve most effectively. Data were provided by Livestock Improvement Association of Japan and consisted of 19,397,399 test-day records and 4,087,621 pedigree records. The test-day records included 6 to 365 DIM. To determine the order of the polynomial, a sample data set with about 30,000 test-day records for 300 cows in the first lactation was extracted from the entire data set. Pedigree records included up to three generations per animal. Using the sample data set, additive genetic variance-covariance components were estimated by REML for four models with second to fifth order Legendre polynomials. All effects in the models, except the order of the polynomial, were the same. The models included herd-test-day, season and age group effects as fixed, and additive genetic and permanent environmental effects as random. Setting the estimate from the fifth order polynomial to the criterion, the F test was used to find out the goodness of fit among the models. The difference between random regression models with the second and the third order polynomials was significant, and no difference was found between those with the third and the fourth order polynomials. The model with the third order polynomial better explained the lactation curve with fewest parameters. All data were divided into 400 datasets because of lack of computation memory, and ten sub datasets were sampled randomly. Genetic parameters were estimated using the random regression test-day model with the third order polynomial for the ten sub datasets. For each dataset, heritability was estimated at twelve points from DIM 30 to 360. The heritability estimates were 0.23 and 0.34 at DIM 30 and 360, respectively, increasing with DIM. The range of the heritability estimates (0.11) was smaller and more stable than that of other studies.

Key Words: Random regression, Test-day record, Holstein


Individual feed intake was recorded during 84-d growing and 112-d finishing periods on Charolais-sired crossbred steers (n = 410). Steers consumed a barley silage-based diet during the growing period, and a barley grain-based diet during the finishing period. Following finishing, steers were harvested at a commercial packing facility where carcass data were collected 24 h postmortem. Net feed efficiency was estimated for the growing (NFG) and finishing (NFF) periods using linear regression procedures such that within-period phenotypic correlations of efficiency measures with average daily gain and average metabolic body weight were zero. Net feed efficiency during the growing (finishing) period varied from an efficient 4.10 (4.77) kg per d to an inefficient 4.65 (3.30) kg per d. Using an animal model and restricted maximum likelihood, genetic parameters were estimated among NFG, NFF, and age-adjusted (463 d) carcass traits, including hot carcass weight (HCW), fat thickness (FAT), longissimus muscle area (REA), and marbling score (MAR). The relationship matrix among 975 animals included a minimum of a three generation pedigree for the 34 Charolais bulls that sired steers with records. Heritability estimates were moderate for NFG (0.50 ± 0.06) and NFF (0.26 ± 0.07), whereas carcass trait heritabilities were constrained to literature averages to avoid convergence failure. Phenotypic and genetic variance estimates for NFG were higher than those for NFF. The genetic correlation between NFG and NFF was 0.55. Genetic correlations of NFG and NFF with HCW and REA were weak to moderate and positive, but were negative and generally weak with FAT. The genetic correlation of MAR with NFG was near zero (0.08) but was strongly negative (-0.44) with NFF. These results suggest that a high and positive genetic association exists between net feed efficiency measured when cattle were consuming roughage- versus grain-based diets, although these traits may not be biologically equivalent.

Key Words: Beef cattle, Net feed efficiency, Genetic parameters

M76 Genetic parameters for longevity in a colony of German Shepherd dog guides. J. B. Cole¹, D. E. Franke¹, and E. A. Leighton², ¹Louisiana State University, Baton Rouge, LA, ºThe Seeing Eye, Inc., Morristown, NJ.

Data on longevity for 1,304 German Shepherd dogs (GS) was used to estimate genetic parameters for working life. A Cox proportional hazards model on unadjusted working life was used to test the assumption that the baseline hazard function for the population is a Weibull hazard. The rejection of that assumption led to the definition of two measures of working life: estimated for working life to 18 months post-graduation (EWL) and working life beyond 18 months post-graduation (LWL). For EWL, 92.45% of the records were censored after 540 days, while for LWL 47.89% of the records were censored after 4,361 days. The Survival Kit v3.12 was used for variance components and breeding value estimation. Estimates of additive sire genetic value for Cox and unstratified Weibull models were 0.87 and 0.36 for EWL and 0.05 and 0.03 for LWL, respectively. Heritability estimates on a log scale (assuming no censoring) were 0.19 and 0.61 for EWL and 0.09 and 0.04 for LWL, respectively. For both traits, the standard deviations and skewness of the posterior distributions of the sire variance were fairly large. Due to the small size of the dataset and the large number of censored records, it was not possible to obtain more precise estimates of the sire variance. The large heritabilities observed for EWL under the Cox and Weibull models should be interpreted with caution because virtually all EWL records were censored. Pearson’s product-moment correlation coefficients for sire breeding values estimated under the Cox and Weibull models were 0.99 for EWL and 0.88 for LWL, respectively. The low correlation between the models may be due to large prediction error variances and the skewness of the posterior distribution of sire effects, although these problems were noted for EWL as well.

Key Words: Variance components, Working life, Dog guides


A total of 214 sires sired by Landrace or Duroc-Hampshire boars out of Landrace, Yorkshire, or multi-breed crosses were evaluated for preweaning performance. Traits of the dam (litter) that were studied included litter size, number born alive, litter birth weight, number alive at weaning, litter weight at weaning, and percentage of piglets born alive surviving at weaning. Other traits studied were piglet birth weight, weaning weight, and preweaning average daily gain. Six-subclass progeny records for growth performance indicating presence of genetic variability. In general, Duroc-Hampshire sires were the best ranked by breeding values for growth performance indicating presence of genetic variability. In general, Duroc-Hampshire sires were the best ranked by breeding values for growth performance indicating presence of genetic variability.
**M78** Preliminary study of daily gain in central station-tested Nelore bulls. J.A.C. Pereira1 and J. E. Chavez2, 
1Gabriel Rene Moreno University, 2ASOCEBU.

The objectives of the study were 1) to investigate a method to base the selection of Nelore bulls on their growth performance in a grazing system under subtropical conditions, and 2) to determine the preferable trait to be used as a selection criterion in a central evaluation station. Each year approximately 1.500 weaned, young bulls were available to be tested. This number was restricted due to the physical limitations of the station. Therefore, each year, a pre-classification of the bulls was performed. Only young bulls with weaning weights above the herd average and acceptable conformation were selected. In this study data was collected on 130 young sires from different farms over four consecutive years. They were kept on pasture before and during the test (280 days). All the animals were managed under a rotational grazing system. The only ad libitum supplementation was mineral salt. During the test period the animals were weighted every 28 days. Six traits were measured: Birth Weight (BW), Beginning Weight at Test (BGT), Age in Days at the beginning of the Test (ADT), Daily Gain from birth to the beginning of the test (DG1), Daily Gain during the test (DG2) and the Final Weight at the test (FW). Harvey’s least square program was used to analyze the data. The model used was the pre-determined “model 1” of fixed effects. The results showed that BW, DG1 and FW were significantly different among farms and were not used as selection criteria. It is proposed to select bulls using their DG2 value, which is a preferable selection criterion because it was not affected by farm. The results also indicated that Nelore bulls might have great potential to be selected under grazing systems. The adjusted daily gain measured in the four consecutive years ranged between 0.658 and 0.726 grams per day. Further research should be performed including other effects such as dam’s parity, in order to estimate the genetic performance more accurately. In addition, a new approach (testing on farms) should be investigated in order to include all the young bulls weaned each year.

**Key Words:** Grazing systems, Nelore, Daily gain

**M79** Setting up the Gelbvieh multiple breed evaluation. A. Legarra1, T. Strabel1, J. K. Bertrand1, and I. Miształ1, 
1University of Georgia, Athens, GA, 2Agricultural University of Poznan, Poznan, Poland.

The Multiple Breed Evaluation for the Gelbvieh breed was developed, generally following ideas applied first in the Simmental evaluation by Cornell University. The main challenges for genetic evaluation were related to assumptions of grouping breeds to form super-breeds and fixing genetic group effects. The data set did not allow for a correct estimation of all these effects, so priors were taken from literature. Genetic difference between Gelbvieh and Angus breed of founder priors were 26.5 (var=7.48E-05) and -3.7 (var=0.11E-05) kg for weaning weight and yearling gain respectively. Some results of the evaluation were strongly affected by the priors, although results for Gelbvieh as the main breed stayed basically the same. Genetic trends for Gelbvieh were: 0.34 and 0.33 kg/year for weaning weight and 0.43 and 0.44 kg/year for yearling gain with or without priors, respectively. For Angus, trends were non-linear and about 0.10 and 0.32 kg/year for weaning weight and 0.71 and 0.67 kg/year for yearling gain with or without priors, respectively. As the number of pure-bred Angus animals in data was very low (97 out of 666,513) it seems that genetic trends for Angus were a mixture of the evolution of Angus genes in the Gelbvieh population and the original Angus population. Differences between Gelbvieh and Angus genetic average breeding value for year 1995 were 0.87 and 9.91 kg for weaning weight and 3.64 and 4.04 kg for yearling gain with and without priors, respectively. The results from the study indicate that estimation of genetic differences between breeds in current pure-breed associations data banks is very dependent on the weight given to the prior literature values relative to the data. More understanding on how results are influenced by priors and data is needed.

**Key Words:** Gelbvieh, Multiple breed evaluation, Genetic evaluation

**M80** Differences in growth trajectories in seven beef breeds. J. Bohmanova1, I. Misztal1, and J. Pribyl2, 
1University of Georgia, Athens, GA, 2Research Institute of Animal Production, Prague, Czech Republic.

The objective of this study was to estimate average breed growth curves and assess differences in growth performance between breeds and sexes. A total of 140,503 weight records from birth to 360 days on 60,284 animals provided by Czech Beef Breeders Association were used to compare growth of Charolais (14,340), Simmental (10,382), Angus (9,622), Limousin (6,046), Hereford (16,362), Blond D’Aquitaine (2,020) and Piedmontese (1,512). Effects included in the model of analysis were herd, year and dam age class and regression on orthogonal polynomials nested within sex. Adjusted mean weight from birth to 360 days was estimated for heifers and bulls. All computations were by breed. Charolais bulbs and heifers had the highest birth weights with 41 kg and 39 kg, respectively. Hereford bulbs and heifers had the lowest birth weights with 30 kg and 29 kg, respectively. Simmental and Charolais were the fastest growing breeds, with bulls from these breeds weighing 484 kg and 467 kg at 360 days of age, respectively. Herefords had the slowest growth of all breeds. Simmental, Charolais, Angus and Blonde D’Aquitaine bulbs had similar growth trajectories. Sex differences in body weight at 240 days of age ranged from 33 kg in Blond D’Aquitaine to 18 kg in Hereford. Growth of heifers slowed down considerably after 240 days of age. Angus and Piedmontese heifers stopped growing at 330 days. Bulls grew linearly till 270 days of age, after which their growth accelerated considerably. This increased growth after 270 days of age can be explained by an increasing proportion of records coming from bulls raised in test stations.

**Key Words:** Beef cattle, Growth, Breed differences

**M81** Economic evaluation of sow longevity using data from commercial herds. S. L. Rodriguez-Zas1, B. R. Southey1, R. Knox1, J. F. Connors2, J. F. Lowe3, and B. Roskamp1, 
1University of Illinois Champaign-Urbana, Urbana, IL, 2Cartahge Veterinary Service, Ltd., Cartaghe, IL.

Sow longevity and lifetime production are critical determinants of the profitability of pork production systems. A study was conducted to assess the impact of genetic line on multiple indicators of sow longevity and production traits. Records from more than 100,000 sows in 32 US commercial herds across five years were analyzed using survival and mixed effect repeatability models. The variation among genetic lines was evaluated in biologic and economic units using the net present value per sow. Explanatory variables included herd, year of entry into the herd and genetic line. Significant differences in sow longevity and production traits were observed between genetic lines. Since the economic magnitude of the effect of sow longevity primarily depended on the discount rate and net income per litter, all genetic lines were assumed to differ in the median longevity. Hence, the results from the economic analysis apply to the average sow from each genetic line. Assuming zero discount rate per parity, the genetic line with longer herd life showed greater profit than genetic lines with the shorter herd life. Under these conditions and assuming a $10 net income per litter, no genetic line was profitable. Assuming a $50 net income per litter, the difference in net present value per sow between the highest and lowest lines for longevity was $52.39 and the difference between the highest two lines for longevity was $13.94. Assuming a $10 net income per litter, the difference between the highest and lowest lines for longevity was $10.48 per sow and the difference between the highest two lines for longevity was $2.79 per sow. The difference in net present value between genetic lines was considerably reduced with increasing discount rates and was reversed with high discount rates and low net income per litter. The significant differences in sow longevity among genetic lines were not translated into substantial economic differences for the range of discount rates considered. Results from this economic analysis indicate that the manipulation of the genetic line composition of a herd is an important factor in the achievement of a profitable swine production.

**Key Words:** Economic, Survival, Swine

**Swine: Impact of Weight and Sex on Meat Quality, Effect of Age Management on Biochemical Parameters, Disinfectant, Gilt Selection and Sow Longevity**

**M82** Economic evaluation of sow longevity using data from commercial herds. S. L. Rodriguez-Zas1, B. R. Southey1, R. Knox1, J. F. Connors2, J. F. Lowe3, and B. Roskamp1, 
1University of Illinois Champaign-Urbana, Urbana, IL, 2Cartahge Veterinary Service, Ltd., Cartaghe, IL.

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**Key Words:** Economic, Survival, Swine
M82 Gilt selection based on age at first estrus and breeding herd efficiency. J. L. Patterson*, G. H. Foxcroft*, M. J. Pettitt†, and E. Beltranena, †Prairie Swine Centre, Inc., Saskatoon, SK. 2Prairie Research & Technology Centre, University of Alberta, Edmonton, AB.

The impact of gilt selection based on age at first estrus on breeding herd performance was determined in 509 C22 and L42 (PIC Canada) gilts given direct daily contact with vasectomized boars from 140.1 ± 5.1 d of age and 1% of the individuals with respect to age at first estrus. EP: 148.0 ± 0.5; Intermediate: IP: 159.8 ± 0.4; Late: LP: 175.7 ± 0.5 d; or Non-Responsive by 180 d: NR: P<0.05. For gilts in estrus by 180 d, breeding at third estrus resulted in differences in body weight at breeding (EP: 130 ± 2; IP: 143 ± 2; and LP: 153 ± 2 kg; P<0.01). Breeding rate (percentage of gilts on inventory eventually bred) was lowest for NR gilts (EP: 93.5%; IP: 90.6%; LP: 93.2%; P<0.05). Gilts given direct daily contact with vasectomized boars from 140.1 ± 5.1 d of age and 1% of the individuals with respect to age at first estrus. EP: 148.0 ± 0.5;


Flavoring compounds used in feeds interact with the feedstuffs to such extent that flavor performance may differ if feed ingredient formulation changes. Earlier studies have shown that content of crude protein, starch and crude fat of feedstuffs account for most of the interactions with flavoring compounds. In the current study, corn, soybean, blood plasma and fish meal where flavored with a strawberry aroma in powder form, and the release of selected aromatic compounds at 0, 7 and 21 d post-application of an accelerated stability test was traced and quantified by Head Space-Solid Phase Microextraction and Gas Chromatography-Mass Spectrometry. The selected aromatic compounds were ethylbutyrate (bp760=212°C, MW=116.16), isomyval valerianate (bp760=191°C, MW=172.27) and alpha-ionone (bp760=250°C, MW=192.30) and were chosen to represent very high, high and medium volatilities, respectively. The feedstuffs content of crude fat, crude protein, starch, moisture, crude fiber, Fe, Cu, Zn and total ash were evaluated and correlated with aromatic compound losses expressed as a percentage of initial values. Regardless of the feed ingredient, at 7 d no trace of ethylbutyrate could be found, therefore linear correlations were very low (R²≤0.20). Losses of isomyval valerianate were highly correlated linearly with crude fat content at d 7 (Y=−0.0036X+92.528, R²=0.9438) and 21 (Y=1.8303X+101.35, R²=0.9549), indicating that the higher the fat content, the slower the aromatic compound release. Furthermore, alpha-ionone release, showed only a medium correlation with fat content at d 7 (R²=0.7857) and very low at d 21 (R²≤0.20). Overall, retention of all analyzed aromatic compounds revealed that the higher the fat content of the feedstuffs, the lower the losses (d 7: Y=−3.5744X+94.922, R²=0.9485; d 21: Y=−0.37017X+99.478, R²=0.9079).

Key Words: Feedstuffs, Crude fat, Strawberry flavor

M86 Effect of feeding management and feeding time on urea nitrogen levels in swine research. I. Moreira*, M. Kutschenko†, A. Fraga*, E. Sakaguti*, G. Oliveira*, and D. Souza†, 1Universidade Estadual de Maringá-Maringá-PR/BRASIL, 2UNESP-Jaboticabal-SP/BRASIL.

Two experiments were conducted to evaluate the effect of feed management (“ad libitum” or fasting before bleeding) on the plasma urea nitrogen (PUN). All pigs (n = 30) were bled on the last (seventh) day of the experiments. Initial body weight was 46.1 kg in Exp 1 and 50.8 kg in Exp 2. Pigs were allotted in a 3 x 2 factorial arrangement of treatments (three protein concentrations in the Exp 1 or three lysine concentrations in Exp 2, two feeding management schemes and two bleeding times) in a randomized complete block design with 10 replicates. The three protein-lysine levels were 13.9±0.71, 16.4±0.83 and 19.0±0.95 %. The two feeding management schemes were “ad libitum” or 12 h fasting (20:00 p.m. to 8:00 a.m.) before bleeding. After fasting, pigs were fed for 1 h, followed by 5.5 h of fasting and then bled. The two bleeding times were in the morning (8:00 a.m.) and in the afternoon (1:30 p.m.). Results of PUN determinations were submitted to ANOVA and polynomial regression analysis. The ANOVA results showed higher PUN when bleeding in the afternoon, compared to the morning. The effect of feeding management and feeding time on urea nitrogen levels in swine research. I. Moreira*, M. Kutschenko†, A. Fraga*, E. Sakaguti*, G. Oliveira*, and D. Souza†, 1Universidade Estadual de Maringá-Maringá-PR/BRASIL, 2UNESP-Jaboticabal-SP/BRASIL.
mg kg⁻¹ for a period of 35 days. In addition, there was a control group that was injected with vehicle and allowed ad-libitum access to feed, and a third group that was injected with vehicle and had their feed intake restricted to that of the group injected with leptin. All of the barrows were injected intramuscularly with 1 mg of Limulus haemocyanin (LH) emulsified in incomplete Freund’s adjuvant on days 0 and 14 of the experiment. Blood samples were collected on days 0, 7, 14, 21, and 35 for analysis of serum antibodies to LH (IgG1 and IgG2) and for the whole blood proliferative response to LH and to concanavalin A (Con A). Leptin reduced (P < 0.05) average daily feed intake by 20.7 % as compared to the control group. All pigs developed an antibody response (IgG1 and IgG2) to LH by day 14. Pigs injected with exogenous leptin had lower (P < 0.05) serum IgG1 against LH on days 21 and 35 than did the control or limit-fed group. There was no effect (P > 0.05) of leptin on serum IgG2 concentrations. Leptin had no effect (P > 0.05) on the proliferative response to Con A or LH at any time point. For in vitro experiments, blood was collected from healthy pigs and peripheral blood mononuclear cells (PBMCs) were isolated to test the effect of leptin (0.6 ng/mL) on the blastogenic response to Con A (5 g/mL) and interferon-γ (IFN-γ) production, and to determine whether these cells express the long form of the leptin receptor (Ob-Rb). Leptin had no effect on blastogenesis or IFN-γ production in the stimulated PBMCs. However, expression of Ob-Rb in these cells was confirmed at the mRNA level, and the relative mRNA abundance was down-regulated (P < 0.05) in response to Con A. This result indicates that leptin modifies antibody isotypes in the pig, and that the long form of the leptin receptor is regulated in response to some immunogens.

Key Words: Leptin, Pig, Immune system


A total of 189 half duplex passive injectable transponders (PIT) of two different sizes (31.5 x 3.8 mm, n=106; and, 23 x 3.8 mm, n=83). Tiris, Almejo, Holland) were used to identify 48 castrated Iberian pigs, in order to evaluate the effects of s.c. inoculations in different body sites (ear base, EB; ciliary arc, CA; armpit, AR; and, shinbone, SH). Pigs were randomly allotted into two groups (24 pigs each) and injected (four PIT per pig) at 4 mo of age. One group was kept outdoors in intensive conditions and slaughtered at 9 mo of age (80 kg BW), whereas the other was kept outdoors in extensive conditions and slaughtered at 15 mo of age (120 kg BW). Readability of PIT (readable/injected) was checked weekly by using two types of handheld readers (Gesreader I, Gesimex, Spain; and, Hokofarm, Insentec, Holland). Migration distance was measured by the X-Ray method (Caja et al., 1998; Livest. Prod. Sci., 55:279). Injection point was marked with a surgery clamp and pigs radiographed at 0, 7, 15, 30, 45, 90 and 180 d post-injection. Management system did not affect PIT performances. Readability did not vary by PIT size but was greater (P<0.05) for EB (93.6%) than other injection sites (CA, 59.6%; AR, 79.2%; and, SH, 74.5%). Only values in AR and SH did not differ. Up to 80% of unreadable PIT occurred during the first month in all injection sites. Migration distances were in all cases shorter than needle length (60 x 4.8 mm) and varied according to PIT size and injection site (P<0.05), and averaged: EB, 8.9 1.6 cm; CA, 3.7 0.8 cm; AR, 20.5 3.4 cm; and, SH, 16.7 8.6 cm. Difficulties of PIT location at slaughter were very variable and no significant effects were reported in recovery time from the carcass (EB, 78; CA, 107; AR, 166; and, SH, 105 s). No recovery time was compatible with the average speed of swine commercial abattoirs. We conclude that no subcutaneous injection is recommended in the electronic identification of pigs for any of the body sites evaluated.

Key Words: Transponder, Migration, Electronic identification

M91 Sex effect on performance and carcass quality of heavy pigs. J. Peinado1, A. Fuentetaja2, M. A. Latorre3, G. G. Mateos5, and P. Medel5, 1 IMSAP Agropecuaria, S.L., Spain, 2 COPESE, S.A., Spain, 3 Universidad Politécnica de Madrid, Spain.

A total of 150 Pietrain*Large White x Landrace*Large White pigs of 23.3 ± 1.6 kg of initial BW was used to study the influence of sex (castrated males, CM; castrated females, CF; entire females, EF) on...
productive performance and carcass quality. Each treatment was replicated five times (10 pigs housed together). Males were castrated at birth and females at 75 d of age, and all the pigs were slaughtered at 120 kg BW. Feeding program was common for all the pigs and consisted of three commercial diets offered ad libitum (2.3 Mcal NE/kg and 0.97 % lys from 30 to 65 kg BW, 2.4 Mcal NE/kg and 0.7 % lys from 65 to 95 kg BW, and 2.4 Mcal NE/kg and 0.67 % lys from 95 to 105 kg BW). Performance of females was penalized by castration in the first 15 d period following surgery, but the pigs recovered and showed a compensatory growth at the end of the trial. Castrates of both sexes grew faster (877, 868, 813, and 807 g/d for CM, CF, EM, and EF, respectively; P < 0.05) and tended to have poorer feed conversion (2.62, 2.55, 2.46, and 2.50 g/kg for CM, CF, EM, and EF respectively; P < 0.10) than entire pigs. Females had more carcass fat and fat thickness at Gluteus medius than entire males (75.1, 75.1, and 74.5 %, and 16.42, 16.58, and 14.87 mm for CF, EF, and EM respectively; P < 0.05). Ham and loin yields were greater for EF than for EM, with intermediate values for CF (26.63, 26.12, and 26.54 % and 6.87, 6.59, and 6.82 % for ham and loin yields in EF, EM, and CF, respectively; P < 0.05). In conclusion, castrated pigs, both males and females, grew faster and tended to have poorer feed conversion than entire pigs. Percentage of carcass fat was greater for castrated than for entire pigs.

Key Words: Pig performance, Sex, Carcass quality

M94 Effect of sex, castration, and slaughter weight on pig performance and carcass. P. G. Lawlor1, P. B. Lynch1, J. Kerry2, and P. Allen3, 1Teagasc, Moorepark, Fermoy, Co. Cork, Ireland, 2Dept. of Food Technology, University College, Cork, Ireland, 3National Food Centre, Ashington, Dubai 15, Ireland.

The aim of this study was to examine the effect of sex and slaughter weight on performance and carcass in pigs of a lean genotype. Ninety single sex pairs of pigs (Meatline Landrace sire on Landrace X Large White sows) were used in a 3 (sex) X 5 (slaughter weight) factorial design with 6 pairs per treatment. The experimental pigs were weaned at 21 d of age (mean = 26 days; 7 kg) to slaughter. Sexes were boar (B), castrate (C) and gilt (G), and the slaughter weights were 80, 90, 100, 110 and 120 kg live weight. All pigs were fed the same diets based on wheat, barley and soybean meal ad libitum as dry pellets. Nutrient content of the diets were 14.5 M/kg digestible energy (DE) and 13.0 g/kg total lysine (LYS) from weaning to 15 kg; 14.1 M/kg DE and 13.0 g/kg LYS from 15 to 30 kg and 13.5 M/kg DE and 11.0 g/kg LYS from 30 kg to slaughter. Sex X slaughter weight interaction effects were not significant (NS; P>0.05). Daily weight gain and feed conversion ratio (FCR) were 748, 756 and 712 g (s.e. 10, NS) and 2.28, 2.49 and 2.46 (s.e. 0.03; P<0.01) for B, C and G, respectively. Backfat depth, muscle depth and carcass lean meat content (by Hennessey Grading Probe) were 12.2, 13.5 and 12.4 mm (s.e. 0.4; P<0.05); 55.9, 57.0 and 58.0 mm (s.e. 1.1; NS) and 579, 582 and 591 g/kg (s.e. 6, NS) for B, C and G, respectively. Daily weight gain and feed conversion ratio (FCR) for slaughter weights were 715, 737, 756, 737 and 748 g (s.e. 14, Linear effect (Lin) - P=0.09; Quadratic effect (Quad) - P = 0.09) and 2.24, 2.39, 2.41, and 2.48 (s.e. 0.04; Lin - P<0.01) for 80, 90, 100, 110 and 120 kg respectively. Backfat depth, muscle depth and carcass lean meat content were 11.2, 11.9, 13.0, 13.8 and 13.5 mm (s.e. 0.5; Lin - P<0.01; Quad - P<0.09; 52.1, 53.3, 58.4, 62.4 and 57.8 mm (s.e. 1.4; Lin - P<0.01; Quad - P<0.01) and, 55.3, 585, 588, 587, 592 and 568 g/kg (s.e. 7, Lin - P<0.10; Quad - P<0.01) respectively.

Key Words: Castration, Slaughter weight, Carcass

M95 Effects of feeding blends of grains naturally-contaminated with Fusarium mycotoxins on antibody-mediated immune response and brain neurochemistry in starter pigs, H.V.L.N. Swamy1, T. K. Smith1, E. J. MacDonald2, N. A. Karow1, and H. J. Boermaans3, 1University of Guelph, Guelph, ON, Canada, 2University of Kuopio, Kuopio, Finland.

An experiment was conducted in starter pigs to: (1) determine the effect of feeding blends of grains naturally-contaminated with Fusarium mycotoxins on antibody titers to sheep red blood cells (SRBC) and brain neurochemistry, (2) to delineate direct and indirect effects of Fusarium mycotoxins on antibody titers to SRBC and (3) to test the efficacy of a polymeric glucamannan mycotoxin adsorbent (GMP, MTB-100, Alltech Inc.) in preventing Fusarium mycotoxins. A total of 150 starter pigs (initial weight of 9.3 kg) were fed 5 diets (6 pens of 5 pigs per diet) for 21 days. Diets included: (1) control (2) a blend.
of 17 blend of 24.5 group for comparison with the group fed 24.5ol contaminated grains in the diet increased linearly the ratio of hypothalamic 3,4-dihydroxyphenylacetic acid to dopamine (DA) concentrations and cortex 5-hydroxytryptamine (5HT) concentrations, while hypothalamic norepinephrine and tryptophan, and pons DA and homovanillic acid concentrations increased linearly with dietary 5-hydroxyindoleacetic acid to 5HT ratios responded quadratically to the inclusion of contaminated grains. The feeding of contaminated grains did not alter primary antibody response to SRBC but further studies on the secondary antibody response were warranted. It was concluded that the major effect of feeding *Fusarium* mycotoxin-contaminated grains to pigs is to alter brain neurochemistry.

**Key Words:** Antibody-mediated immune response, *Fusarium* mycotoxins, Neurochemistry

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## Nonruminant Nutrition

### M96 Effect of dietary supplementation of 1% L-glutamine on the intestinal morphology of early weaned piglets 14d and challenged with transmissible gastroenteritis virus. H. Herrera1, A. G. Borbolla1, H. Ramirez2, and G. Mariscal2.1 Universidad Nacional Autonoma de Mexico, 2INIFAP CENID Fisiologia.

The aim of this work was to determine the effect of dietary supplementation of L-glutamine (Gln) on villous height (VH) and crypt depth (CD) in three portions of the small intestine of piglets weaned at 14d and challenged with the transmissible gastroenteritis virus (TGV) after 0d of weaned (W). Weaned pigs (35) of 14d of age and weight of 4,660.2 Kg were used in this study. Thirty pigs were randomly assigned to two different treatments (tx): 1) 0% Gln and 2) 1% of Gln supplemented (1% Gln) and housed in 6 pens (3 pens of 5 animals per treatment), in facilities appropriate for the animal's age. The 5 remaining piglets were slaughtered on 0d (14d of age) to obtain VH and CD as baseline measures. Both groups received the same diet and a daily oral dose of water or 1% of crystalline L-Gln according to the amount of feed consumed the previous day. Feed intake was registered in a daily basis. On d4 after weaning, the piglets were oro-nasally inoculated with 1x10^6 infective doses of TGV. On d5, 14 and 21, 5 pigs by tx were slaughtered with pentobarbital to measure VH and CD. The samples were included in paraffin for a later histological evaluation. Ten villous samples of each intestine portion were measured with a graduated ocular (1mm/100).

Comparisons were made in time between animals in the same treatment versus the baseline measures. Of each pig, 10 cm of the middle jejunum was sampled to isolate the virus and blood serum to detect antibodies with a Kit ELISA. In the jejunum of all the inoculated pigs the TGV was isolated but antibodies were not detected. In the duodenum of the 1% Gln group, the VH was smaller (P<0.05) at 5d than 0d (450 vs. 258, 389 and 409 mm for 0, 0.5, 14 and 24 W). In jejunum the tx 1% Gln showed an atrophy of 61 and 33% (P<0.05) the 5 and 14 vs 0d (456 vs 177, 303 and 445 mm), while tx 0% Gln the atrophy it was of 36% (P<0.05) in the 5 and 14 d (456 vs 288, 287 and 527 mm). Atrophy in ileum for tx 1%Gln were 24 and 18% (P<0.05) the 5 and 14 d (268 vs 202, 219 and 297 m), and in tx 0% it was 30 and 16% (P<0.05) in the same period (268 vs 187 and 225 and 265 m). The supplementation of 1% Gln doesn't prevent the atrophy of the villous during the first five days of viral challenge, but it accelerates the recovery of the intestinal damage caused by the virus and the effect of the weaning.

**Key Words:** Glutamine, Wean, Small intestine


A 2 x 3 factorial experiment in a randomized complete block design was conducted to evaluate the effects of lactose and organic acid complex consisted of butyrate, formate, lactate and phosphoric acid on growth performance and intestinal environments for 21 d after weaning. A total of 360 weaned pigs were used. The dietary treatments were: 1) high level of lactose (HL) + 0% organic acids, 2) HL + 0.15% organic acids, 3) HL + 0.30% organic acids, 4) low level of lactose (LL) + 0% organic acids, 5) LL + 0.15% organic acids and 6) LL + 0.30% organic acids. Feed intake and body weight of pigs were measured at d 0, d 14 and d 21. Five pigs per treatment were sacrificed at d 0, d 3, d 7 and d 21 for sampling of intestinal digesta, ileal tissues and blood. The ADG and ADFI were numerically higher in treatment 2 than other treatments. Feed efficiency in treatment 3 tended to be higher than other treatments during the entire experimental period. But no significant difference was observed. Pigs fed diets containing organic acid complex and high level of lactose showed better performance, in general, but it was not significantly different. The digesta pH was not different among treatments at dl 3 and 7. At d 21, treatment 3 had a higher pH of jejunal digesta (P<0.1). Treatments 3 and 2 also showed a higher leukocyte counts at d 3 and d 21 than other treatments, respectively (P<0.1 and P<0.05). In gastrointestinal microbiology, there was no favorable effect of organic acids and lactose supplementation except decreased number of coliform bacteria in treatment 3 at d 21 (P<0.1). Villus height and crypt depth were not different among treatments but villus height/crypt depth ratio was higher in treatments 2 and 5 at 7 (P<0.1). These results suggest that organic acid complex and lactose have no interactive effect on growth and intestinal environments in weaned pigs.

**Key Words:** Pigs, Organic acid, Lactose

### M98 Bone mineral content gain is reduced in weaned pigs fed diets with low-buffer capacity and organic acids. G. Biagi1, A. Piva1, T. D. Hill2, D. K. Schneider2, and T. D. Crenshaw2.1 University of Bologna, Italy, 2University of Wisconsin, Madison, WI.

Consumer preferences continue to pressure reliance on sub-therapeutic use of antibiotics in swine diets. Current experiments were designed to evaluate diet buffer capacity and use of organic acids for their potential to maintain growth and bone status during the most problematic period of nutritional management, immediately after weaning. Three trials were conducted using either all 6 (Trial 1) or a subset (Trial 2 and 3) of 6 dietary treatments. Treatments were: 1) Control, complex diet with plasma protein and carboxido; 2) Plant protein, high-buffer diet; 3) Plant protein, low-buffer diet; 4) Diet 3 + 1% citric acid; 5) Diet 3 + 1% fumaric acid; 6) Diet 3 + 0.2% Tetracid 500 (a protected combination of organic acids, JEFAGRO Technologies Inc.). No antibiotics were added to Diets 2 through 6. Reduced buffer capacity involved shifts in sources (tricalcium phosphate and calcium sulfate) and concentrations of Ca and P (0.75% Ca, 0.81% P, diet 2; 0.50%Ca, 0.65% P, diet 3) previously shown to reduce undesired gut microbes. In trial 1, 96 pigs (PIC Cambrough X Line 19) were weaned (3 wk) and randomly allotted to diet groups for a 6 wk trial (Phase I, 6 diets, 14 d; Phase II, 6 diets, 14 d; Phase III, common diet, 14 d). In Phase I, pigs fed Control diets gained faster and more efficiently (P<0.01) than those fed other diets, but no differences were detected (P>0.10) in growth or efficiency among groups during Phase II or III. Duration of Trials 2 and 3 were 28 d and only diets 2, 3, 5 and 6 were included. On d 0 and 28 of Trials 2 and 3, 30 barrows were scanned by dual energy x-ray absorptiometry (DXA), and bone mineral content gain (BMC) was calculated. Pigs fed low-buffer diets and organic acids had 50% lower (P<0.01) daily BMC gain (adjusted for differences in weight gain) over 28 d (10.8, 6.2, 4.8, and 5.6 g BMC/kg weight gain for pigs fed diets 2, 3, 5 and 6 respectively). The long-term consequences of feeding low-buffer diets and organic acids were not assessed in these trials.

**Key Words:** Bone, Buffer, Antibiotics


To compare effects of the Carbadox and a mannanoligosaccharide product on performance, a total of 48 crossbred (Yorkshire × Landrace × Duroc) pigs were weaned at approximately 21 days of age and blocked by gender, genetics, and weight. Pigs were randomly assigned to one of 4 treatments 3 tended to be higher than other treatments during the entire experimental period. But no significant difference was observed. Pigs fed diets containing mannanoligosaccharide in the feed, a rotation of the above two treatments, treatments included 55 mg Carbadox/kg of feed, 0.4% Bio-Mos® (mannanoligosaccharide) in the feed.
or an NRC based control diet with no growth promoting additives. Each group was allowed ad libitum access to water and the assigned treatment as a single phase diet. Pens were used as the experimental units. Performance parameters, including average daily gain, average feed intake, and feed conversion ratio, were measured for a 28-day period and compared among treatments. Feed intake and feed conversion ratio were measured for individual pigs. No treatment effects (P > 0.05) were noted for any of the growth parameters measured. Although not significant, the Bio-Mos® treatment produced a numerically higher weight gain and lower feed consumption, which resulted in an improved feed conversion ratio when compared to the other treatments. These data indicate that growth performance parameters were not significantly affected by the addition of Carbadox or mannanoligosaccharides in the diet. It is possible that the lack of statistical differences was due to the controlled environment of the experiment, which may have reduced the level of disease challenge presented to the pigs and thereby reducing the intensity of growth promoting benefits. Further research will be necessary to determine the potential for mannanoligosaccharides as an effective growth-promoting alternative to antibiotics.

Key Words: Antibiotics, Mannanoligosaccharides, Pigs

M100 Effects of antibiotics versus mannanoligosaccharides on intestinal pH and volatile fatty acid concentrations in weaning pigs. J. Fullam*, R. Clift, S. Chattin, and A. G. Mathew, The University of Tennessee, Knoxville TN USA.

Three replicate trials with a total of 36 ileal cannulated pigs were conducted to observe intestinal pH and volatile fatty acid (VFA) concentrations. Individual pigs were used as the experimental units and were weaned at approximately 21 days of age, blocked by gender, genetics and weight, and allotted to pens in groups of three. Pens were randomly assigned to one of four treatments including: 55 mg Carbadox/kg, 0.4% Bio-Mos® (mannanoligosaccharide), a rotation of the above two treatments, or an NRC based control treatment with no additives. Pigs were allowed ad libitum access to water and the assigned treatment as a single-phase diet for a 35-day period. Ileal digesta were collected on days 1, 14, and 28 of the trial. Pigs were sacrificed on day 35 and digesta were collected from the duodenum, jejunum, ileum, cecum, and spiral colon. Digesta were analyzed for pH and VFA including: Acetate, Propionate, Butyrate, Valerate, Isovalerate, and Isobutyrate. Intestinal pH of the Carbadox treatment was more alkaline and the Control treatment was more acidic when treatments were compared (P < 0.001). A site effect (P = 0.001) was also observed where the ileum was more alkaline and the cecum more acidic. Treatment effects were noted for ileal Butyrate (P = 0.0001) and Acetate (P = 0.0174) where Acetate and Butyrate concentrations were greater in the ileum for the Carbadox and Rotation treatments compared to the Bio-Mos® and Control treatments (P < 0.05). Time (day) affected ileal Isovalerate (P = 0.0133), Butyrate (P = 0.0001), and Acetate (P = 0.0001) concentrations. A site effect (P < 0.05) was observed for all VFA concentrations. Treatment x site interactions were observed (P = 0.0297) for Valerate concentrations. These data indicate that dietary additives affected intestinal pH and VFA concentrations.

Key Words: Mannanoligosaccharides, pH, VFA

M101 Use of probiotics in the diet of weaning and growing pigs. A. C. Murry, Jr.*,1 and A. Hinton, Jr.,2 1The University of Georgia, 2Agricultural Research Service/United States Department of Agriculture, Athens.

Sixty crossbred pigs (6 kg BW and 21 d of age) were used to evaluate the efficacy of probiotics containing Lactobacilli on growth performance and fecal microflora. Pigs were randomly assigned to receive one of four treatments: (a) control diet with antibiotics (CA); (b) control diet without antibiotics and supplemented with 0.2% probiotics in feed alone, (PBBF); (c) control diet without antibiotics and supplemented with 0.2% probiotics in feed and 0.1% in water (PBBFW); and (d) control diet without antibiotics and supplemented with 0.1% probiotics in water alone (PBW). Diets were fed from d 0 to 56 after weaning. Pig body weights and feed intake were measured biweekly to determine growth and feed efficiency. Fecal grab samples were collected weekly and dissolved in anaerobic diluents and analyzed for lactic acid bacteria and Escherichia coli. From d 0 to 56, ADG, ADFI, and gain:feed ratio of pigs fed the CA diet were not different (P > 0.05) from those pigs fed PBF, PBFW, and PBW. Colony forming units (CFU) of lactic acid bacteria of pigs fed the CA diet were not different (P > 0.05) from CFU in pigs fed PBF, PBFW, and PBW from d 0 to 14. Colony forming units of lactic acid bacteria were higher (P < 0.06) at d 21 in pigs fed PBF and PBFW and higher (P < 0.03) at d 28 in pigs fed PBF than CFU in pigs fed the CA diet. From d 0 to 28, Escherichia coli CFU of pigs fed PBF, PBFW, and PBW were not different (P > 0.05) from CFU in pigs fed the CA diet. From d 35 to 56, CFU of lactic acid bacteria of pigs fed the CA diet were not different (P > 0.05) from CFU in pigs fed PBF, PBFW, and PBW. Colony forming units of E. coli were higher (P < 0.001) at d 35 in pigs fed the CA diet than CFU in pigs fed PBF and PBFW. Escherichia coli CFU were higher (P < 0.06) at d 42 in pigs fed PBFW than CFU in pigs fed PBF and PBFW and the CA diet. The results indicate that probiotics containing Lactobacilli can be supplemented without antibiotics in diets of weanling and growing pigs at a rate of 0.2% in feed and 0.1% in water without negatively affecting growth performance. Also, fecal microflora can be affected by the inclusion of probiotics during different stages of the growth period.

Key Words: Probiotics, Growth, Fecal microflora

M102 Dietary supplementation with botanical compounds depresses piglet feed intake while fecal E. coli counts remain unchanged. P. Blikker1, R. Fontanillas*2, and N. D. Roura2, 1Institute for Animal Nutrition, De Schothorst, Lelystad, The Netherlands, 2Lucta, S.A. Barcelona, Spain.

A four week trial was carried out at the “De Schothorst” Institute for Animal Nutrition Lelystad (The Netherlands) to study the effect of feed supplementation with botanical compounds on the ileal pH and fecal content of E. coli in weanling piglets. 300 piglets weaned at 26 days of age with an initial body weight of 8 kg were randomly allotted in five experimental treatments of 10 replicates (pens) with 6 piglets per pen. The experimental treatments were: T0 (control, no growth promoter), T1 (500 ppm cinnamaldehyde), T2 (30 ppm carvacrol), T3 (40 ppm salvia dalmatica) and T4 (400 ppm cinnamaldehyde + 10 ppm capric acid). The piglets received a phase 1 diet during week 1-2 and a phase 2 diet during week 3-4 post weaning based on wheat, barley, soybean meal and milk products and did not contain any antibiotic growth promoting substances. Feed and water were offered ad libitum. Weights of piglets and feed intake per pen were recorded at day 0, 14 and 28 of the trial. Average daily gain (g/d), daily feed intake (g/d) and feed conversion were calculated for each phase and for the whole trial. Fresh rectal samples of two piglets per pen from six replicates of each treatment were taken at 14 days post weaning. Samples were pooled per pen and analysed for E.coli (log cfu/g). Daily feed intake and average daily gain of piglets fed with diets supplemented with botanical compounds were between 2 and 10% lower as compared to the control group. Decreases were statistically significant (p < 0.05) for feed intake of T1 group during phase 1 (332 vs 300) and T3 group during phase 2 (832 vs 767) and overall (574 vs 526) as well as for average weight gain of T3 for the overall period (392 vs 357). Furthermore, botanical compounds supplementation did not significantly change (p > 0.05) the number of colony forming units of E. coli in the feces (from 7.1 to 7.9 log cfu/g).

Key Words: Weanling piglets, Botanical compounds, E. coli

M103 Plant extracts enhance performance in broilers under Clostridium perfringens challenge. C. Kamel1 and R. McKay2, 1AXISS France SAS, 2MLF AgResearch.

Many plant extracts have been reported to improve animal performance and well-being especially under dietary or other enteric stressors. A pilot challenge model to reproduce necrotic enteritis (NE) from Clostridium perfringens inoculation in broiler chickens was commissioned to evaluate a commercial product standardized in the active substances from capsicum, cinnamon and origanum extracts (XTRACT Code 6990, Canadian registration 982063). A total of 162 animals were randomly allotted to 3 floor pens of 18 birds each for three treatments of a commercial diet differing only the XTRACT at 150 ppm. C. perfringens broth was administered via feed with approximately 106 cfu per ml at 14 days of age. Feed intake and growth were measured at day 1, 14 and 21. Mortality was recorded daily and necrotic enteritis lesion score was recorded at day 17 for five randomly selected animals from each pen. Raw data means were analysed by Analysis of Variance. In general, the NE challenge was successful, resulting in post-challenge NE mortality (14-21 days) ranging from 22.2% to 44.5%. Broilers on XTRACT at 300 ppm and 150 ppm showed significantly
The objective of this study was to determine the effect of an herbal plant mixture containing Angelica gyps Nakai, Rheummann glutinosum Libosch., Cnidium officinale Libosch., Glycyrrhiza glabra, Schizandra chinensis and Dioscorea japonica Thunberg, MIRACLE 20 suplementation on the growth performance, nutrient digestibility, serological changes and carcass characteristics in finishing pigs. Eighty crossbred [(Duroc × Yorkshire) × Landrace] pigs (115.85 kg average initial BW) were used in a 65d growth assay. Dietary treatments included 1) NC (negative control), 2) PC (positive control, NC diet added 0.1% of chitin), 3) HPM (NC diet added 0.1% of herbal plant mixture), and 4) PHPM (PC diet added 0.1% of herbal plant mixture). There were four pigs per pen and five pens per treatment. Experimental diets were formulated to contain 3,365 kcal/kg of DD (14.80% of CP, 0.89% of lysine, 0.74% of Ca and 0.54% of P for the finishing pigs. ADG was significantly increased in PC and HPM treatments compared with NC treatment (P < 0.05). ADFI and G:F were higher in pigs fed herbal plant mixture and antibiotics than pigs fed antibiotic-free diet with no significant differences (P > 0.05). Backfat thickness was not significantly different among the treatments (P > 0.05). Digestibility of DM and N were not affected by the herbal plant mixture supplementation. There were no significant differences in total protein, albumin and IgG (P > 0.05). In conclusion, PC and HPM treatments improved ADG compared to antibiotics free diet.

Key Words: Herbal plant mixture, Pigs, Performance

M105 Effect of feeding geranium biotite on growth performance, nutrient digestibility and serum characteristics in nursery pigs. W. B. Lee1, B. J. Kim1, J. W. Hong1, O. S. Kwon1, B. J. Min1, K. S. Son2, and Y. K. Jung2, 1Department of Animal Resource & Science, Dankook University, 2Agribrands Purina Korea, Inc. 3Hanpel tech. co. Ltd.

The objective of this study was determined the suitability of geranium biotite as a dietary supplement on growth performance, nutrient digestibility and serum characteristics in nursery pigs. A total of seventy five pigs (initial body weight 21.18 ±0.15kg) were used in this experiment. This study was carried out for 21 days. The five treatments were control (CON, basal diet), GB0.5-200 (basal diet + 0.5% geranium biotite, 200mesh), GB1.0-200 (basal diet + 1.0% geranium biotite, 200mesh), GB0.5-325 (basal diet + 0.5% geranium biotite, 325mesh) and GB1.0-325 (basal diet + 1.0% geranium biotite, 325mesh). Each treatment had five replicates with three pigs per replicate. For overall period, average daily feed intake and gain/feed were not significantly different among the treatments (P > 0.11). Animals fed GB0.5 diets had higher average daily gain than pigs fed GB0.5 diets with significant differences (P < 0.05). Dry matter tended to increase as the particle size and dietary supplement of geranium biotite in the diet was increased. N and Ca digestibility were significantly different among the treatments (P < 0.01). Supplementing geranium biotite in the diet reduced the fecal NH3-N concentration. The fecal NH3-N and butyric acid tended to increase as the particle size of geranium biotite in the diet was decreased (P < 0.01). RBC and WBC were significantly different among the treatments (P < 0.05). In conclusion, supplementing geranium biotite in diets for nursery pigs reduced fecal noxious gases.

Key Words: Geranium biotite, Performance, Pigs

M106 Effect of dietary green tea on productivity and egg composition in laying hens. C. J. Yang1, D. Uganbayar2, S. S. Sun3, and J. D. Firman1, 1Sunchon National University, Sunchon, Korea, 2Chonnam National University, Chonnam, Korea, 3University of Missouri, Columbia, MO.

This experiment was designed to evaluate the effects of green tea on productivity and egg composition in laying hens. One hundred eighty Brown Tetran layers (40 weeks old) were randomly allotted to 6 treatments (control, antibiotics, green tea 5%, 1%, 1.5% and 2% supplementation) groups and 5 replications per treatment. Diets were formulated to provide a minimum of 15% CP and 2750 kcal/kg ME. Diets were fed in mash form, and feed and water offered ad libitum. The control diet was based on a corn-soybean meal mixture. Hen-day egg production, egg weight, egg mass, feed intake, PCR and egg shell thickness were determined in every week from each treatment. For egg quality, egg yolk cholesterol, TBA value and fatty acid composition analysis. Hen-day egg production was not affected by dietary green tea supplementation (P > 0.05). The egg weight and egg mass were reduced in green tea 5% treatment (P < 0.05). The feed intake was increased in 1% and 1.5% of green tea treatments. Egg shell thickness was reduced significantly in all treatment groups (P < 0.05). The egg yolk cholesterol content was decreased significantly in 2% green tea treatments (P < 0.05). The value of TBA in egg yolk was reduced in 2% of green tea supplementation compared to control (P < 0.05). The yellowness of egg yolk was increased in dietary supplementation of 2% green tea (P < 0.05). There were no significant differences in juiciness, texture and overall acceptability of the eggs (P > 0.05). Palmitic acid content in eggs was increased in 1% and 1.5% of green tea treatment but other fatty acids were not affected by any level of green tea treatment. These results indicate that dietary supplementation of 1 to 2% green tea didn’t have negative effects on laying performance but dietary supplementation 2% of green tea could reduce the egg yolk cholesterol and increase the yellowness of egg yolk.

Key Words: Laying hens, Green tea, Egg yolk cholesterol


The objectives of this study were to determine the effect of Korean, Japanese and Chinese green tea on growth performance and body composition in broilers. One hundred sixty eight (1-day old) Ross broiler chicks were randomly allotted to 7 treatments with 4 replications (6 chicks per replication) and raised in battery cages. The seven dietary treatments were negative control (without antibiotics) and positive control (basal + 1% chlortetracycline) and 5 experimental diets (basal + 0.5% Korean green tea (KGT), (basal + 1% KGT, (basal + 1.5% KGT, (basal + 1.5% Japanese green tea (JGT) and (basal + 1.5% Chinese green tea (CGT), respectively. Basal and experimental diets were formulated to meet 23% CP and 3.2 Mcal/kg of ME. The basal diet was based on a corn-soybean meal mixture. Diets were fed in mash form, and feed and water offered ad libitum. The body weight gain was reduced slightly in broilers fed diets containing green tea supplements compared to antibiotics treatment (P < 0.05) but not consistent in other treatments. Feed conversion ratio was not significantly different between both 1.5% KGT and JGT and antibiotics diets. Also, there were no significant differences in the feed intake among treatments with 0.5% KGT, 1.5% CGT and control (P > 0.05). Green tea from different origins didn’t have effect on the vital organs weight (P > 0.05). The TBA content in chicken meat was slightly decreased when fed diets containing different levels of...

The objectives of this study were to determine the effect of Korean, Japanese, Chinese green tea on productivity and egg composition in laying hens. One hundred sixty eight Brown Teter laying hens (40 week old) were randomly assigned to 7 treatment groups. Layers were located in battery cage and environmentally regulated closed house and given ad libitum access to feed and water. Treatments were a control of corn-soybean based diet (15% CP, 2765kcal/kg ME, 3.9% Ca, .24 Mg), and three diets containing 1% and three diets included 2% Korean (KGT), Japanese (JGT) and Chinese (CGT) green tea respectively. Hen day-egg production, egg weight, eggs mass, feed intake, FCR and egg shell thickness were determined every 7 days. Five eggs from each treatment were selected for egg quality, yolk cholesterol, TBA value and fatty acid composition analysis. Hen day-egg production was increased significantly at 1 to 2% of green tea supplement (P < .05). The CGT 1% showed significant increase in egg production rate and significant decrease in egg weight compared to control (P < .05). There was observed not significant difference between egg masses of the layers fed green tea diets (P > .05). Feed intakes of 2% KGT, 2% CGT and 1% JGT diets were reduced significantly (P < .05). Egg shell thickness was decreased significantly in layers consuming diets containing JGT at both levels of inclusion (P < .05). Egg yolk cholesterol tended to decrease with green tea supplemented diets. The CGT in both level of inclusion reduced significantly egg yolk cholesterol content (P < .05). There were no significant differences in β and D-homo-r-linolenic acids in the egg yolk from different dietary groups (P > .05). These results indicated that dietary supplementation of green tea in layer diets had positive effects in egg production and reduction of egg yolk cholesterol.

Key Words: Green Tea, Laying hens, Egg yolk cholesterol

M109 Feeding seaweed extract to nursery pigs alters circulating thyroid hormones. J. L. Turner1, S. S. Dritz2, and J. E. Minton2,1. 1New Mexico State University, 2Kansas State University.

Alternative feed additives that may have value in replacing traditional antimicrobials in swine diets have received increased attention in recent years. Extracts of the seaweed Asposphylum nodosum (AN) have been evaluated in nursery pig diets, and show some promise in supporting pig growth performance in the absence of other antimicrobials in the diet. However, the extract of this seaplant is relatively high in iodine. Thus, we hypothesized that feeding the product might affect the concentration of circulating thyroid hormones. Weaned pigs (initial mean wt 6.4 kg) were housed in pens in an environmentally controlled nursery. Pigs were fed diets containing 0 (control), n = 6) or 2 % AN extract (n = 6) for 4 wk. After 14, 21, and 28 d on treatment diets, jugular blood samples were obtained and sera evaluated for triiodothyronine (T3) and thyroxine (T4) by radioimmunoaassay. No treatment x day interaction was observed for either T3 or T4 (data in table). However, the overall concentration of T4 was increased (P < 0.05) in pigs fed AN (48.1 ± 1.6 ng/mL) compared to pigs fed the control diet (42.2 ± 1.6 ng/mL). In addition, there was a strong tendency (P < 0.06) for T3 to be elevated by feeding AN (994 ± 70 vs 789 ± 70 pg/mL). In summary, feeding AN at 2 % of the diet for 28 d elevated T4 by about 14 % and T3 by about 26 %. Although feeding AN at this level may have implications relative to the use of AN to respond to thermal challenge, this level of dietary AN inclusion is at least fourfold greater than the rate of inclusion found to maximize growth performance in weaned pigs.

Key Words: Breakfast, Green tea, Cholesterol

T3, pg/mL

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The objectives of this study were to determine the effect of Korean, Japanese, Chinese green tea on productivity and egg composition in laying hens. One hundred sixty eight Brown Teter laying hens (40 week old) were randomly assigned to 7 treatment groups. Layers were located in battery cage and environmentally regulated closed house and given ad libitum access to feed and water. Treatments were a control of corn-soybean based diet (15% CP, 2765kcal/kg ME, 3.9% Ca, .24 Mg), and three diets containing 1% and three diets included 2% Korean (KGT), Japanese (JGT) and Chinese (CGT) green tea respectively. Hen day-egg production, egg weight, eggs mass, feed intake, FCR and egg shell thickness were determined every 7 days. Five eggs from each treatment were selected for egg quality, yolk cholesterol, TBA value and fatty acid composition analysis. Hen day-egg production was increased significantly at 1 to 2% of green tea supplement (P < .05). The CGT 1% showed significant increase in egg production rate and significant decrease in egg weight compared to control (P < .05). There was observed not significant difference between egg masses of the layers fed green tea diets (P > .05). Feed intakes of 2% KGT, 2% CGT and 1% JGT diets were reduced significantly (P < .05). Egg shell thickness was decreased significantly in layers consuming diets containing JGT at both levels of inclusion (P < .05). Egg yolk cholesterol tended to decrease with green tea supplemented diets. The CGT in both level of inclusion reduced significantly egg yolk cholesterol content (P < .05). There were no significant differences in β and D-homo-r-linolenic acids in the egg yolk from different dietary groups (P > .05). These results indicated that dietary supplementation of green tea in layer diets had positive effects in egg production and reduction of egg yolk cholesterol.

Key Words: Breakfast, Green tea, Cholesterol

M110 Effect of diet supplementation meal (Macrocytis pyrifera) to wheat-based diets for growing pigs. R. Gomez*, M. Cervantes, N. Torrenera, and S. Baca, Instituto de Ciencias Agrícolas, UABC. Mexico.

An experiment was conducted to evaluate the effect of adding kelp (Macrocytis pyrifera) meal to the performance, incidence of diarrhea, and mortality of recently weaned pigs. Sixty-four crossbred (Landrace-Hampshire-Duroc) piglets weaned at 18-21d (5.79 kg av. Initial body wt.) were randomly allotted to four dietary treatments. There were four replicates of four pigs per treatment; the trial lasted three weeks. Treatments were: T1) wheat-soybean meal-milk whey basal diet, T2) +1.0% antibiotic, T3) + 2.0% kelp meal, and T4) + 4.0% kelp meal. All diets contained the same amount of milk whey and were added with vi- tamin and minerals to meet the requirements of pigs within the range of 5 to 10 kg. Weight gain, weight, weight gain, feed consumption, incidence of diarrhea and mortality were: 180, 180, 180, 170 g; 220, 270, 250, 240 g; 1.31, 1.47, 1.40, 1.52; 11, 10, 11, 11 pigs; 18.8, 6.3, 12.5, 12.5%, for treatments T1 to T4, respectively. None of the performance vari- ables evaluated in this trial and the incidence of diarrhea were affected (P >.10) by the addition of either the antibiotic or the kelp meal. But, the antibiotic and kelp meal reduced the mortality of piglets in 66 and 33%, respectively. Although the incidence of diarrhea was not affected, the difference in mortality indicates that the antibiotic and kelp helped to reduce the severity of diarrhea in these animals. Thus, these data may suggest that kelp may stimulate the baby pig immune system or that it partially protects the pigs against pathogens, but this effect is around 50% less effective than that of the antibiotic added to the diet at sub-therapeutical levels.

Key Words: Kelp meal, Weaning pigs, Performance

M111 Supplementation of kelp meal (Macrocytis pyrifera) to wheat-based diets for growing pigs. M. Cervantes*, E. Chi2,3, J. Yañez1, J. Bazza2, N. Torrenera1, and M.A. Barrera, Instituto de Ciencias Agrícolas, UABC, 2Colegio de Postgraduados, Mexico.

An experiment was conducted to evaluate the benefit of adding kelp meal (Macrocytis pyrifera) to wheat-based diets for growing pigs. Twenty-eight pigs (22.0 kg av. Initial body wt.) were randomly allotted to four dietary treatments; seven replicates per treatment, according to a complete block design. Treatments were: T1) wheat-based diet containing 100% the requirement of lysine, threonine, and methionine, T2 as in T1, + 1.5% kelp meal, T3) wheat-based diet containing 120% (the requirement of lysine, threonine, and methionine, T4 as in T3, + 1.5% kelp. Average weight gain; intake of feed, lysine, and threonine, and feed conversion were: 610, 697, 693, 688 g/d; 1.56, 1.66, 1.52, 1.61 kg/d, 14.8, 15.8, 17.3, 18.3 g/d; 14.9, 15.8, 18.6, 18.5 g/d; 2.54, 2.38, 2.57, 2.34, respectively. Dietary amino acid level did not affect (P >.10) daily weight gain or feed conversion, although it increased lysine intake. But, the addition of 1.5% kelp meal increased (P < 0.01) 14.5% the weight gain, regardless of the amino acid level in the diet. Also, kelp meal tended (P < 10) to improve 6.7 and 9.9% feed conversion, when diets contained 100 and 120% the amino acid requirements, respectively. The amino acid level or the addition of kelp to the diet did not affect feed intake. Lysine and threonine intakes were higher in pigs fed the 120% diets. Pigs fed the diet with 100% the amino acid requirements utilized lysine more efficiently than those fed the 120% diet. Also, the efficiency of lysine utilization was better when kelp was added to the diet. These results indicate that the 100% diet indeed supplied the total require-
kelp has one or more compounds that improve the availability and/or the efficiency of utilization of amino acids, and that it exerts a growth promoting effect on growing pigs.

**Key Words:** Kelp meal, Amino acids, Swine performance

M112 Effect of kelp (Macroystis pyriforma) meal supplementation to wheat based diets for finishing pigs. J. Yañez1, M. Cervantes*1, F. Copado2, N. Torrentera1, J. L. Figueroa3, and M. Barrera4, 1Instituto de Ciencias Agrícolas, Universidad Autónoma de Baja California, México, 2Colegio de Postgraduados, Montecillos, México.

An experiment was conducted to assess the effects of adding kelp (Macroystis pyriforma) meal to wheat-based diets on the performance of finishing pigs. Forty crossbred (Landrace-Hampshire-Duroc) finishing (63.6 kg av. initial wt.) pigs were randomly allotted to four dietary treatments; five replicates of two pigs (one male and one female) per treatment. The treatments were: T1) basal diet, wheat plus lysine and threonine, T2) + 1.5% kelp meal, T3) + 3.0% kelp meal, and T4) + 4.5% kelp meal. The basal diet was formulated with wheat and crystalline lysine and threonine to meet or exceed the requirements of all the essential amino acids; a vitamin and mineral premix was also added to the basal diet to meet the requirements for these pigs. Weight gain, feed intake, feed conversion, back fat thickness, and loin area were: 707, 813, 776, 751 g/d; 2.15, 2.24, 2.03, 2.23 kg/d; 2.83, 2.70, 2.48, 2.74; 2.55, 2.42, 2.18, 2.55 cm; 26.2, 26.7, 29.8, 26.3 cm2; for treatments T1 to T4, respectively. Growth rate was 15.0% higher (P<0.05) in pigs fed the diet added with 1.5% kelp meal, but no further effect was observed with higher levels. In fact, the daily gain in pigs fed the diets containing 3.0 and 4.5% kelp meal was similar to that of pigs fed the basal diet. Kelp meal did not affect (P>0.10) feed intake. Feed conversion improved 12.8% with the addition of 3.0% kelp meal; no difference was observed between pigs fed the diet added with 1.5 or 4.5% kelp meal and those fed the basal diet. Also, back fat thickness was smaller (P<0.05) and the loin area bigger in pigs fed the diet added with 3.0% kelp meal. These data suggest that kelp meal in diets based on wheat contains one or more compounds with anabolic or growth promoting effects on finishing pigs, although the mode of action is unknown.

**Key Words:** Kelp meal, Swine, Performance


An experiment was conducted to evaluate the effects of dietary levels of kelp meal on the body condition of sows and the growth performance of piglets during lactation. Eighty cross breed sows (Landrace x Yorkshire) artificially inseminated with Duroc x semen were assigned to four dietary treatments. Basal diet was formulated to contain 16% crude protein, 3250 kcal/kg ME, and 3% of cellulose. Cellulose was replaced by kelp meal. Experimental diets contained 0%, 1%, 2%, or 3% of kelp meal. Post-farrowing body weight of sows was calculated by using gestation model. Weaning weights of sows and piglets were measured. The P2 back fat depth was measured both sides and an average value was used. Feed intake was increased until 7 days after farrowing. After 7 days, sows were allowed to consume diet ad libitum basis. There was no difference in body weights and P2 back fat depth changes among treatments. But, sows in 3% kelp meal group tended to lose less body weight and P2 back fat during lactation. In piglets, average daily gain was linearly increased as kelp meal contents in sow diet were increased. A model was developed to adjust weaning day (21 day) and sucking piglet number (9 piglets). The results of this experiment suggest that addition of kelp meal in lactation sow diet would improve suckling piglet growth without affecting body condition of sows.

**Key Words:** Kelp meal, Swine, Performance

M114 A comparison of the effects of supplementation of probiotic and humad on egg production and quality during the late laying period in hens. M. A. Yoruk1, M. Gu1, A. Hayirli*, and M. Macit1, 1Department of Animal Nutrition and Nutritional Diseases, School of Veterinary Medicine, 2Department of Animal Sciences, College of Agriculture, Ataturk University, Erzurum 25700, Turkey.

As an alternative to antibiotics, inclusions of probiotics and humads into rations as feed additives to promote growth and reduce subclinical infections is favorable due to a lack of harmful effects on consumers. This study was designed to investigate whether inclusions of probiotic and humad into diets of hens during the late laying period increase egg production and improve egg quality. Three hundred Hi-Sex Brown layers at age of 54 weeks were allocated randomly to receive a diet containing no probiotic and humad and diets containing either probiotic (0.1 and 0.2%) or humad (0.1 and 0.2%) for 12 weeks. Experimental units were 6 groups of birds with each containing 10 birds. Egg yield was recorded daily, whereas feed intake (FI) and egg weight (EW) were determined bi-weekly. Egg density, shape index, unbrokeness, shell length, yolk color, albumen index, yolk index, and Haugh unit were egg quality parameters. Twelve eggs from each experimental group were collected randomly to determine egg quality parameters every month. Data were analyzed using the Multivariate Analysis Procedure of SPSS with repeated measures option. Moreover, orthogonal contrasts to determine the effects of probiotic and humad and compare their effects and polynomial contrasts to evaluate the nature of responses to increasing levels of probiotic and humad were constructed. There were no orthogonal and polynomial effects of supplementation of probiotic and humad on FI and EW. Egg yields of hens supplemented with probiotic and humad were not different, but were greater than hens not supplemented with either. Egg yield and feed conversion efficiency (both kg feed per 100 eggs and kg feed per kg egg) linearly increased with suplementations of both probiotic and humad. There were no orthogonal and polynomial effects of suplementations of probiotic and humad on egg quality parameters. In conclusion, suplementations of probiotic and humad during the late laying period increase egg yield at similar magnitude, but do not improve egg quality.

**Key Words:** Probiotic, Humad, Hen

M115 WITHDRAWN...
A total of 288 pigs (20 d of age; 7.9 ± 0.08 kg BW) were fed one of four dietary treatments to determine the potential for an animal-based protein to replace fish meal. The study used randomized complete block design with four trts, each based on a single corn hybrid. Hybrid pigs (n=160, 40 pigs/trt; equal numbers of barrows and gilts) were used. Test period was from 30 to 115 kg BW with pigs kept in single-sex groups of five. Pigs were given ad libitum access to feed and water. The study was carried out in a controlled environment finishing facility, with part-slatted, part-solid concrete floors. A three-phase diet program was used. Growing diets (30 to 50 kg BW) had 0.10% lysine, 18.7% CP, and 3,340 kcal ME/kg. Early- (50 to 80 kg BW) and late- (80 to 115 kg BW) finishing phase diets had 0.8 and 0.7% lysine, 15.0 and 13.5% CP, and 3,368 and 3,390 kcal ME/kg, respectively. Diets were formulated with a fixed corn inclusion level for all trts of 65, 72, and 76% for grower, early- and late-finishing phases, respectively. The end of test, pig BW, sex, and the slaughter, feed efficiency, carcass net meat, quality, and carcass measurements taken. Treatment had no effect (P > 0.05) on ADFI (2.60, 2.41, 2.54, and 2.46 kg for Trt. A, B, C, and D, respectively). Treatment had no effect on F/G (0.34, 0.36, 0.35, and 0.37 kg/kg, respectively) for the four treatments. Differences in performance between castrates and gilts were in line with previous research. Results indicate that performance of growing-finishing swine fed diets containing Corn Root Worm Protected corn (event MON 863) is equivalent to that of animals fed non-transgenic genetically similar corn and conventional corn hybrids.

Key Words: Pigs, Swine, Transgenic corn

M120 A comparison of swine performance when fed diets containing Roundup Ready® wheat (event MON 71800) and conventional wheat varieties. B. A. Peterson¹, Y. Hyun², E. P. Stanisiewski³, G. F. Hartnell², and M. Ellis¹, ¹University of Illinois, Urbana, IL, ²Monsanto Company, St. Louis, MO.

This study was conducted to evaluate growth and carcass traits of growing-finishing pigs fed diets containing Roundup Ready® wheat (event MON 71800), the non-transgenic genetically similar control wheat (MON 71900) and four commercial varieties of non-transgenic wheat (Zeke, Hank, 926, and Express). The study was carried out as a randomized complete block design with six dietary treatments, each treatment based on a single wheat variety. Hybrid pigs (n=240; 40 per treatment; equal numbers of barrows and gilts) were used. Pigs were grown from 29.5 ± 0.29 to 114.5 ± 2.23 kg BW in single-sex groups of five pigs and had ad libitum access to feed and water. The study was carried out in a controlled environment facility with part-slatted, part-solid concrete floors. A three-phase diet program was used. Phase 1 diets (25 to 50 kg BW) contained 1.00% lysine, 18.0% CP, and 3,428 Kcal ME/kg. Phase 2 (50 to 80 kg BW) and Phase 3 (80 to 110 kg BW) diets contained 0.77 and 0.62% lysine, 16.0 and 15.0% CP, and 3,363 and 3,363 Kcal ME/kg, respectively. Diets were formulated with a fixed wheat inclusion level for all treatments of 70, 80, and 85% for Phases 1, 2, and 3, respectively. At the end of test period, ultrasound backfat thickness and longissimus muscle area were taken at the tenth rib. Pigs fed the six wheat lines had similar (P>0.05) ADFI (mean 2.26 kg, SEM 0.06; range 2.20-
to 2.32 kg). ADG (mean 0.85 kg, SEM 0.03; range 0.82 to 0.87 kg), and G:F ratio (mean 0.38, SEM 0.01; range 0.37 to 0.38). In addition, there was no effect (P>0.05) of wheat variety on ultrasound measurements. These results indicate that performance of growing pigs fed diets containing Roundup Ready wheat (event MON T1880) is equivalent to that of pigs fed diets containing non-transgenic control wheat or commercial wheat varieties.

**Key Words:** Swine, Growth, Transgenic wheat

### M121

**Pea and Lupin (*lupinus albus*) as an alternative protein source in growing pig diets.** F. Massero1, A. Prandini1, G. Piva11, M. Morlacchini2, M. Moschini1, and D. Díaz3.

1 Università Cattolica del Sacro Cuore, Piacenza, Italy, 2 CERZO, San Bonico, Piacenza, Italy, 3 Fondazione Parco Tecnologico Padano, Lodi, Italy.

The use of alternative Mediterranean feed protein sources into piglet diets was investigated. One hundred forty Duroc pigs (Large white × Landrace) piglets (10.4±2.2 kg live weight) were randomly assigned to 5 dietary treatments and raised in 35 pens (7 pens per treatment/4 animals per pen). Experimental treatments were identified by the protein source as: soy bean meal (control) (C); raw pea (RP); extruded pea (EP); Lupin (*lupinus albus variety multitaglia*) (L); extruded lupin (EL). Diets based on corn, wheat and barley plus synthetic amino acids were isonutritive and isonitrogenous and supplied 18% crude protein, 1% lysine, 0.6% methionine + cystine, 0.64% threonine, 0.2% tryptophane and 9.84 MJ/kg NE. When used, RP and EP were included into diets at 20%, L and EL at 17%. Diets were fed ad libitum for the duration of the experimental period (42d). Animals were weighed at 0, 21 and 42d on trial start, for assessment of mortality (1.6% for the all experiment) recorded daily and dead animals were removed and weight was recorded. The pen feed consumption and weight were recorded weekly and the pen final weight was cleared from weight of removed animals. The pen average daily gain (ADG) was obtained and adjusted gain to feed ratio (G:F) of experimental periods was obtained by dividing the total weight gain of surviving and dead animals by the feed consumption per pen. The ADG, average daily intake (ADI) and G:F were not statistically affected by the treatment diets. Data suggest partial substitution of soybean with pea or lupin, either extruded or not, had no effect on animal performance and could represent an alternative valuable protein source in swine diet formulation.

**Key Words:** Swine, Lupin, Pea

### M122

**Methods of improving the nutritive value of Jackbean for poultry industry in the tropics.** B. O. Esonu* and A. B. I. Udediebie, Federal University of Technology, Owerri, Nigeria.

Methods of improving the nutritive value of the jackbean for poultry have been developed and tested by many researchers. The discrepancies between the findings of different researchers make it difficult to make clear and definite conclusions as to which method is most scientifically appropriate and relevant and can be used as a standard method for improving the nutritive value of this tropical legume for poultry. Besides the scientific aspect, the appropriateness of the method to be used must be based also on the local context and available facilities as well as economic viability. This paper, reviews five different methods farmers and feed millers could employ to improve the nutritive value of jackbean: 1. Dry urea treatment prior to toasting 2. Two-stage cooking 3. Sprouting 4. Cooking in Trona solution 5. Crack and cook method.

**Key Words:** Jackbean, Nutritive value, Poultry

### M123

**Growth performance of growing-finishing pigs fed low-protein, low-energy, grain sorghum-soybean meal diets.** J. L. Figueroa1, M. Mendez1, M. Cervantes2, and J. M. Cuenca1.

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Two experiments were conducted to assess the effect of reducing the content of metabolizable energy in low-protein grain sorghum-soybean meal diets on the performance and carcass composition of growing-finishing pigs. In Exp. 1, 32 growing (35.3 kg initial weight) pigs were randomly allotted in a randomized complete block design to four diets, with four two-pig (a gilt and a barrow each) replicates. Diets were as follows: T1) grain sorghum-soybean meal, 16.5% CP, 3265 Mcal/kg, control diet; T2) grain sorghum-soybean meal, 12.5% CP, 3265 Mcal/kg; T3) as in T2, but with 3165 Mcal/kg; T4) as in T2, but with 3065 Mcal/kg. Energy concentration was obtained by substituting grain sorghum with wheat bran and sand, until the energy level was reached. There was no effect (P>0.05) of CP nor ME on ADG (0.981, 0.932, 1.016, and 1.049 kg for T1, T2, T3, and T4, respectively). ADFI/ADG ratio (2.42, 2.508, 2.667, 2.459 kg/kg), ADLG (0.351, 0.358, 0.355, 0.378 kg), backfat thickness (38.9, 38.4, 37.4, 37.8 mm), longissimus muscle area (35.2, 36.48, 32.9, 36.64 cm²), and percentage of lean tissue (32.5, 36.31, 32.72, 32.74). There was an increase (P<0.05) in ADFI (2.362b, 2.287b, 2.673a, 2.532a) as ME was reduced. In Exp. 2, 32 finishing (56.2 kg initial weight) pigs were randomly allotted in a completely randomized design to four diets, with four two-pig (a gilt and a barrow each) replicates. Initial weight was used as a covariate for all variables. Diets were as follows: T1) sorghum-soybean meal, 13.5% CP, 3265 Mcal/kg; T2) sorghum-soybean meal, 9.5% CP, 3265 Mcal/kg; T3) as in T2, but with 3165 Mcal/kg; T4) as in T2, but with 3065 Mcal/kg. The ME concentration was obtained as in Exp. 1. There was no effect (P>0.05) of CP nor ME concentration on ADFI (2.825, 2.854, 2.878, 2.823 kg/kg), ADG (0.968, 0.844, 0.783, 0.792 kg/kg), ADFI/ADG ratio (2.994, 3.433, 4.22, 3.733 kg/kg), ADLG (0.317, 0.231, 0.317, 0.239 kg), backfat thickness (37.9, 37.5, 33.9, 33.3 mm), longissimus muscle area (44.72, 40.32, 43.94, 42.88 cm²), and percentage of lean tissue (35.52, 34.2, 36.47, 34.58). These results showed that the growth performance and carcass characteristics of growing and finishing pigs fed low-protein, grain sorghum-soybean meal diets are not affected by the decrease of dietary energy content.

**Key Words:** Pigs, Low-protein diets, Low-energy diets

### M124

**Effect of amino acid intake on fecal digestibility of amino acids and on urinary amino acid excretion of adult roosters.** L. Babinszky*, J. Tossenberger, and K. R. Kovacs, University of Kaposvar, Faculty of Animal Science, Hungary.

Urinary amino acid excretion of poultry is generally recognized to be very low. However, certain trial data show that poultry may have considerable levels of urinary amino acid excretion. Hence, the aim of our trials was to determine the effect of feeding diets with identical total but different digestible amino acid contents on the digestibility of amino acids and on the quantity of urinary and fecal amino acid excretion of roosters. The trials were conducted with 4 adult roosters per treatment, in two replicates (n=8/treatment). Prior to the trial a simple T-cannula was implanted in the terminal colon of the birds, allowing separate quantitation of faeces and urine collections on 4 consecutive days. Nutrient content of the trial diets followed the NRC (1994) requirements. The two treatments of the trial were (i) a diet formulated using “low digestible” ingredients (LD), (ii) a diet formulated with “high digestible” ingredients (HD). The AMEn and total LYS, MET+CYS and THR contents of the two diets were similar (13.1 MJ/kg, 7.1-, 4.5-, 5.8 g/kg, respectively), the calculated digestible amino acid content, however, differed by 10%. The experimental data were analyzed by means of ANOVA (SAS, 1991). Our results showed, that in the LD-group the apparent fecal digestibility of LYS, MET+CYS and THR was 84.5-, 89.6-, 82.8 %, respectively, while the same in the HD-group was 86.7-, 91.8 and 87.4 %. Digestibility measured in the HD-group was significantly higher in comparison to the LD-group (P<0.05). Birds in the LD-group excreted on average 22 mg/kg of LYS daily, the HD-group significantly higher in comparison to the LD-group (P<0.05). Birds in the LD-group excreted the same amount of urinary amino acids and on the quantity of urinary amino acid excretion of roosters showed similar trends. Our data show that adult roosters may have considerable levels of urinary amino acid excretion, which should be taken into account when determining the amino acid requirements of poultry.

**Key Words:** Rooster, Amino Acids, Urinary-excretion
M125 Evaluation of the effects of dietary fat, conjugated linoleic acid and racoptamine on the fatty acid profiles of fat and muscle tissue of lean gilts. T. E. Weber, B. T. Richert, M. A. Belurth, V. Gu, and A. P. Schinckel. Purdue University. The Ohio State University. Research Institute of Basker University.

Lean gilts (n = 180), with an initial BW of 59 kg, were assigned to a 2 × 2 × 3 factorial arrangement consisting of racoptamine (RAC; 0 or 10 ppm), conjugated linoleic acid (CLA; 1% of a product containing 60% CLA and 1% soybean oil), and dietary fat in an 8-wk feeding trial. Dietary fat treatments consisted of: 1) 0% added fat; 2) 5% choice white grease; and 3) 5% beef tallow. RAC treatments were imposed when the gilts reached an average BW of 85.5 kg and lasted for the final 4-wk until carcass data were collected at an average BW of 112 kg. Lipids from fat tissues of the belly, outer, and inner layers of backfat and longissimus dorsi were extracted and analyzed for fatty acid composition (six pigs/treatment; 72 pigs total). Dietary CLA increased the concentration of saturated fatty acids (43.1 vs. 35.9%; P < 0.001), decreased the concentration of monounsaturated fatty acids (41.4 vs. 47.5%; P < 0.001), and decreased IV values (56.1 vs. 63.0; P < 0.001) of the belly fat. Dietary fat reduced the concentrations saturated fatty acids (41.6 vs. 45.0%; P < 0.01) and increased IV values (60.7 vs. 57.4; P < 0.001) in the belly fat. Dietary CLA increased the concentration of saturated fatty acids in both the inner (44.1 vs. 37.6%; P < 0.01) and outer (43.1 vs. 35.9%; P < 0.001) layers of backfat. CLA increased the IV values of both layers of backfat (67.6 vs. 62.5%; inner 68.0 vs. 65.7%, outer; P < 0.001). Pigs fed diets containing 5% animal fat had increased IV values of the inner (66.5 vs. 62.1; P < 0.001) and outer layers (68.1 vs. 64.3; P < 0.01) over pigs fed diets without added fat. CLA increased the total saturated fatty acids (44.6 vs. 38.4%; P < 0.001) and reduced the IV values 57.9 vs. 65.2%; P < 0.001) in the longissimus dorsi muscle. Racoptamine decreased the intramuscular fat content of the longissimus dorsi (1.95 vs. 2.43%; P < 0.01) and increased the IV values of the outer (68.0 vs. 65.7; P = 0.07) and inner layer (66.2 vs. 63.9; P = 0.02) of backfat. These results indicated that CLA results in more saturated fat.

Key Words: CLA, Racoptamine, Fatty acids

M128 In vitro gas production of Iranian barley silage treated and untreated by urea and formaldehyde. A. Taghizadeh, M. Danesh Mesgaran, R. Valizadeh, F. Efekhar Shahroodi, and K. Stanford. 1Ferdowsi university, Mashhad, Iran, 2University, Mashhad, Iran, 3Ferdowsi university, Mashhad, Iran, 4Lethbridge Research center, Alberta, Canada.

In Vitro gas production Technique was used to measure the production gas from barley silages as experimental feed. The feeds were barley silage (unincorporated), BS treated with urea (20 g kg−1), DM) (BSU) or formaldehyde (4 g kg−1, DM) (BSF) or urea and formaldehyde (20 g kg−1 and 4 g kg−1, DM, respectively) (BSFU). One steer (42018 Kg, fed a diet containing (as fed) 700 g kg−1 alfalfa hay/timothy and 300 g kg−1 a 15% CP concentrate) was used as ruminal fluid donor for the preparation of ruminal fluid. One hundred percent of the added urea concentration on nitrogen absorption and retention by feedlot steers. A. Gueye, C. R. Richardson, J. H. Mikus, G. A. Nunnery, A. N. Cole, and L. W. Greene. 1Texas Tech University, Lubbock, Texas, 2USDA-ARS-CPR, Bushland, Texas, 3Texas Agricultural Experimentation Station, Amarillo, Texas.

Twenty seven crossbred steers (average BW = 353.2 ± 8.4 kg) were used in a metabolism trial with three collection periods (approximately 35, 95, and 155 d on feed) to evaluate the effects of dietary CP source and concentration on nitrogen balance by steers. Treatments were arranged in a factorial arrangement and consisted of three dietary CP concentrations (11.5, 13.0, and 14.5%) and three supplemental urea:cornseed meal (CSM) ratios (100:0, 50:50, and 0:100 of supplemental N). During each nutrient collection period steers were housed in individual metabolism stalls and urine and feces excreted were collected and frozen. Collection periods consisted of a 2- to 5-d adaptation period followed by a 5-d collection period. On d 35 on feed, total N excretion increased linearly (P = 0.002) with increasing CP concentration. Nitrogen absorbed (g/d) and N retained (g/d) linearly increased (P < 0.0001 and P = 0.01, respectively) with increasing CP concentration. On d 95 on feed, total N excretion linearly increased (P < 0.0001) with increasing CP concentration. Nitrogen absorbed (g/d) and N retained linearly increased (P < 0.0001 and P = 0.01, respectively) when CP increased from 11.5 to 14.5%. On d 155 on feed, DM digestibility decreased linearly (P < 0.005) with increasing dietary CP. Pecul N excretion increased linearly (P < 0.0001) with increasing CP. Nitrogen absorbed (g/d) decreased linearly (P = 0.03) with decreasing urea:CSM ratio. Nitrogen

Key Words: CLA, Racoptamine, Fatty acids

M129 The effects of dietary crude protein concentration on nitrogen absorption and retention by feedlot steers. A. Gueye, C. R. Richardson, J. H. Mikus, G. A. Nunnery, A. N. Cole, and L. W. Greene. 1Texas Tech University, Lubbock, Texas, 2USDA-ARS-CPR, Bushland, Texas, 3Texas Agricultural Experiment Station, Amarillo, Texas.

Conceivable effort is spent assembling datasets from research trials in preparation for statistical analysis. In many cases a spreadsheet such as Microsoft® Excel is used. Spreadsheets can be programmed to provide substantial amounts of information from data in the form of summaries and graphs before the statistical analysis is performed. These summaries assist the researcher in identifying problems and errors before a statistical analysis is made. These errors can be difficult or impossible to uncover if data has been passed to a statistical analysis package and checks are not performed there. Little emphasis has been placed on teaching students and researchers how to maximize the utility of spreadsheets. Consequently, many do not explore possibilities of dataset preparation beyond simple capabilities of summing and calculating averages for vectors of data. If researchers were aware of more complex formula they may develop spreadsheets that detect more errors allowing easier identification of problematic data. If spreadsheets were robustly built the same template sheet could be used to assemble numerous datasets in a rapid and efficient manner. In MS® Excel the use of the OFFSET, TRANSPOSE, MATCH, RAND, V and H LOOKUP, AND, OR, IF, CHOOSE, ISERROR and DATABASE (specifically DAVERAGE and DSUM) functions are of value to the animal science researcher. They facilitate rapid summarization of data. They ensure the continuity and interactivity of calculations that operate on raw data when summaries and means are calculated for analysis. Often discovery of an error in the raw data requires the regeneration of a summary before a statistical analysis is performed. If summaries are linked through formulas to raw data they change automatically when the raw data are altered. Formulas can be written to perform complex tasks. The programming of the spreadsheets is relatively simple and the uses of some of the above formula are detailed and can be easily taught. Spreadsheets are ubiquitous; most researchers have access to their use. Their utilization could be increased if effort was expended in learning more of their capabilities.

Key Words: MS Excel, Formulas, Dataset

Ruminant Nutrition
absorbed (% of intake) increased quadratically (P = 0.05) with decreasing urea:CSM ratio. As days on feed increased, total N excretion also increased (P < 0.02). Based on our observations, feeding growing steers diets containing 11.5 to 13.0% CP and supplemented with higher proportions of degradable protein may potentially optimize N utilization and potentially reduces N losses to the environment.

Key Words: Retention, Dietary protein, Steers

M130 Effect of dietary crude protein on serum and urine urea nitrogen in feedlot steers. A. Gueye1, C. R. Richardson2, J. H. Mikus3, G. A. Nunney4, N. A. Cole5, and L. W. Grenne1. 1Texas Tech University, Lubbock, Texas, 2USDA-ARS-CPR, Bushland, Texas, 3Texas Agricultural Experimental Station, Amarillo, Texas.

We evaluated the effects of dietary CP concentration and source on serum urea N (SUN) and urine urea N (UUN). A metabolism trial with three collection periods (approximately d 35, 95, and 155 on feed) was conducted using twenty seven crossbred steers (average BW = 353.2 ± 8.4 kg). Treatments were arranged in a factorial arrangement and consisted of three dietary CP concentrations (11.5, 13.0, and 14.5%) and three supplemental urea:cornsseed meal (CSM) ratios (100:0, 50:50, and 0:100 of supplemental nitrogen). During each collection period, steers were housed in individual metabolism stalls; urine collected and frozen; and blood samples obtained via jugular venipuncture. Collection periods consisted of a 2- to 5-d adjustment period followed by a 5-d collection period. On d 35 on feed, SUN as steers entered the stalls (SUN-in) increased linearly (P = 0.001) with increasing CP concentration. Urine urea nitrogen (mg/dL) responded linearly (P < 0.05) to increasing CP concentration, and steers in the 50:50 treatment tended (P = 0.10) to have higher UUN than steers in the 0:100 treatment. On d 95 on feed, SUN-in and SUN as steers exited the stalls (SUN-out) increased linearly (P = 0.03 and P = 0.009, respectively) when dietary CP increased from 11.5 to 14.5%. Urine urea N linearly (P < 0.0001) increased with increasing CP. On d 155 on feed, SUN-in and SUN-out linearly increased (P = 0.005 and P = 0.003, respectively) with increasing CP concentration. Urine output increased linearly (P = 0.0000) when CP level increased from 11.5 to 14.5%. Increasing CP concentration produced a linear increase (P = 0.04) in UUN (mg/dL). Urine urea N (% of UN) decreased linearly (P = 0.007) with increasing CP. Results suggest that the amount and degradability of dietary protein affect urea metabolism by feedlot steers, as evidenced by changes in serum and urinary urea nitrogen.

Key Words: Urea nitrogen, Dietary protein, Steers

M131 Effect of a Yucca Schidigera-based surfactant on ruminal degradability of corn grain dry matter and starch. J. K. Ropp1, D. Greer2, 1Department of Animal and Veterinary Science, University of Idaho, Moscow, ID, 2AgriChem, Inc., Ham Lake, MN.

The effect of a Yucca Schidigera-based surfactant (Grain Prep®; GP, containing 8.4% Yucca Schidigera saponins) on grain production and ruminal in vitro degradation parameters of flaked corn DM and starch was tested in a commercial feed mill setting. Over a two-day period, a total of 59 separate samples were collected. GP was applied at 22 g/ton grain; Control was water (average water addition during the flaking process was 3%). Three lactating Holstein cows fitted with ruminal canulae, fed a 40% energy concentrate/17% protein concentrate/40% forage diet were used in the in sacco experiment. Flaked, intact corn kernels (34 lb./bun) were incubated in the rumen for a period of 0, 2, 4, 6, 16, 24, 48, and 72 h. Bags were replicated within animal. Average DM and starch content of the grain were not different (P > 0.05) between treatments (mean±SE): 80.00±17 and 73.11±0.7%. Solubility of corn DM and starch was increased (P < 0.001) in GP compared to Control: 45.81±0.09 vs 39.61±1.1% and 45.71±1.31 vs 38.61±0.36% (DM and starch, respectively). The potentially degradable DM and starch in the rumen were reduced (P < 0.05) by GP compared to the Control: 52.11±1.3 vs 57.61±1.82 % and 55.42±0.66 vs 61.31±1.96 %, respectively. Rate of degradation of the potentially degradable DM or starch was not affected (P > 0.05) by treatment. Effective degradability of DM and starch in the rumen (calculated at 6% passage rate) was increased (P < 0.001 and P < 0.05, respectively) by GP compared to Control: 68.20±0.63 vs 65.10±0.64 and 70.90±0.75 vs 68.20±0.76 %, respectively. In conclusion, compared to untreated control, GP-treated corn had higher overall degradability of DM and starch in the rumen of lactating dairy cows. The difference was mostly due to an increase in the soluble/instantly degradable DM or starch with the GP corn. Increased ruminal degradation of corn starch may result in enhanced microbial protein synthesis and production in the rumen.

Key Words: Saponins, Corn, Starch degradability

M132 Effect of grain type and Yucca Schidigera-based surfactant on bacterial utilization of ruminal ammonia in vitro. K. L. Grandeen1, A. N. Hristov2,1, J. K. Ropp1, and D. Greer2. 1Department of Animal and Veterinary Science, University of Idaho, Moscow, ID, 2AgriChem, Inc., Ham Lake, MN.

The objective of this study was to investigate the effect of grain type and a Yucca schidigera extract-based product, Grain Prep® (GP), on ruminal fermentation and specifically, ammonia utilization by mixed microbial populations, in vitro. Three, 8-h incubations were carried out with ruminal inoculum from two lactating dairy cows. GP-treated feed mix, containing 40% alfalfa hay/58% grain/2% soybean meal, was incubated at 15.5% concentration with buffer and ruminal inoculum. The grain part of the diet was either corn (C) or 50% corn and 50% high-amylpectin barley grain (B). GP was applied to the feed mix at 0, 60, and 120 ppm. At time 0 h, the ammonia pool was labeled with 15N. Inclusion of 50% barley into the grain mix slightly increased (P < 0.05) media pH (6.68 vs 6.71, C and B, respectively) and decreased (P < 0.05) ammonia concentration (13.0 vs 12.7 mmol/L, respectively). Concentration of total and individual VFA was not affected (P > 0.05) by type of grain. GP had no effect (P > 0.05) on ammonia or VFA concentrations. Incorporation of 15N into fluid bacteria tended to be greater (P = 0.107) in B than in C (0.69 vs 0.59 mg of 15N). Overall recovery of the 15N tracer was not affected (P > 0.05) by type of grain. The proportion of bacterial N originating from ammonia in N was not different (P > 0.05) between C and B (16.5 and 17.6%). GP had no effect (P > 0.05) on the tracer-related parameters. At 8 h, B treatments had greater (P < 0.05) recovery of 15N (23.5 vs 21.8 mg) and proportion of bacterial N originating from ammonia (35.1 vs 31.9%, respectively) than C. GP tended to increase (P = 0.111) the proportion of bacterial N originating from ammonia N (31.3, 33.6, and 36.2%, 0, 60, and 120 ppm GP). In conclusion, a 50% substitution of corn by barley had a positive effect on ammonia N utilization in the rumen, in vitro. A trend for enhanced bacterial incorporation of ammonia N was observed with GP addition.

Key Words: Saponins, Corn, Barley

M133 Changes in serum metabolites and growth characteristics of Korean steers fed alcohol-fermented feedstuffs. J. S. Shin1, B. W. Kim1, and M. L. Eastridge2. 1Kangwon National University, 2The Ohio State University.

This study was carried out to assess whether feeding alcohol-fermented feedstuffs (AFF) affects the nutritional metabolism and growth characteristics of Korean steers. Ten Korean steers were randomly assigned to one of two treatment groups. The treatments were AFF (50% commercial feeds for beef + 30% alcohol-fermented soybean curd plus 20% rice straw) and control (80% commercial feeds for beef + 20% rice straw). The change of serum metabolites and growth characteristics were measured every 2 mo at 2 h after feeding during the whole 12 mo experiment period, and the relationships between serum metabolites and growth characteristics were examined. The AFF had significantly higher (P < 0.05) serum protein, serum glucose (63.1 mg/dl) and inorganic phosphorous (IP)(8.4 mg/dl) concentrations than control (4.9, 6.6, and 120 ppm). At time 0 h, the ammonia pool was labeled with 15N and 120 ppm. At time 0 h, the ammonia pool was labeled with 15N. At 8 h, B treatments had greater (P < 0.05) recovery of 15N (23.5 vs 21.8 mg) and proportion of bacterial N originating from ammonia (35.1 vs 31.9%, respectively) than C. GP tended to increase (P = 0.111) the proportion of bacterial N originating from ammonia N (31.3, 33.6, and 36.2%, 0, 60, and 120 ppm GP). In conclusion, a 50% substitution of corn by barley had a positive effect on ammonia N utilization in the rumen, in vitro. A trend for enhanced bacterial incorporation of ammonia N was observed with GP addition.

Key Words: Serum metabolites, Korean steers, Alcohol-fermented feedstuffs
M134  Effects of long-acting estrogen implant with and without trenbolone acetate on performance, carcass characteristics and meat tenderness in Holstein steers. J. L. Beckett1*, R. N. Brewer1, L. K. Hendricks2, R. Potts2, D. Cook3, and P. Anderson2. 1Cal Poly State University, 2VetLife, LLC.

Two hundred thirty-six Holstein steers (141 kg) randomly assigned to one of four treatment groups (A, B, C, D; n = 59) were used to investigate the effects of a long-acting estrogen implant with and without a trenbolone acetate estradiol terminal implant on growth, performance and carcass characteristics. Implants contained zeranol (Z), progesterone (P4), estradiol benzoate (EB) or trenbolone acetate (TBA) and estradiol (E2). Animals were treated as described (table) and weight gain, average daily gain (ADG), and feed efficiency were calculated on 30-d intervals. Steers were harvested after 276 d on feed and carcass measurements were collected. All implanted groups had heavier (P<0.05) average final live weights and carcass weights, and improved ADG (P<0.05) compared with non-implanted controls. Cattle receiving the TBA/E2 terminal implant produced heavier carcasses than implanted cattle not receiving the terminal implant (P<0.05). Average REA were significantly greater (P<0.05) for all groups receiving the terminal implant than either E2 only or non-implanted groups. The percentage of carcasses with USDA quality grade of Choice or better was significantly lower (P<0.05) for treatment A (66.7%) than treatment B (83.9%) and non-implanted controls (85.2%), but treatment C (72.9%) was not different from any other treatment group. Based on these data, a long-acting estrogen implant is effective in increasing growth and efficiency compared with non-implanted controls. A TBA/E2 terminal implant when initiated 90 d after the initial estrogen implant significantly improved growth and efficiency, yet did not significantly suppress quality grades compared with non-implanted controls.

Key Words: Holstein steers, Implants, Estrogen

M135  Use of exogenous fibrolytic enzymes and bluegrass seed straw in wintering beef cow feeding regimens. J. I. Szasz1*, C. W. Hunt1, K. A. Johnson2, J. J. Michal3, and D. J. Coonrod3,1 University of Idaho, 2Washington State University.

Grass seed aftermath is abundant throughout many regions of Northwest US and may have potential as an economic feed resource for wintering beef cattle. A 2 x 2 factorial treatment arrangement was utilized to examine the impact of ammoniation and exogenous fibrolytic enzyme on performance of cattle fed bluegrass straw diets. Approximately four months prior to the calving season, 89 crossbred beef cows (mean initial BW 636 kg) were stratified by days-to-parturition and randomly allotted the following treatments: 1) bluegrass straw, 2) amoniated bluegrass straw, 3) bluegrass straw with enzyme, or 4) amoniated bluegrass straw with enzyme. Cows were offered grass straw treatments ad libitum. Cows fed amoniated straw also received 4.6 kg alfalfa daily while cows fed non-amoniated straw received 6.1 kg alfalfa. The enzyme utilized contained xylanase and cellulase activity and enzyme activity was 676 µmol reducing sugars/g CP/min (20.9% CP). Enzyme was administered to steer by hand-spraying freshly prepared enzyme solution onto straw at a rate of 0.22 g enzyme (4.4 IU xylanase)/kg. When initial measurements served as a covariate, BW and condition score were not different (P > 0.10) among treatments at 260 d of gestation or at 2, 30, and 45 (adjusted) d post-partum. Calf BW at 2, 30, and 205 (adjusted) d of age did not differ (P > 0.10) among dietary treatments. Pregnancy rate at 60 and at 90 d post-partum also did not differ (P > 0.10) between treatments. Likewise, treatment differences were not detected (P > 0.10) for percentage of cows pregnant at weaning. Cows fed amoniated straws consumed less DM (P<0.001) compared with cows fed non-amoniated straw. No enzyme or enzyme by ammoniation effects were observed (P>0.10) for any variable measured. Data indicate that while cows fed amoniated straw diets consumed less DM, they maintained similar levels of production. Ammoniation of bluegrass straw may be cost-beneficial by reducing dependence on more expensive alfalfa hay to maintain proper body condition.

Key Words: Xylanase, Forage, Ammoniation

M136  Evaluation of alfalfa cubes with or without incorporated barley in beef cattle diets. P. A. Szasz*, C. W. Hunt, J. I. Szasz, and T. M. McCalman, University of Idaho.

Metabolizable energy can often be supplied more economically from grain than from forages; however logistics often preclude inclusion of grain in wintering beef cattle rations. Incorporation of grain into pressed alfalfa cubes may provide a means of delivering energy via processed grain. Four ruminally cannulated Jersey steers were used to evaluate the fermentation and preservation characteristics of a pressed alfalfa cube, is a feasible alternative strategy for meeting the energy requirements of wintering beef cattle.

Key Words: Grain, Metabolizable energy, Rumen fermentation


Wet corn distillers grains (WDG) have become increasingly available as a feedstuff for cattle. The objective of this study was to evaluate the fermentation and preservation characteristics of ensiling WDG with corn silage (CS). Combinations of CS and WDG were ensiled in silo bags as follows: 1) 100% CS; 2) 75% CS + 25% WDG; 3) 50% CS + 50% WDG; and 4) 100% WDG. Samples from each treatment were collected for analyses prior to ensiling. Samples were collected from the silo bag at d 3, 7, 14, and 129 and evaluated for fermentation characteristics. The initial pH was the greatest for 100% CS and decreased (P<0.05) as concentration of WDG increased (5.7, 4.6, 4.0, and 3.1 for 100%, 75%, 50%, and 0% CS, respectively). Dry matter of the feedstuffs prior to ensiling was 27.7, 28.6, 30.0, and 30.8% for 100%, 75%, 50%, and 0% CS, respectively. Concentrations of ammonia-nitrogen (1.2, 2.7, 4.1, and 5.1% DM) and crude protein (9.9, 15.6, 20.7, and 30.8% of DM) increased with increasing concentrations of WDG. Lactic acid prior to ensiling was greater for 100% WDG (0.9% of DM) and decreased as CS was included in the treatments. Acetic, propionic, and butyric acids were not present prior to ensiling. There was no change in DM content, but Kjeldahl N and ammonia-nitrogen increased over time (P<0.05) in all silages. The pH of the ensiled feeds had dropped below 4.0 by d 3, with no further decrease over time. Acetic acid increased (P<0.05) from less than 0.01% of DM at d 0 to 3.89, 5.67, 4.32, and 0.23% of DM at d 129 as concentration of WDG increased. There was no ethanol detected prior to ensiling; however, it increased (P<0.05) with time in all treatments. Ethanol concentration was highest (2.36% of DM) for 50% WDG on d 129. Ensiling WDG with CS can be an effective method of preserving WDG. Combining both feedstuffs at the 50% ratio resulted in a blend with an initial pH of 4.0 (day 0). The low initial pH coupled with the high acetic acid concentration verified for this treatment during days 3 (2.77%), 7 (3.25%), 14 (3.34), and 129 (4.32) suggests preservation could be enhanced by combining both feedstuffs.

Key Words: Wet distillers grains, Corn silage, Fermentation
Greater energy demands during late gestation and lactation may amplify the need for supplementation of cattle grazing dormant New Mexico range grasses. Stocking rate and soil quality availability may affect postpartum energy balance. A study was conducted to evaluate responses of postpartum 2-year-old beef cows (n = 27) to supplements differing in glucogenic precursors. Cows were grouped fed (suckl bank 6 h post feeding) a mixture of wheat straw and alfalfa hay adjusted monthly to match the CP percentage of native range (5 to 8% CP, OM basis) in central New Mexico from February to May. Supplements were individually fed three times weekly at 908 g-cow−1-d−1 for 90 d postpartum and provided 1) 327 g CP, 118 g UIP, 47 g glucogenic potential (GP) (LGP), 2) 327 g CP, 158 g UIP, 63 g GP (MGP), or 3) 327 g CP, 164 g UIP + 100 g propionate salt (NutroCal, Kemin Industries, Inc.), 144 g GP (HGP). A glucose tolerance test was conducted 35 d postpartum and cows were milked by machine 50 d postpartum. Glucose and insulin areas under the curve were similar (P > 0.05) among treatments (11662, 10909, and 11605 ± 1063 and 462, 442, and 428 ± 49 for LGP, MGP, and HGP, respectively). Glucose-half-life averaged 87, 77, and 95 ± 10 min, for LGP, MGP, and HGP, respectively (P > 0.05). Cows supplemented with HGP tended (P = 0.13) to produce more milk than did cows fed LGP, while MGP cows were intermediate (5087, 5220, and 5846 ± 330 g d−1 for LGP, MGP, and HGP cows, respectively). A similar trend (P = 0.14) existed for lactose produced (251, 260, and 286 ± 16 g d−1 for LGP, MGP, and HGP cows, respectively). Cows supplemented with HGP lost 30% more weight (P < 0.05) from pre-calving to BW nadir than did MGP-supplemented cows (59, 53, and 69 ± 4 kg for LGP, MGP, and HGP, respectively). Results suggest that the supply of additional glucogenic precursors from HGP supplementation of confinement-fed cows was used to produce more milk.

Key Words: Glucose, Propionate, Protein supplements

Eight Charolais-cross heifers (359 ± 28 kg) were used in a two period crossover design experiment to determine the impact of corn flake weight on nutrient intake and retention. Heifers were randomly assigned to one of two 85% concentrate diets (79% steam-flaked corn, 15% alfalfa hay, 2.5% supplement) with corn steam-flaked at either 1) 322 g/L (25 lb/bu; SF25) or 2) 387 g/L (30 lb/bu; SF30). Dietary treatments were fed ad libitum to individually penned heifers. Each period lasted 14 d; 9 d for adaptation to dietary treatments and 5 d for daily collections of feed samples, feed refusals, and total fecal and urine output (using fecal bags). Rectal grab samples of feces were collected daily at 5 h after feeding to determine fecal pH. Daily fecal and urine output were mixed thoroughly and 5% aliquot retained and frozen for subsequent analysis. Feed, feed refusals, and fecal plus urine samples were composited for each heifer by period and analyzed for DM, OM, CP, NDF, and N. Intakes of DM (7.72 and 8.64 ± 0.31 kg for SF25 and SF30), OM (7.26 and 8.09 ± 0.10 kg for SF25 and SF30), NDF (2.01 and 2.18 ± 0.03 kg for SF25 and SF30), and CP (1.02 and 1.19 ± 0.02 kg for SF25 and SF30) decreased (P < 0.01) with lighter flake weight corn (SF25). Retention of DM (76.1 and 77.8 ± 1.0% for SF25 and SF30), OM (81.1 and 81.8 ± 1.0% for SF25 and SF30), and NDF (56.6 and 59.7 ± 2.3% for SF25 and SF30) were not affected (P > 0.15) by level of corn processing, but CP retention (48.2 and 52.9 ± 2.1% for SF25 and SF30) tended (P = 0.15) to be greater for SF30 than SF25. Fecal pH (6.48 and 6.40 ± 0.04 for SF25 and SF30) was not affected (P = 0.21) by treatments. Results suggest that greater degree of corn steam-flaking decreases dietary intakes but does not affect nutrient retention and fecal pH of heifers fed an 85% concentrate diet.

Key Words: Heifers, Steam-flaked corn, Nutrient retention
throughout the United States. Limited comparisons are available evaluating differences between the feed value of corn and barley. Eighty steers (avg initial wt 344 kg) were fed finishing diets for 112 d to determine the effects of corn and three barley varieties (H3, Harrington, and Valer) on feedlot performance, nutrient digestion, carcass characteristics, and grain energy content. Grains were dry-rolled, and diets were formulated to contain 2.4% N, 2.03 Mcal/kg NE\textsubscript{m} and 1.37 Mcal/kg NE\textsubscript{p}. Steers were allotted by weight to 16 pens in a completely randomized design with pen as the experimental unit. Steers were weighed every 28 d and diet, ort, and fecal samples were collected, composited by pen, and analyzed for DM, N, ADF, AIA, and starch. Fecal output was estimated using acid insoluble ash as an internal marker. Steers were harvested when 70% were visually estimated to grade Choice. There were no differences ($P > 0.10$) among diets for ADG (avg 1.58 kg/d), feed efficiency (FE; avg 16.31 kg gain/100 kg fed), DM (avg 9.62 kg), or starch digestibility (avg 97%). Fat thickness was greatest ($P = 0.03$) for steers fed corn (avg 1.2 cm), and least for steers fed H3 and Valer (avg 0.93 cm). Steers fed corn had higher ($P = 0.07$) yield grades than steers fed barley (avg 3.1 vs 2.8, respectively); however, there were no differences ($P > 0.10$) detected for any other carcass characteristic. Barley had similar ($P > 0.10$) NE\textsubscript{m} and NE\textsubscript{p} values as compared to corn (avg 2.19 and 1.53 Mcal/kg, respectively). Lack of differences in animal performance and grain energy values suggest that barley has equal feeding value to corn in finishing diets, and that the NRC may underestimate net energy values for barley.

**Key Words:** Barley, Corn, Grain net energy values

### M143 Growth and carcass fatty acid composition of beef steers fed soybean oil for increasing duration before slaughter


Ninety-six Gelbvieh × Angus rotationally-crossed steers (293.6 ± 3.9 kg) were used in a 189-d experiment to evaluate duration of soybean oil (SBO) supplementation on feedlot performance, carcass traits, and longissimus dorsi oil (SBO) supplementation on feedlot performance, carcass characteristics, and grain energy content. Grains were dry-rolled, and diets were formulated to contain 2.4% N, 2.03 Mcal/kg NE\textsubscript{m} and 1.37 Mcal/kg NE\textsubscript{p}. Steers were allotted by weight to 16 pens in a completely randomized design with pen as the experimental unit. Steers were weighed every 28 d and diet, ort, and fecal samples were collected, composited by pen, and analyzed for DM, N, ADF, AIA, and starch. Fecal output was estimated using acid insoluble ash as an internal marker. Steers were harvested when 70% were visually estimated to grade Choice. There were no differences ($P > 0.10$) among diets for ADG (avg 1.58 kg/d), feed efficiency (FE; avg 16.31 kg gain/100 kg fed), DM (avg 9.62 kg), or starch digestibility (avg 97%). Fat thickness was greatest ($P = 0.03$) for steers fed corn (avg 1.2 cm), and least for steers fed H3 and Valer (avg 0.93 cm). Steers fed corn had higher ($P = 0.07$) yield grades than steers fed barley (avg 3.1 vs 2.8, respectively); however, there were no differences ($P > 0.10$) detected for any other carcass characteristic. Barley had similar ($P > 0.10$) NE\textsubscript{m} and NE\textsubscript{p} values as compared to corn (avg 2.19 and 1.53 Mcal/kg, respectively). Lack of differences in animal performance and grain energy values suggest that barley has equal feeding value to corn in finishing diets, and that the NRC may underestimate net energy values for barley.

**Key Words:** Barley, Corn, Grain net energy values

### M145 Effects of exposure to ammoniated wheat straw as a suckling calf on subsequent utilization as a yearling beef heifer

R. D. Wiedmeier*, P. R. Schmidt, B. A. Kent, B. R. Bowman, and D. M. Meek, Utah State University, Logan, Utah.

Ten crossbred yearling beef heifers (355 kg) were selected for the study. Five heifers were from cows wintered on an ammoniated wheat straw (AWS) diet from late gestation through early lactation (exposed). The other five heifers were from cows wintered on alfalfa-grass hay through the same period of time (nave). After weaning, heifer calves were placed in a common pen and fed a grower diet composed of alfalfa hay, corn silage, dry-rolled barley and vitamin-mineral premix until they were yearlings. Yearling heifers were then placed in individual pens to measure utilization of AWS. Each heifer received 2.94 kg DM of supplement daily that was composed of ground alfalfa hay, sugar beet pulp, dry rolled barley and vitamin-mineral premix. All heifers were offered ad libitum access to AWS with intake measured daily. Diets were fed for a 21 d adaptation period followed by a 5 d diet and fecal collection period to estimate DM digestibility. Acid insoluble ash was used as an internal marker to estimate apparent nutrient digestibility. Exposed heifers consumed more AWS than nave heifers (5.45 vs 4.89 kg/d, $P = 0.04$). Digestibility of DM was not affected by previous exposure to AWS (60.61% vs 60.17%, $P = 0.45$, exposed vs nave, respectively). Consequently, exposed heifers consumed 8% more DMD than nave heifers (5.09 vs 4.73 kg, $P = 0.05$, respectively). Heifer calves from cows wintered on AWS diets from late gestation through early lactation will exhibit higher AWS intake as yearlings compared to heifer calves without such exposure.

**Key Words:** Heifers, Ammoniated straw, Nutrition

### M146 Effects of RumaPro on plasma ammonia and urea concentrations in beef steers

C. Huntington and J. Spears, North Carolina State University, Raleigh NC.

The objective of the experiments was to describe the ability of a slow urea release product (RumaPro) to alter plasma concentrations of ammonia and urea in steers after ingestion of a potentially toxic dose of urea. In Exp. 1, Four Angus beef steers (471±21 kg body weight) were group-fed a liberal diet of hay and concentrate (17% NDF, 15% CP) for several weeks before the start of the experiment. Steers were fed once daily, and water was available free choice. In Exp. 2, Six Angus steers (339±14 kg body weight) were fed fescue hay (63% NDF, 11.3% CP), for 3 wk before their initial dosing. Hay, mineralized salt, and water were provided ad libitum. Each experiment had a crossover design with steers selected at random to receive initial oral doses of urea (0.25 g of urea per kg of BW from either source). On sampling day, two hours after feeding, blood samples were collected into heparinized tubes -5.
5, 15, 30, 45, 60, 90, and 120 minutes after oral dosing with urea or RumaPro. Seven days later the process was repeated to complete the crossover design. ANOVA was conducted on ammonia and urea concentrations after concentrations were adjusted by subtraction of pre-dosing values within steer and treatment. Steers in both experiments had lower (P < 0.05) adjusted plasma urea-N concentrations with RumaPro (0.066 mM) compared with the urea (0.122 mM). Area under the curve calculations show that the amount of added ammonia over the time of the experiments was at least 1.6 times greater when urea was dosed than when RumaPro was dosed. Compared with steers fed the all-hay diet (Exp. 2), steers fed the high-grain diet (Exp. 1) had lower adjusted peak concentrations (0.15 vs 0.20 mM) and returned sooner to pre-dose ammonia concentrations. Treatments did not affect (P > 0.15) adjusted plasma urea-N concentrations (2.78 mM). The pattern of increased plasma urea-N concentration after dosing was similar between treatments in both experiments. We conclude that as doses calculated to be equivalent to 25% of the steers’ daily CP requirement, RumaPro reduced hydration of urea in the rumen and decreased ammonia absorption by approximately 50%.

Key Words: Beef Steer, Ammonia, Urea

M147 Effects of five grain conditioners, water, and bulk density on processing ease and flake quality with regards to feed-out. L. L. Berger*, L. F. Sewell 1, P. RumaPro, E. F. Stanisiewski 2, and G. F. Hartnell 2, 1Texas Tech Univ., Lubbock, 2Loxindland, Greeley, CO., 3Southwest Texas State Univ., San Marcos.

Processing ease for the five conditioners and water were determined by steam-flaking 27.2 kg batches of corn at bulk densities of .34, .36, .38, and .40 kg/L at an energy usage of 2.3 kWh/kg and feeding period, steers receiving the flaxseed or corn diet had a greater (P < 0.01) ratio of weight gained to feed consumed (0.119 and 0.108, respectively) than steers receiving the milo diet (0.093). There was a tendency (P < 0.06) for this gain to feed ratio to decrease with increased WCS inclusion in steers fed the milo diet. There were no differences in the rate of final live weight gain among treatment groups. Following trans- portation to a local abattoir and overnight deprivation of food, there was a reduced (P < 0.01) percentage decrease in weight (i.e., shrink) in the steers fed the flaxseed diet (1.51%) than in the steers fed the corn (2.89%) or milo diet (3.11%). Marbling score was not affected by WCS inclusion (P = 0.14) nor was there an interaction between grain source and WCS inclusion (P = 0.16). There was an interaction (P < 0.02) in that lean maturity decreased with increasing percentages of WCS when the steers were fed the corn or milo diets, yet lean maturity remained unchanged in steers fed flaxseed. Ribeye area of steers fed milo was less (P < 0.01) than that of steers fed the corn or flaxseed diets. These data indicate that a ration formulated to provide increased levels of α-linolenic acid (i.e., flaxseed) will increase feed efficiency without affecting carcass yield or composition of the beef carcasses. Additionally, the inclusion of WCS in milo diets may cause a decrease in efficiency and less salable lean.

Key Words: Steers, Linolenic acid, Cottonseed

M150 Effect of feeding diets containing corn grain with corn rootworm protection (event MON863), control, or conventional varieties on steer feedlot performance and carcass characteristics. L. B. Berger* 1, N. D. Robbins 1, J. R. Sewell 1, E. P. Stanisiewski 2, and G. F. Hartnell 2, 1University of Illinois-Urbana, 2Northwestern University, St. Louis, MO.

A steer finishing trial was conducted to determine the effect of feeding corn that was genetically modified to protect against corn rootworm (CRW) (event MON863) on performance and carcass characteristics. All hybrids were grown in Illinois, ground through a tub grinder and then stored in Harvestore silos. Continental-cross steers (n = 196) were assigned to one of four dietary treatments differing only in the corn hybrid (WCS). There were 7 pens with 7 head/pen in each treatment-group. Steers were adapted to a common finishing diet based on a commercially available corn over a 21-d period prior to starting the study. Feed intakes were adjusted for each pen on a daily basis andorts collected as needed. Two consecutive daily weights were taken and averaged for initial weight. All steers were harvested at a commercial packing plant after 102 d on trial. Data were analyzed using the PROC MIXED procedure of SAS with pen as the experimental unit for performance data and individual steer for carcass data. There were no significant differences in...
Intramuscular fat of beef can be modified favorably by feeding grass and concentrate supplementation rich in unsaturated fatty acids.

Key Words: Intramuscular fat, Fatty acids, Linseed supplementation


Three hundred and twenty three steer calves (249 kg, 1.9) were used to determine the effects of trace mineral (TM) source and growth implants on performance, carcass characteristics, and lipid metabolism. Steers were blocked by ranch and stratified by initial body weight and randomly assigned to one of 36 pens (n=9 to 12 steers/pen). Pens within a block were then randomly assigned to treatments. Treatment consisted of: 1) control (no supplemental Cu, Zn, Mn, or Co), 2) inorganic mineral (CuSO4, ZnSO4, MnSO4, and CoCO3), and 3) organic mineral (iso-amounts of Cu, Zn, Mn, and Co). At the beginning of the experiment, 6 pens of animals/treatment received an implant and the other 6 pens of animals/treatment received no implant. Steers were fed a corn silage-based growing diet for 56 d then were gradually switched to a high concentrate finishing diet for 132 or 156 d. At the beginning of the finishing phase, previously implanted steers were reimplanted. Treatments during the finishing phase consisted of: 1) control (no supplemental Zn); 2) inorganic Zn (30 mg of Zn/kg DM from ZnSO4); and 3) organic Zn (iso-amounts of organic Zn). During the growing phase, implant and TM supplementation had no effect on ADG, ADFI, and FE. During the finishing phase, steers that were implanted had greater final body weight (P < 0.01) and ADG (P < 0.01) in the non-implanted steers. Overall, implanted steers had lower (P < 0.01) marbling scores than non-implanted steers and steers that were supplemented with TM had greater (P < 0.05) dressing percentage than controls. Longissimus muscle of implanted steers had greater (P < 0.01) C18:2 and lower C16:1 (P < 0.01) and C18:1 (P < 0.01) than longissimus muscle of non-implanted steers. Steers supplemented with inorganic TM had greater C18:2 (P < 0.01) and C18:1 (P < 0.03) and lower (P < 0.03) C22:6 than steers supplemented with organic TM. These results indicate that TM source and growth implants may affect performance, carcass characteristics, and lipid metabolism in steers.

Key Words: Zinc, Implant, Carcass characteristics

M152 Influence of linseed supplementation on quality and fatty acids in beef. J. Hollo1, E. Szűcs2, K. Endre1, J. Csapó1, G. Hollo2, J. Sereg2,1, J. Seenger2,1, and I. Repa1 *

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Full fat linseed meal supplementation of diet on meat quality and fatty acid composition of intramuscular fat was investigated in this study. Hungarian Grey (HG) Holstein-Friesian (HF) growing-finishing bulls were fed rations consisting of either grass silage and concentrate or maize silage and concentrate with and without linseed supplementation according to 2x2 factorial experimental design in four groups A and B vs. C and D, respectively. Equal number (n=10 in each group) of animals were assigned to treatments above. Concentrates for groups A and C were supplemented 20% linseed meal containing 40% linolenic acid fed for the last month of growing-finishing period. Average final weights were actually identical in all groups (512±±48±54 kg). The animals were slaughtered after a 24 hr chilling LDL samples were taken from the right half carcasses. Data processing was made by SPSS 10.0 program package. Statistical differences were recorded between feeding intensities for dressing percentage, and that of lean and fat content of carcass (P<0.001), and pH5 (P<0.01). Meat color was measured by Minolta Chromameter the results of which differed among treatments in terms of a+ and b+ value (P<0.01, P<0.001), but L+ (P>0.05). Dry matter and the moisture content of LD showed significant variation due to treatments, as well (P<0.001). Marked statistical differences were present for crude protein (P<0.001) and ether extract of LD (P<0.01) except for groups A and C. Higher concentrations of palmitic, stearic and oleic acids content in intramuscular fat were recorded in groups B and D than in A and C ones (79-82 vs. 73-74%, P<0.001). The rate of oleic acid seems to decline significantly (P<0.001) as a result of linseed supplementation. Means for group A and C were 29.6±±1.9 and 28.3±±2.5 vs. B and D 36.3±±1.5 and 35.5±±1.5, respectively. The ratio of PUFA increased. Means were as follows: groups A and C 13.7±±3.0 and 16.5±±3.8; groups B and D 7.3±±2.5, respectively (P<0.001). A ratio of saturated to unsaturated fatty acids was highest in A and C (3.4-4.4 vs. B and D 7.7-10.3, P<0.001). In conclusion, the fatty acid composition of intramuscular fat of beef can be modified favorably by feeding grass and concentrate supplementation rich in unsaturated fatty acids.

Key Words: Corns, Corn rootworm, Feedlot performance

M154 Effect of condensed-tannins addition to a corn-sunflower meal based feedlot diet. A. J. Pordomingo*, M. P. Azcarrate, and N. A. Juan, INTA Anguil Experiment Station, La Pampa, Argentina.

Addition of condensed tannins in ruminant diets has been suggested to reduce rate and extent of rumen degradation of soluble proteins and increase nitrogen and feed efficiency. This experiment evaluated the effects of adding 2 levels of tannins, compared with a control and a metabolizable-protein (MP) balanced diet, on weight gain and feed efficiency of feedlot steers during a 92-day period. Ninety six Angus steers (live weight = 200 ± 5 kg) were distributed in a completely randomized design of 24 pens with 4 steers each. Treatments applied were: T1= Diet based on sunflower meal, alfalfa hay and corn grain, T2= Similar to T1 plus 2.5% tannins added on dry-matter (DM) basis, T3 = Similar to T1 plus 3.5% tannins; and T4 = Diet based on corn, no tannins added, and balanced for MP supply (NRC, 2000) with sunflower, feather and fish meal. Diets were equivalent in metabolizable energy content.

Key Words: Ionophores, Brewers grain, Feedlot
A mineral and vitamin mix (3%-DM basis) and monensin (33 mg/kg of mixed feed) were added to all diets. Treatment T1 served as control for tannin effects and T4 as a reference for maximum potential. Weight gains (ADG) were determined on day 0 and at the end of 4 periods on days 24, 46, 69 and 92 of trial, after a 17-hour fast. Feed intake was measured daily by pen and averaged by period. Albite treatment by period interactions (P<0.05), after the 92 days of trial ADG resulted greater (P<0.01; SE=0.029) for T2 (1.67 kg/d), compared with the other treatments (1.56 kg/d; P>0.257). Addition of tannins did not affect (P>0.25) DM intake. Treatments 1, 2 and 3 resulted in greater intakes (P<0.01) than T4 (3.87 ± 1.67 kgDMD/SE = 0.262), maybe due to effects of protein profiles supplied Treatment 4, however, yielded the greatest feed efficiency (5.29 ± 5.421 for T4 and the combined T1, T2 and T3, respectively; SE = 0.226). Fitted to NRC (2000) model, treatments 2 and 4 showed improved nitrogen use efficiency compared with T1 and T3 (P<0.05).

Key Words: Protein use efficiency, Feedlot cattle, Condensed tannins

M155 Effect of age, sex, and grain processing method on rate and efficiency of gain of beef cattle. B. M. Rainey*, J. A. Paterson, M. C. King, L. W. Barney, and W. T. Chot, Montana State University, Bozeman, MT.

The objectives of this factorial growth study were to determine the effects of animal age (cows vs. calves), animal gender (steers vs. heifers) and barley processing method (whole vs. rolled) on rate and efficiency of gain when fed as a supplement to medium quality grass hay (12.3% CP; 37.7% ADF, DM basis). Also evaluated was a control treatment in which animals were fed a supplement of whole barley. Angus cows (493 ± 49 kg), twenty-one, heifer calves (98 ± 8 d of age) (107 ± 15 kg), and nineteen, steer calves (99 ± 7 d of age) (121 ± 16 kg) were allotted to treatments in a 2 x 2 x 1 arrangement. All cattle were blocked by age and sex and fed for 65 d. Pen was the experimental unit. Light test weight barley (20.9 kg bu−1) was provided at 0.5% BW (2.4 kg cow−1d−1 and 6.6 kg calf−1d−1, DM basis). Grass hay was provided to cows at 9.7 kg d−1 and calves at 2.8 kg d−1 (DM basis). Rations were formulated to be isonitrogenous using a 31.6% CP supplement and cows received 0.9 kg ha−1d−1, while calves received 0.45 kg ha−1d−1. Individual full weights were taken on two consecutive days at the beginning and end of the study. Data were analyzed as a factorial for the main effects of animal age, barley processing method and the processing x age interaction. No interactions were measured in this study. Animals fed the control diet had a similar rate and efficiency of gain as supplemented animals. barley processing had no effect on rate or efficiency of gain for cows or calves (P>0.05). However, age (cow vs. calves) was significant (P<0.0001). Cows gained more weight than calves, consumed more DM but were less efficient (5.73) than either heifers (5.32) or steers (4.74). Similar to ADG was faster (P<0.01) for cows than calves.. These data suggest that improved performance was not measured when the barley was rolled. Also, even though cows gained more than calves, gains were more efficient for calves than cows (1.04 kg vs 0.58), cow vs heifer (P = 0.0019), (1.04 kg vs 0.51) for cows vs steers. These data suggest that calves which are out performed are still more efficient in their gains than older animals.

Key Words: Barley, Processing, Cattle


The objective of this study was to investigate the effects of fiber from cottonseed hulls (CSH) added to the starter and of live yeast (YST) or mannanoligosaccharide (MOS) added to milk, on growth, intake, rumen development, and health parameters in calves. Bull and heifer calves (n=116) were assigned randomly at birth to one of six treatments for 63 d. Calves were dehorned at 42 d. Bulls were castrated by 14 d. Calves were fed 3.8 L of colostrum once daily for the first 2 d and then 3.8 L of whole milk supplemented with either no additive, 4g YST, or 3g MOS once daily through weaning at 42 d. Treatments included: 1) a corn/soybean meal based starter, 20% CP, 6% ADF (CON), 2) a blend of 85% starter and 15% CSH, 18% CP, 15% ADF (CON + CSH), 3) starter and MOS (CON + MOS), 4) starter with CSH and MOS (CON + CSH + MOS), 5) starter and live yeast (CON + YST) and 6) starter with CSH and live yeast (CON + CSH + YST). Starter diets were offered from 1 d and daily amounts were increased by 0.09 kg when ors were 0 kg. Weekly measurements included body weight (BW), wither height, hip width, and dry matter intake from starters (DMI). Daily measurements included rectal temperatures, fecal, and respiratory scores. Twelve steers (2 per treatment) were sacrificed for rumen tissue samples. Data were analyzed for the main effects of CSH, YST, and MOS. Average DMI was greater for calves consuming CSH diets (0.41 kg) than diets without CSH (0.34 kg). Calves fed CSH treatments (54.9 kg) had greater BW than those fed diets without CSH (53.3 kg) (P<0.05). Average daily gain was greater for calves fed CSH diets (0.58 kg/d) than without CSH (0.51 kg/d) (P<0.05). However, calves diets with CSH had a greater feed efficiency (0.67 kg feed/kg BW gain) than those fed CSH diets (0.73 kg feed/kg BW gain) (P<0.05). There were no significant effects of YST or MOS on DMI, gain, or feed efficiency (P>0.05).

Key Words: Dairy calves, Cottonseed hulls, Yeast

M157 Effects of grazing fresh forages on milk fat in Holstein and Jersey cows. C. L. Freeman*, J. A. Bertrand, T. C. Jenkins, B. W. Pinkerton, and D. L. Palmquist, 1Clemson University, Clemson SC / USA, 2Ohio State University, Columbus OH / USA.

The objective was to determine effects of grazing different forages on concentrations of cis-9, trans-11 conjugated linoleic acid (CLA) in milk fat of Jersey and Holstein cows. Two treatment groups were utilized for each of three studies: control (C) or pasture (P). Cows on C were fed a total mixed ration (TMR) and P cows were offered a diet of alfalfa hay and supplemental feed, which was limited to 60% of ad libitum dry matter intake (DMI). In Experiment 1, Holstein and Jersey cows on P grazed ryegrass pasture. Milk samples from each cow were taken at the end of two three-week periods for four consecutive milkings. In Experiment 2, Holstein and Jersey cows on P grazed dwarf hybrid pearl millet pasture. Weekly milk samples were taken from four consecutive milkings for the six-week trial. In Experiment 3, Holstein cows on P grazed ryegrass pasture. Milk samples from each cow were taken at the end of two three-week periods for four consecutive milkings. In Experiment 2, Holstein and Jersey cows on P grazed dwarf hybrid pearl millet pasture. Weekly milk samples were taken from four consecutive milkings during two five-week periods. Linolenic acid (C18:3) content was higher in P diets compared to C (31% and 4%, respectively). Saturated fatty acid content (C16:0 and C18:0) was higher in C diets than P (51% and 30%, respectively). For all three forages, C18:3 was the fatty acid in highest concentration, ranging from 48% of total fatty acids (TFA) in dwarf hybrid pearl millet, 49% in ryegrass, to 57% in rye. Palmitic (C16:0) and linoleic (C18:2) acids concentrations were each approximately 11% of TFA. DMI from pasture ranged from 54% to 77%. Milk fat CLA as a percentage of TFA were significantly higher for P cows in all experiments. In Experiment 1, milk fat CLA for cows on P was 0.47% of TFA for Holsteins and 0.42% for Jerseys. In Experiment 2 and 3, milk fat CLA for cows on P was 0.57% of TFA for Holsteins and 0.45% for Jerseys. In Experiment 3, milk fat CLA for cows on P was 0.44% of TFA. Substitution of fresh forage for a portion of TMR in dairy cows significantly increases CLA concentrations to twice that of the control, as well as differences between Jersey and Holstein breeds. Cows responded similarly to all three forages.

Key Words: Pasture, CLA, Dairy cows


Thirty-two lactating Holstein cows averaging 225 ± 63 DMU were used in a 6 wk randomized complete block trial to determine the response to dietary cation-anion difference (DCAD) and dietary crude protein (CP) concentration fed during hot weather. The study was conducted from July 17 through August 27. Mean temperature and minimum temperature, relative humidity, and temperature-humidity index (THI) were 29.9, 22.5°C; 98.1 and 65.7%; and 80.5 and 72.3, respectively. Treatments were arranged as a 2 x 2 factorial to provide 15 or 17% CP and DCAD of 25 or 50 meq/100g DM (Na+K-Cl). A DCAD x CP interaction (P<0.09) was detected for average daily milk yield with high DCAD resulting in lower yield (27.8 kg/d) than low DCAD (31.4 kg/d) at high dietary CP. No differences were noted at low CP. High DCAD (P<0.01) and CP (P=0.06) resulted in higher milk fat percentage than low DCAD and
CP respectively. No differences between treatments were observed for intake of DM or milk protein percentage. Blood urea nitrogen (BUN) was higher for 17% CP than 15% CP (P < 0.01). A DCAD x CP interaction (P < 0.01) was noted for blood Na (P < 0.01). At 17% CP, blood Na was higher at DCAD 50 versus 25. At 15% CP, no difference was observed. Fractional excretion of K (P < 0.01) was greater at DCAD 50 than DCAD 25. A DCAD x CP interaction (P = 0.05) was noted for fractional excretion of Na with a greater increase with increasing DCAD at 15% CP than at 17% CP. A difference was also observed for urinary bicarbonate level for low (47.7 mmol/l) and high (88.8 mmol/l) DCAD (P < 0.01). No CP differences were observed for fractional excretion.

While results of this research indicate a relationship between DCAD and dietary crude protein, the mechanism behind this relationship is unknown.

Key Words: Dietary cation-anion difference, Dietary crude protein, Heat stress

M159 Amino acid composition of ruminant feeds and feed fractions. D. A. Ross* and M. E. Van Amburgh, Cornell University, Ithaca, NY.

To improve the ability to predict amino acid flows in ruminants, which will enhance the efficiency of use of absorbed nitrogen (N), a better description of the amino acid (AA) content of feeds used in ruminant diets is necessary. The objective of this study was to analyze the AA composition of some common dairy feeds to determine variation among and within feed fractions and to evaluate typical fractionation methods for AA recovery. Twelve feeds (three alfalfa silages (AS), four soy products (SOY) and five corn silages (CS)) were partitioned to yield six N containing fractions: whole feed (W), insoluble N (IN), true soluble N, neutral detergent (ND), acid detergent (AD) and lignin (L). Residues from these fractions were analyzed for AA content using HPLC after acid hydrolysis or precipitation followed by acid hydrolysis. Dry matter, ash and N were determined on all fractions. True soluble N was precipitated with 10% tungstic acid. The IN, ND and AD residues were prepared using standard procedures: lignin was obtained by hydrolysis of AD residue in 72% sulfuric acid for 3 hr. Amino acid values are presented as the mean sd as the percent of the crude protein in the residue (CP, % DM). Within AS, the mean Arg contents of the fractions (W, IN, TIN, ND, AD and L) were 4.13 ± 0.21, 3.91 ± 0.09, 5.84 ± 0.89, 3.15 ± 0.85, 1.59 ± 0.43, 1.94 ± 0.80 (CP % DM) (P < 0.008). Within the ND residues of the AS the Met content was 1.16 ± 0.56. Among the CS fractions the Leu contents were 8.47 ± 0.40, 11.16 ± 1.45, 14.62 ± 5.10, 7.31 ± 1.36, 4.80 ± 2.24, 6.44 ± 2.45 (CP % DM), respectively (P < 0.001). Within the CS the Lys contents of the W and IN fractions were 2.30 ± 0.63 and 3.40 ± 0.38 (P < 0.039) while the Thr contents were 3.26 ± 0.09 and 4.08 ± 0.37 (P < 0.01). For the SOY the mean Leu content of the ND residues was 7.16 ± 1.92 with a range of 1.75 to 10.70 (CP, % DM). The Leu content of the AD residue of the SOY ranged from 7.16 to 14.67 with a mean of 10.96 ± 3.07. The mean Phe contents of the SOY AD and L fractions were 6.12 ± 1.86 and 3.35 ± 1.13, respectively (P < 0.012). The results of this work demonstrate that variation exists among similar feeds and within routine chemically determined feed fractions.

Key Words: Amino acid, Feed, Nitrogen

M160 Effects of feeding graded amounts of liquid molasses to high producing dairy cows. G. A. Broderick* and W. J. Radloff, U.S. Dairy Forage Research Center, Madison, WI.

Previously, we observed that feeding sugar as sucrose or dried molasses increased DM and fat yield in lactating cows. This trial tested effects of replacing dietary high moisture shelled corn (HMSC) with liquid molasses. Multiparous Holstein cows (48) were assigned by DM to 12 blocks; cows were fed a covariate diet formulated to 17% CP and 26% NDF containing (DM basis): 30% alfalfa silage, 26% corn silage, 37.4% HMSC, 7.0% soybean meal, 4.4% roasted soybeans, plus 1.2% minerals. After an 8 wk covariate period, cows within blocks were randomly assigned to TMR supplemented with (DM basis): 0% molasses, 37.4% HMSC (covariate diet); 3% molasses, 34.4% HMSC; 6% molasses, 31.4% HMSC; or 9% molasses, 28.4% HMSC. Cows were fed experimental diets for 8 wk. Milk yield and DM were measured daily. Yield of milk components was determined one day during the covariate period and every 2 wk during the trial. The statistical model included fractional excretion of Na with a greater increase with increasing DCAD at 15% CP than at 17% CP. A difference was also observed for urinary bicarbonate level for low (47.7 mmol/l) and high (88.8 mmol/l) DCAD (P < 0.01). No CP differences were observed for fractional excretion.

While results of this research indicate a relationship between DCAD and dietary crude protein, the mechanism behind this relationship is unknown.

Key Words: Dietary cation-anion difference, Dietary crude protein, Heat stress

M161 Soy hulls as barley grain replacement in pellets fed to lactating cows; effect on digestion and milk performance. J. Miron, E. Yosef*, M. Nikbakht, E. Maltz, and D. Ben-Ghedalia, Dept of Dairy Science, The Volcani Center, ARO, Israel.

The potential of soy hulls rich in primary cell walls for replacing of barley grain when included as major components in pellets fed to dairy cows was measured. Hypothesis being that this replacement can avoid the inhibitory effect of starch on neutral detergent fiber digestion and utilization in the rumen, while improving milk fat synthesis by the cow. Ten lactating cows, similar in initial average performance, were divided into two dietary groups of five cows each and fed two different diets based on 73% pellets and 27% oat plus pelleted hays (2:1). The two dietary groups differed in the pelleted ingredient of the diets consisting of either 48% rolled barley grains in B group or 48% soy hulls in the SH cows. The hays and pellets were mixed together and fed ad lib in three meals during the day, allowing for 10% orts. Chromium oxide marker was used to measure digestibility. Cows were allocated for 42 d in individual metabolic stalls, had free access to water and milked twice daily. Data of individual cows were analysed by ANOVA using the GLM procedure of SAS (1996). Dry matter and NDF intakes were significantly higher in the SH cows (20.4 and 9.63 kg/d, respectively, P = 0.05) compared to the B group (16.9 and 4.95 kg/d, respectively). The in vivo digestibility of organic matter was slightly higher (P = 0.06) in the B cows, however, NDF digestibility was significantly higher in the SH group (50.9 versus 36.2%, P = 0.02). This difference is probably a result of the inhibitory effect of barley starch on the cellulosytic population of the rumen in the B cows. Intake and digestibility differences were reflected in higher content of milk fat (P = 0.04) and higher yield of milk fat and 3.5% fat-corrected-milk (P = 0.01) of the SH cows (3.65%, 1.13 kg/d and 26.2 kg/d, respectively) compared to the B group (2.32%, 0.67 kg/d and 24.1 kg/d, respectively). Milk and milk protein yields were similar in both groups. This study demonstrates that a dietary regime based on feeding high proportion of concentrated pellets to dairy cows (e.g. in dairy herds using robots for milking or concentrate feeders) should be based on soy hulls as starchy grains replacement, in order to maintain high milk fat level.

Key Words: Dairy cows, Soy hulls pellets, Barley pellets

M162 Effects of prepartum dietary energy level and calcium propionate supplementation on energy metabolism in transition dairy cows. C. C. Stanley**, C. C. Williams1, H. G. Bateman1, A. E. Beem1, D. T. Gant1, Y. H. Chung1, and F.R. Valdez1, 1Louisiana State University Agricultural Center, Baton Rouge, LA, 2Kemin Americas, Des Moines, IA.

Forty-one Holstein cows were grouped by anticipated parturition date and assigned to one of four treatments that were arranged as a 2x2 factorial based on 105 and 145% (NRC, 2001) of prepartum dietary energy requirements with or without a prepartum addition of Ca-Propionate (11.3 g/d provided as NutroCALTM; Kemin Americas, Des Moines, IA). Cows were fed treatment diets from 21 d prior to their anticipated parturition date
until parturition. After parturition, all cows were fed a standard lactation diet with Ca-propionate supplementation continued as assigned prepartum. Individual cow DMI were measured daily. Blood samples were collected during wk -3,-2,-1, +1, +2, and +3 relative to calving for glucose, nonesterified fatty acids (NEFA), urea nitrogen (PUN), insulin, and thyroxine concentrations. Cortisol and glucagon concentrations were measured at wk -1 and +1. At wk -1 and +1, minimal model intravenous glucose tolerance tests were performed to assess glucose effectiveness ($S_{e}$), insulin sensitivity ($S_{i}$), and the acute insulin response relative to glucose administration ($AIR_{Glucoose}$). Glucose, NEFA, insulin, cortisol, and glucagon concentrations were not affected by diet energy level or Ca-propionate supplementation. There were diet by week by Ca-propionate interactions ($P < 0.05$) for thyroxine and PUN concentrations. The $S_{e}$ and $AIR_{Glucoose}$ were not affected by Ca-propionate supplement or diet. The $S_{i}$ were not affected by Ca-propionate supplement but were greater for cows fed the low energy diet ($P < 0.05$). Clinical health problems not related to dietary treatments of the experimental herd pre- and post-partum may have affected DMI, and therefore these data may not accurately reflect treatment effects on glucose metabolism.

Key Words: Calcium propionate, Glucose metabolism, Transition cows

M165 Silymarin and lycopene in peripartum dairy cows: Effect on milk productivity and quality. D. Tedesco1, S. Galletti1, M. Tameni2, S. Steidler1, A. Costa1, and P. Morazzoni2. 1Department VSA, University of Milan, Italy, 2Indena S.p.A., Milan, Italy.

Objective was to test silymarin + lycopene (Indena S.p.A.) in transient cows, in a period when oxidative stress can impair health status. Silymarin is a hepatoprotective and antioxidant substance which has shown a positive effect on productivity and health in transition cows. Lycopene is an important antioxidant of the human diet. 20 cows were selected according to parity, previous production and BCS, were divided into two groups. From 7 d before expected date of calving to 14 d after calving, 10 cows received 50 g/d of a mixture of silymarin + lycopene by oral drench. Milk production was recorded daily for 305 d and samples were collected at 7, 14 and 21 DIM. The BCS was evaluated just before calving. Body weight was recorded at 0, 21 and 30d after calving. Blood samples were collected at 7, 0, 7, 14, 21, and 31 d from calving to evaluate anti-oxidant power (OXY) and reactive oxygen metabolites (ROMs) in sera with two colorimetric micromethods. Treatment increased milk production. The a, b and c parameters from Wood equation of both lactation curves showed significant differences (P<0.05), on average 2.5 kg/d for each animal. No difference was found in BCS and body weight between groups. Protein, fat, lactose and urea content in milk was not influenced by treatment. No inebihent activity was detected in milk. Somatic cell count (SCC) was lower in treated animals. The values were significantly different at 14 and 21 DIM (respectively 337700 vs. 62625 and 261500 vs. 66333; P<0.05). At the start of trial (-7d) a lower OXY level (expressed in μM H2O2) was found in the treated group. Antioxidant activity was significantly higher for treated cows than controls (P<0.05). No variations were found in the control group in all the considered days. No differences were found in ROMs values (expressed in mM H2O2) considering treatment and day effect (P>0.05). These results suggest that silymarin + lycopene treatment increases milk production and may have an effect on udder health.

Key Words: Dairy cow, Somatic cell count, Silymarin + Lycopene


The objective of this experiment was to develop an apparatus to assess nutritional motivation. A push door was designed to fit within a cow’s tie stall manger area, the width 92 centimeters and the height of the door 130 centimeters. The apparatus works by the animal pushing the door open with the crown of the head in a lunging action. Successive addition of weights was used to determine the level of motivation to obtain a food reward. For validation, three non-lactating dairy animals of varying body weights were fasted for 0, 24, 48, and 72 hours. At these designated time points motivation was assessed with the offering of dry hay. The test was completed once the animal would no longer push the door to receive the reward. With advanced duration of fast, there was a significant increase in dry hay intake from 0 to 24 hours - 19.3 ± 3.8 kg or 3.8% of body weight; 24 to 48 hours - 49.5 ± 3.7 kg or 7% of body weight; 48 to 72 hours - 83.5 ± 5.1 kg or 13% of

Key Words: Transition cow, Yeast, Heat stress

M164 The effect of short vs long term yeast supplementation during the period transition of Holstein cows. J. D. Ward*, J. P. Cant, W. J. Bettger, and B. W. McBride, LSU AgCenter, Southeast Research Station.

A 56 d study using 30 component fed Holsteins was conducted to determine the effect of yeast culture supplementation during the transition period. Treatments were control, yeast supplementation from 21 d prior to expected calving date through 21 d after calving (short regimen) and yeast supplementation 21 d prior to expected calving date through 56 d after calving (long regimen). Prior to calving, cows received 3.6 kg of DM per d for a concentrate mix, ad libium access to ad libium grass hay and pasture, and 3.8 kg of DM of corn silage every other d. After parturition, multiparous cows and primiparous cows received 8.1 or 7.3 kg of DM per d, respectively, of a concentrate mix. All cows received, for ad libium consumption, a mixture containing on a DM basis 33.0%corn silage, and 7.6 and 113.4 kg after calving) to the concentrate of treatment cows. Plasma was collected on d 7, 14, 21, 28 and 56 for BHBA analysis. Milk components were analyzed every 14 d. Milk production, BHBA on d 7, 14, 21, and 28 d, DMI, and milk component data were analyzed using the mixed models of SAS and differences among treatments were tested using single degree of freedom contrasts. General linear models of SAS were used to analyze BHBA concentrations on d 56 and differences among treatments were analyzed using single degree of freedom contrasts. The contrasts were yeast supplementation vs no supplementation, and length of yeast supplementation. Overall, yeast supplementation had no effect on DMI, or milk production. However, cows on the long regimen had higher (P = 0.02) milk production (36.2 vs 33.7 kg per d) and less (P = 0.06) grain intake (7.3 vs 7.4 kg of DM per d) than cows on the short regimen. Neither yeast supplementation nor length of supplementation had any effect on BHBA during the first 28 d of the study. However, on d 56 cows on the long regimen had lower (P = 0.06) plasma BHBA concentration than cows on the short regimen (5.11 vs 7.4 mg/dL). Neither yeast supplementation nor length of yeast supplementation had any effect on SCC or milk fat. However, yeast supplementation decreased (P = 0.09) milk protein content (2.67 vs 2.81 benefical when fed throughout the entire study.

Key Words: Transition cow, Yeast, Heat stress

M163 Conjugated linoleic acid and transvaccenic acid content of milk from cows fed fish meal and extruded soybeans for an extended period of time. A. A. AbuGhazaleh1, D. J. Schingoethe, A. R. Hippen, and K. F. Kalscheur, South Dakota State University, Brookings.

The objective of this study was to determine the effect of feeding a conjugated linoleic acid (CLA)-stimulating diet for an extended period of time on milk CLA and transvaccenic acid (TVA) concentrations. Twenty cows (16 Holstein, 4 Brown Swiss) were divided into 2 groups (n=10/treatment) for the 10 wk study. Cows in the first group were fed a blend of 0.5% fish oil from fish meal (FM) and 2% soybean oil from extruded soybeans (ESB) to achieve higher milk fat CLA and TVA. Diets were formulated to contain 18% crude protein and were composed (dry basis) of 50% concentrate mix, 25% corn silage and 25% alfalfa hay. Intake of DM was not affected by diet (29.3 and 27.7 kg/d for groups 1 and 2, respectively). Milk production (34.5 and 38.9 kg/d) increased (P <0.05) when fed the blend of FM and ESB. Milk fat percentages (3.74 and 3.17), and milk protein percentages (3.39 and 3.18) decreased (P < 0.05) with the FM and ESB diet. However, milk fat yield (1.29 and 1.21 kg/d) and protein yield (1.16 and 1.23 kg/d) were not affected by treatments (P > 0.05). Concentrations of milk cis-9, trans-11 CLA (0.33 and 1.16 g/100g of fatty acids) and TVA (0.58 and 2.1 g/100g of fatty acids) were 2.5-fold greater (P < 0.05) for cows fed the FM and ESB diet during the 10 wk trial, increasing to approximately 3.5-fold higher than the control diet by wk 3, decreasing during wk 4 and 5, and remaining constant at approximately 2.3-fold higher throughout the remainder of the experiment. Yields of cis-9, trans-11 CLA and TVA in milk fat can be increased by feeding a blend of FM and ESB and that increase is relatively constant after 5 wk on the diet.

Key Words: Conjugated linoleic acid, Milk, Fish meal


The objective of this experiment was to develop an apparatus to assess nutritional motivation. A push door was designed to fit within a cow’s tie stall manger area, the width 92 centimeters and the height of the door 130 centimeters. The apparatus works by the animal pushing the door open with the crown of the head in a lunging action. Successive addition of weights was used to determine the level of motivation to obtain a food reward. For validation, three non-lactating dairy animals of varying body weights were fasted for 0, 24, 48, and 72 hours. At these designated time points motivation was assessed with the offering of dry hay. The test was completed once the animal would no longer push the door to receive the reward. With advanced duration of fast, there was a significant increase in dry hay intake from 0 to 24 hours - 19.3 ± 3.8 kg or 3.8% of body weight; 24 to 48 hours - 49.5 ± 3.7 kg or 7% of body weight; 48 to 72 hours - 83.5 ± 5.1 kg or 13% of
body weight). In conclusion, the push door proved an effective tool in determining the level of motivation to receive a food reward.

**Key Words:** Nutritional motivation, Push door, Dairy cattle

### M167 Production efficiency of mid-lactation dairy cows fed yeast culture during the summer


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Thirty-eight Holstein cows (26 multiparous and 12 primiparous), which averaged 105 d postpartum at the start of the experiment, were used to evaluate the feeding of yeast culture (Diamond V XP®) on production efficiency during hot summer weather. After a 2 wk covariate period, cows were fed a control diet or control diet with 60 g yeast culture/cow daily for 12 wk from early June until early September. Weekly daily-time high temperatures averaged 33°C (28 to 39°C) during the 12 wk period. Total mixed diets contained 28.5% of DM as corn silage, 21.5% as alfalfa hay, and 50% as concentrate mix with the yeast culture. Body weights (629 and 616 kg) and body condition scores (3.12 and 3.16) were similar (P > 0.05) for both groups. The results suggest that the yeast culture can improve production efficiency of dairy cows in mid-lactation.

**Key Words:** Yeast culture, Lactating cows, Production efficiency

### M168 Effects of diet forage:concentrate ratio on splanchnic nutrient metabolism in lactating dairy cows

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**1 The University of Reading, Reading, UK, 2 Purina Mills LLC, St. Louis, MO, 3 The Rowett Research Institute, Aberdeen, UK.**

The objective was to determine the effects of diet forage:concentrate ratio on the net absorption and metabolism of nutrients by the portal-drained viscera (PDV) and liver of 6 multiparous, catheterized, lactating (214 DIM) Holstein X Friesian cows (714 kg BW). Treatments were forage (60:40 dehydrated alfalfa:grass silage) or an isonitrogenous concentrate (2.64 % N) fed as a TMR in ratios (DM basis) of 60:40 (F) or 40:60 (C) in a single-reversal study with 5 wk periods. Blood flow (L/h) and net PDV and liver nutrient flux (mmol/h) were measured hourly (n = 6) on the last d of each period. Diets were offered hourly at below ad libitum DIM and equal calculated ME, but DIM (18.9 vs. 19.6 kg/d) and N intake (488 vs. 510 g/d) tended (P > 0.16) to be lower for F, thus ME intake was greater (P < 0.03) for C (202 vs. 221 MJ/d). Milk yield (20.2 kg/d) and composition were not affected by diet, but milk fat concentration was numerically lower for C (44.6 vs. 40.8 g/kg, SEM = 2.0). Blood flow for PDV (1874) and liver (2267) and net PDV flux of oxygen, ammonia, urea, acetate, n-butyrate, β-OH-butyrate, or glucose (~3562, 736, -472, 418, 169, 232, and -35, respectively) were not affected (P > 0.10) by diet. Similarly, net liver flux of oxygen, ammonia, urea, acetate, n-butyrate, and β-OH-butyrate (~3588, -754, 779, 563, -138, and 330, respectively) were not affected (P > 0.12) by diet. However, greater (P < 0.05) net PDV release of lactate (146 vs. 177) and numerically greater net PDV release of glucose (620 vs. 713) and less (P < 0.10) net liver release of lactate (69 vs. 28) for C. In conclusion, greater ME intake, from a higher concentrate diet, increased net splanchnic supply of glucose and lactate to peripheral tissues of late lactation dairy cows.

**Key Words:** Portal-drained viscera, Liver, Lactation

### M169 Effect of the replacement of corn by citrus pulp on fiber effectivity

G. A. Andrade1, J. C. Teixeira1, J. R. O. Perez1, J. A. Muniz1, P. C. A. Paiva1, and J. S. Oliveira2.

**1 Universidad Federal de Lavras, 2Embrapa Gado de Leite.**

The objective of this experiment was to compare the part (CP50) and total (CP100) replacement of citrus pulp by finely ground corn (CP00) in lactating dairy cow diets in which the forage source was corn silage on fiber effectivity of the by-product. The hypothesis was that the use of citrus pulp in the place of corn increases the faecal fermentation process, the chewing activity and ruminal pH. Twelve cows at the middle third of lactation with an average yield of 28.5 kg of milk were utilized. The animals were fed twice per day with three diets ranging only the levels of NDF and ADF. The design was a replicate 3 x 3 Latin square design with 21-day periods. Two orthogonal contrasts for data analysis I (CP00 x CP50) and II (CP 50 x CP100) were utilized. No differences were found for rumination, intake, mouth inactivity and water consumption, also the ruminal puncture was proceeded for the measurement of ruminal pH. No difference among the intake parameters according to the levels of replacement in relation to the CP00 treatment was detected, only the time spent with water consumption of kg of NDF was shorter for the animals when they were given CP100 diets. The time spent for rumination and of Kg of NDF was shorter for the animals fed CP100 diet. The time of mouth inactivity was longer for the animals when submitted to any of those experimental treatments utilized. Milk fat yield was higher for the animals when fed the CP100 diet and less when fed the CP00 diet.

**Key Words:** Citrus pulp, Corn meal, Fiber effectivity

### M170 Feed consumption and efficiency of lactating cows submitted to part and total replacement of corn by citrus pulp

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The objective of this work was to compare the part (CP50) and total (CP100) replacement of citrus pulp by finely ground corn (CP00) in lactating dairy cow diets in which the source of forage was corn silage on milk yield and composition. The hypotheses were that use of citrus pulp in the place of corn does not show any fall in milk yield and increases the percent of fat and protein. Twelve cows at the middle third of lactation with an average yield of 28.5 kg of milk per day in two daily milkings were used. Milk samples were collected proportionally soon after milking and led to the analyses. The animals were fed twice per day with three diets containing the same nutritional pattern ranging only the replacement of corn by pulp. The experiment was a replicate 3 x 3 Latin square design with periods of 21 days. Two orthogonal contrasts were utilized for data analysis I (CP00 x CP100), II (2* CP50 x CP00 + CP100). Milk yield of the animals when they were fed the CP 50 diet was less than when the same animals were fed the CP00 and CP 100 diets, 28.32, 28.81, 28.58, respectively. Total yield and percent fat was less for the animals which were fed the CP00 diet and higher when they were fed the CP 100 diet , 0.96 x 1.10 kg and 3.37 x 3.84 %, respectively. The values for total yield and percent protein were the inverse of the found for fat with higher yields for the animals fed the CP00 diet and less for CP 100 ( 0.90 x 0.84 ) and 3.10 x 2.97.

**Key Words:** Citrus pulp, Corn meal, Milk production

### M171 Effect of the replacement of corn by citrus pulp on nutrient consumption by lactating cows

G. A. Andrade1, J. C. Teixeira1, J. A. Muniz1, J. R. O. Perez1, J. S. Oliveira2, and P. C. A. Paiva1.

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The aim of this experiment was to compare the part (CP50), total (CP100) and total (CP100) replacement of citrus pulp by finely ground corn (CP00) in diets for lactating dairy cows in which the forage source was corn silage on feed consumption. The hypothesis was that the use of citrus pulp in the place of corn keeps the intake of dry matter with greater consumptions of neutral detergent fiber (NDF) and acid detergent fiber (ADF). Twelve cows at the middle third of lactation with an average yield of 28.5 kg of milk were utilized. The animals were fed twice per day with three diets ranging only the levels of NDF and ADF levels. The experiment was a replicate 3 x 3 Latin square design with 21 days periods. Two orthogonal periods for data analysis I (CP 00 x CP 100), II (2* CP50 x CP00)
gentina.


This experiment evaluated short-term effects of intra-ruminal capsules of monensin on lactating dairy cows under alfalfa grazing condition. Fifty-six Holstein dairy cows (46 multiparous and 10 primiparous) were used in a repeated measures randomized design. The cows were blocked in pairs by calving date, previous milk yield, body weight and lactation number in two treatments: Control and Monensin. Treated cows received the intraruminal capsules 30 days before the expecting calving date and 60 days after calving. Short-term effects were evaluated during the first 150 DIM. All the cows were fed with the same diet, during the dry period a TMR and after calving alfalfa pasture and supplemented with TMR. Corn silage, alfalfa hay, corn grain, cottonseed, mineral and vitamins composed the TMR. Mean quality of the diet pre and postpartum were: 57.8 and 45.6%; 12.7 and 18.8%; 1.51 and 1.65 Mcal/kgDM; 52.1 and 35.8% for DM; CP; NEL; and NDF respectively. Dry matter intakes were comparable (P>0.05) between treatments, averaging 14.16 and 9.25 kgDM/cow/d TMR and alfalfa respectively. There were significant differences (P<0.05) in milk yield and milk composition (fat, protein, and non-fat solids). Monensin capsules improved lactation performance of dairy cows under alfalfa grazing conditions.

**Key Words:** Citrus pulp, Corn meal, Intake


Canola is relatively new as a feedstuff in South Africa and is gaining in popularity. This study investigated the effect of replacing 10% of the traditionally fed oilseed, whole canola seed (WCS) with either 10% whole canola seed (WCA) or 10% roller milled crushed canola seed (CCA). Thirty primiparous Holstein cows were used in randomized block design and blocked on average production from d 17 - d 20 post partum. After blocking the cows were fed one of three experimental diets (WCS, WCA, CCA) for a period of 60 d. The diets were similar in chemical composition (17% CP; 11.4 MJMKE/kg DM) and based on lucerne hay, oat hay, corn and oilseeds. Dry matter intake (20.5; 20.2; 20.3 kg/d), milk production (28.5; 29.4; 29.0 kg/d) body weight (553; 547; 549 kg) and body condition score (3.0; 2.9; 2.7) did not differ between treatments WCS, WCA and CCA respectively. Cows fed the WCA and CCA diets produced milk with a higher fat percentage, compared to the cows fed WCS (3.84 and 3.95% vs 3.47%; P<0.001). Supplementation with CCA decreased the concentration of C16:0 and increased some long chain fatty acids in milk compared to the cows fed the WCS diet (P<0.05). Processing of canola also decreased the C16:0 to C18 total fatty acid ratio from 0.48 to 0.36 (P<0.05) for cows fed the WCA and CCA diets respectively. It can be concluded that there is no need to process canola seed when fed to cows with an intake of around 20 kg DM/d and milk production of 28 - 30 kg/d. At higher intakes (>25 kg DM/d) it might be necessary to process canola due to higher ruminal outflow rates. If the objective is to produce a healthier milk with reduced C16:0 to total C18 fatty acids ratio, then processing would be necessary.

**Key Words:** Dairy cows, Canola, Milk composition


Liver from Holstein cows (n=77) entering second or later lactation was utilized to measure responses of palmitate metabolism to candidate nutrient effectors. Liver slices were prepared from biopsy samples collected 21 d prepartum and 1, 21, and 63 d postpartum. Concentrations of nutrients used in liver incubations were: control (B), 75 µM choline chloride (C), 75 µM L-Met (M), C + M (CM), 75 µM D,L-2-hydroxy-4-(methylthio)-butanoic acid (H), 650 µM sodium propionate (P), 80 µM linoleic acid + 20 µM linolenic acid (E), C + E (CE), and M + E (ME). Liver incubated with CE had greater capacity for conversion of [1-14C]palmitate to CO2 than P [4.1 vs. 3.5 mmol converted/(g wet weight x h)] and tended to be greater than liver incubated with C; CM, E, and ME. Liver incubated with CE had greater capacity for conversion of [1-14C]palmitate to CO2 than those incubated with H and CE [2.98 vs. 3.8 mmol converted/(g wet weight x h)]. Liver incubated with P or E on d 1 postpartum tended to have lower capacities to synthesize CO2 from [1-14C]palmitate than B. On d 63 postpartum, liver incubated with CE had the highest capacity for [1-14C]palmitate oxidation to CO2 compared to all other treatments except E. The capacity of liver to store [1-14C]palmitate intracellularly as
esterified products (SEP) tended to increase from prepartum values on d 1 postpartum and then declined on d 21 and 63 postpartum [225, 241, 197, 197 nmol converted/g wet weight x h]). Overall treatment means of SEP tended to be lower for liver incubated with H, E, and ME compared to B [210, 206, 208 vs. 227 nmol converted/g wet weight x h]). Effects of treatment within day were only significant on d 1 for SEP such that liver incubated with C (232; P < 0.17), E (231; P < 0.15), and ME (228; P < 0.13) tended to be lower than B (264 nmol converted/g wet weight x h)). These data suggest that choline and essential fatty acids modulate liver fatty acid metabolism during the immediate postpartum period.

Key Words: Periparturient cow, Liver, Fatty acids

M176 Evaluation of dry matter intake equations by examining predicted change in bodyweight throughout lactation in dairy cows. J. L. Ellis*, F. Qiao, and J. P. Cant, University of Guelph, Guelph, Ontario, Canada.

In the dynamic modelling of dairy cow performance over a full lactation, the difference between NE intake, NE used for maintenance and output in milk accumulates in body stores. To select, out of some common DMI prediction equations, the one that results in a minimum cumulative bias in body energy deposition, a simple dynamic model of NE balance was constructed. Fat corrected milk yield (kg/d) was calculated as [a(t-1)−e−k(t−1)] [e−κt−1], where a, b0, b1 and c were obtained by nonlinear fit to experimental data. Dry matter intake (DMI) was predicted from FCM yield and bodyweight, with one of the 4 CNCPs equations, the ARC equation or the NRC equation. Energy balance was calculated according to NRC as DMI*1.7-FCM*0.749-BW9.5*0.08. Bodyweight change was 0.203 times NE balance if the balance was negative and 0.195 times balance if positive. The instantaneous bodyweight of cattle at progressive weeks of lactation (WOL) was then simulated as the numerical integral of the bodyweight change. Predicted DMI and body weight from each DMI equation were compared statistically with published observations on Holstein dairy cows with a variety of frame sizes and body conditions, and fed a variety of diets. Regression analysis was performed on all predicted DMI and body weight curves to determine goodness of fit. All equations over predicted body weight, with an increasing difference between predicted and observed body weight as lactation progressed, and this suggests a problem in energy balance calculation, most likely in the maintenance factor. A maintenance cost of 0.11 Mcal/kg.90.5 minimized residual sums of squares of body weight prediction, and taking into account this adjustment the body weight/energy balance of each DMI equation was examined.

Key Words: Energy balance, Dry matter intake, Dynamic modelling

M177 Effect of Tween 80 on milk production by Holstein cows. J. Baah1, *, J. A. Shelloff2, T. A. McAllister3, and K.-J. Cheng3, 1Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB, 2University of British Columbia, Vancouver, Canada, 3Academia Sinica, Taipei, Taiwan ROC.

The effects of the surfactant Tween 80 on milk yield and composition, feed intake and body weight were studied using 108 multiparous Holstein cows in a 12-wk trial. Cows were ranked by previous milk yield and days in milk (DIM) and randomly assigned to three diets. Within diet, cows were further grouped as <30 or >30 DIM. The diets (CON, T1 and T2) were partial mixed rations (PMR) containing barley grain, grass silage, corn silage, hay, canola, bypass protein, mineral mix and 0.25% or 0.50% Tween 80 (w/w). Diets were balanced to NRC requirements for milk production of <29 kg/d, and offered for ad libitum consumption. Cows producing >29 kg/d were also fed dairy concentrate (1 kg per 3 kg milk in excess of 29 kg/d). Data were analyzed using PROC GLM with LSMEANS, with diet and DIM (<30 or >30) as main effects, and significance set at (P<0.05). Across DIM groups, cows fed T1 and T2 produced more (P<0.05) milk with lower (P<0.05) fat content, than those fed CON. PMR intake curves were similar (P>0.05) across diets. Milk yield by cows fed CON, T1 and T2 averaged 30.8, 34.0 and 33.1 kg/d, respectively, with 3.7, 3.5 and 3.5% milk fat content. Among cows ≥30 DIM, intake of PMR was similar (P>0.05) across diets, but those fed T1 and T2 produced 3.75 and 3.03 kg/d more (P<0.05) milk, than those fed CON. Milk fat was reduced (P<0.05) from 4.0% with CON to 3.6 and 3.8% with T1 and T2, respectively, and protein content from 3.33% (CON) to 3.2 and 3.17% (T1 and T2, each P<0.05). Milk yield among cows <30 DIM at the start of the trial was similar to that observed in cows ≥30 DIM, however, milk fat and protein contents with T1 (3.4 and 3.0%, respectively) did not differ (P>0.05) from CON (3.5 and 3.0%), and both were higher (P<0.05) than with T2 (3.2% fat and 2.9% protein). Body weight losses by T1 and T2 cows were 50 and 80% lower (P<0.05), respectively, than those fed CON. Milk yield by dairy cows is improved by including Tween 80 in the diet.

Key Words: Tween 80, Milk production, Cows

M178 Comparison of analytical methods and the influence of milk components on milk urea nitrogen recovery. A. B. Peterson*, R. A. Kohn, and E. Russek-Cohen, University of Maryland, College Park, Maryland.

The objectives of this study were to determine the differences among analytical methods and to determine if any components in milk affected the recovery of milk urea nitrogen (MUN). Duplicate milk samples were collected from 100 Holstein cows fed one ration on a commercial dairy herd with a rolling herd average of 20,600 lbs. One of each duplicate was spiked with a known quantity of urea N (final concentration 4 mg/dl) while the other was not. Recovery was calculated as the difference in MUN between the two samples divided by 4 mg/dl. Each pair of milk samples was sent to 14 independent laboratories involved in the MUN Quality Control Program through National DHIA and analyzed for MUN, protein, fat, lactose, somatic cell count, and total solids. The laboratories analyzed MUN using CL-10 (n=3), Skalar (n=2), Bentley (n=3), Foss 4000 (n=3) or Foss 6000 (n=3) systems. When recovery of MUN was evaluated among the 5 analytical methods, the mean recoveries for the CL-10, Skalar, Bentley and Foss 6000 systems were 85.3, 90.8, 90.8, and 94.0%, respectively and did not differ from each other (or from 100%). However, MUN recovery for the Foss 4000 system was much lower at 46.9% (SE = 6.7%) compared to the other systems and differed from 100% (P < 0.05). Recoveries from all systems except Skalar were influenced by the random effect of lab (P < 0.0001) and the variation associated with recovery was not influenced by the random effect of cow. However, as MUN concentration increased, recovery decreased using the CL-10 and Bentley systems from 92.2% at 3 mg/dl to 75.1% at 4 mg/dl. Overall treatment means were 30.5 and 26.3% lower when compared to the Foss 4000 system (P = 0.05). As milk protein concentration increased, MUN recovery tended to decrease using the Bentley system (P < 0.10). Recovery of MUN using four of the methods was unaffected by most milk components and did not differ from 100%. Only 47% of MUN was recovered using the Foss 4000 system which depended on the lab, and tended to be affected by MUN concentration.

Key Words: Milk urea nitrogen

M179 Feed intake and milk production of Holstein cows fed rations with glucogenic supplements during the transition period. T. I. Belloso*, M. S. Gulay, M. Liboni, M. J. Hayen, and H. H. Head, University of Florida.

Multiparous Holstein cows were used to evaluate glucogenic supplements added to daily TMR. Treatments were 1) control, none; n=29; 2) NutroCAL (Kemin Americas™, 0.114 kg/d; n=33; 3) Metaxerol (Pestell America™, 0.454 kg/d; n=31; and 4) propylene glycol, 0.300 kg/d, n=31. All cows were fed twice daily and intakes recorded from -21 d prepartum through 28 d postpartum. Supplements were mixed with ~13.5 kg of the TMR fed in a.m. Afternoon feed allotment contained no supplement and amount was adjusted for expected 5% orts. Close-up dry TMR was fed through day of calving then fresh cow TMR was fed through 100 DIM, but supplements were discontinued after d 28. Milk yields (MY) were recorded at each of the 3 daily milkings. Body weight (BW) and BCS were recorded weekly beginning -21 d prepartum. Prepartum feed intake (kg/d) at wk -3 (28.85), wk -2 (31.91) and wk -1 (28.89) did not differ due to TRT, except during wk -2 prepartum (1; 2; 30.20 vs 27.37 kg/d). Feed intake decreased 17.8-30.9% the week before calving, greatest decrease was during the 2 d before calving. Postpartum feed intake increased in all TRT groups during each of the 4 wk (26.79, 32.78, 36.32, 38.03 kg/d, respectively). Within week no differences in intake were detected due to TRT except during wk 4 (1; 2; 39.18 vs 36.50, P=0.0608) and (3; 2; 39.05 vs. 36.50, P=0.0698). MY for TRT groups did not differ during the first 4 wk when supplements were fed, except that cows in TRT 4 produced less milk (~2.5 kg/d; P≤0.0356). Overall, 3.4 kg/d less milk was produced during hot season. MY did not differ due to TRT for 28-70 (P=0.7127) or 4-100 DIM (P=0.9072) and no TRT comparisons were significant; overall means were 41.77 and
M180  Effects of prepartum dietary carbohydrate source and monensin on expression of gluconeogenic enzymes in liver of transition dairy cows. E. L. Williams*, M. M. Pickett2, L. C. Griel2, K. S. Heyler2, G. A. Varga2, and S. S. Donkin1, 1 Purdue University, 2 Pennsylvania State University.

Adequate provision of gluconeogenic precursors is crucial to the health of transition dairy cows. Non-fiber source lipid (NFFS) diets act to increase dry matter intake in transition cows and therefore availability of glucose precursors. Feeding monensin favors enhanced supply of propionate for gluconeogenesis. The objective of this study was to determine the effects of NFFS and monensin on expression of gluconeogenic enzymes in the liver of transition dairy cows. Twenty-one multiparous Holstein cows were used in a complete randomized block design. The addition (+) or absence of (-) supplemental monensin (0 or 330 mg/d) was evaluated in a prepartum conventional (CONV) diet and NFFS diet in a 2 x 2 factorial arrangement of treatments. The CONV diet contained 70% forage and 28% of the forage was replaced with cottonseed hulls and soy hulls in the NFFS diet. Diets were formulated to contain 1.55 Mcal NE3/kg, 14% CP, and 40% NDF on a dry matter basis. Treatments began at dry off and continued through parturition. Monensin was topdressed from 28 d pre-calving through parturition. At calving all cows were placed on the same lactation diet. Liver biopsy samples obtained at -28, -14, +1, +14, and +28 d relative to calving (DRTC) were used to determine pyruvate carboxylase (PC) and phosphoenolpyruvate carboxykinase (PEPCK-C) mRNA expression. There was an overall effect (P < 0.05) of DRTC on PC and PEPCK expression. Expression of PC mRNA differed (P<0.05) with prepartum diet and DRTC x diet but there was no effect of diet on PEPCK mRNA. Feeding NFFS increased PC expression on +1 DRTC (P < 0.10) compared with CONV (0.48 0.12 vs. 0.84 0.16; CONV vs. NFFS+). Feeding NFFS+ and monensin results in a combined effect to induce PC expression at calving. Expression of PC mRNA is induced when transition cows are fed conventional diets. The data indicate that NFFS and monensin act in concert to further induce PC expression at calving and consequently suggests increased capacity for gluconeogenesis from lactate.

Key Words: Transition cows, Monensin, Liver


Objective was to determine the effect of method of lipid supplementation and forage length on milk yield and composition, particularly the fatty acid composition of milk fat. Four primiparous Holstein cows were fed one of four diets containing soybean oil fed as part of a TMR (T) or NFFS (N) diet. Forage was either chopped (C) through a 2.5 cm screen or sliced to an approximate 7.5 cm length by a bale slicer (S). Cows were fed one of four diets containing soybean oil fed as part of a TMR (T) or NFFS (N) diet. Forage was either chopped (C) through a 2.5 cm screen or sliced to an approximate 7.5 cm length by a bale slicer (S). Cows were paired according to age, previous lactation production, and expected calving date, then randomly assigned to one of two treatments: Control or Drench. Prior to calving, all cows were fed a negative DCAD diet. Control cows were drenched with a placebo (16 L warm water) while the treated cows received 2.2 kg of a premix containing alfalfa meal (41.4%), Ca propionate (34.0%), Mg sulfate (10.0%), KCl (7.5%), monosodium phosphate (6.0%) and a probiotic preparation. The pre-mix was suspended in 16 L of warm water prior to drenching. All cows were milked twice daily. Blood plasma Ca levels were monitored via venipuncture and subsequent centrifugation at 0 h (just prior to drenching) and at 12 and 48 ± 2 h. Plasma samples were analyzed using the PROC MIX procedure (SAS Version 8) with the 0-h sample serving as the covariate. Cows receiving the TMR had higher (P<0.05) plasma Ca levels compared to Control cows (2.18±0.025 vs. 2.10±0.024 mmol/L) at 12 h post-calving but plasma Ca was unaffected by treatment by 48 h (2.018±0.032 mmol/L for both groups). No treatment differences (P>0.25) were detected for plasma Mg, P, or NEFA at either time point. There was a time x treatment interaction with plasma BHBA concentrations. At 12 h, treated cows had lower BHBA (0.52±0.31 vs. 0.62±0.20; P<0.05) whereas at 48 h, treated cows had higher BHBA levels (0.90±0.060 vs. 0.73±0.057; P<0.05). There was no difference between treatment groups in the incidence of metabolic diseases. In this study, there was no measurable increase in feeding activity and intensity across the two periods. Meal criterion (27.74 min) was calculated meal frequency (meals d−1) and hits per meal min (hits d−1) while the treated cows received 2.2 kg of a premix containing alfalfa meal (41.4%), Ca propionate (34.0%), Mg sulfate (10.0%), KCl (7.5%), monosodium phosphate (6.0%) and a probiotic preparation. The pre-mix was suspended in 16 L of warm water prior to drenching. All cows were milked twice daily. Blood plasma Ca levels were monitored via venipuncture and subsequent centrifugation at 0 h (just prior to drenching) and at 12 and 48 ± 2 h. Plasma samples were analyzed using the PROC MIX procedure (SAS Version 8) with the 0-h sample serving as the covariate. Cows receiving the TMR had higher (P<0.05) plasma Ca levels compared to Control cows (2.18±0.025 vs. 2.10±0.024 mmol/L) at 12 h post-calving but plasma Ca was unaffected by treatment by 48 h (2.018±0.032 mmol/L for both groups). No treatment differences (P>0.25) were detected for plasma Mg, P, or NEFA at either time point. There was a time x treatment interaction with plasma BHBA concentrations. At 12 h, treated cows had lower BHBA (0.52±0.31 vs. 0.62±0.20; P<0.05) whereas at 48 h, treated cows had higher BHBA levels (0.90±0.060 vs. 0.73±0.057; P<0.05). There was no difference between treatment groups in the incidence of metabolic diseases. In this study, there was no measurable benefit to the use of a complex drench compared to a placebo drench of warm water other than a transient increase in plasma Ca. However, this elevated level of Ca is similar to what has been reported previously for less complex oral drenches containing Ca propionate/Ca chloride.

Key Words: Hypocalcemia, Drench, Parturition


New technology has been developed that allows monitoring of feeding behaviour of cows fed via a feed alley in a free stall barn. Objectives were to: 1) determine which measures of feeding behaviour were most repeatable, and 2) describe changes in these measures over peak lactation. The Growsafe™ system recorded cow presence (hits; 6 s resolution) at the feed bunk for 21 lactating cows for two 8 d periods starting at 57 ± 16 (mean ± SD) and 94 ± 16 DIM. Meal criterion (27.74 min) was calculated using a mixed distribution model to fit the log frequency distribution of the intervals between hits. This criterion was then used to calculate meal frequency (meals d−1) and duration (min d−1). Total hits d−1 and hits per meal min (hits d−1 / meal duration) were calculated. Linear regression was used to determine within cow repeatability from period 1 (independent) to period 2 (dependent). Regression coefficients were significant (P < 0.05) for all measures. Within cow repeatability was highest for hits d−1 (R2=0.99) and hits per meal min (R2=0.91), moderate for duration (R2=0.75), and low for frequency (R2=0.22). Estimates for intercept and slope of the regressions were used to determine if cows changed their feeding behaviour over time (intercept not equal to 0) and if this change was relative to initial values (slope not equal to 1). Slopes (± SE) were significantly (P < 0.001) higher than 1 for hits d−1 (1.40 ± 0.11) and hits per meal min (1.67 ± 0.12) indicating an increase in feeding activity and intensity across the two periods. Meal duration and frequency intercepts tended to be above 0 (68.18 ± 37.17 and 3.04 ± 1.70) and slopes tended to be less than 1 (0.79 ± 0.11 and 0.53 ± 0.23), indicating that cows with high duration and frequency

Key Words: Hypocalcemia, Drench, Parturition
tended to reduce these values, and those that began lower tended to increase. These results illustrate that some measures of feeding behaviour are highly repeatable within cows and demonstrate that feeding activity and intensity within a meal increase over peak lactation.

**Key Words:** Feeding behaviour, Dairy cattle, Lactation


Current rationing models for dairy cows tend to be factorial and static and consider energy and protein requirements. They demand little in terms of computational power and as a result have proved valuable as quick and easy methods for rationing dairy cattle. However, they are requirements based and do not predict the yield of milk constituents. Therefore, over the last three decades there has been considerable development of dynamic mechanistic models of ruminant metabolism. This approach offers the potential to predict responses to nutrient intake and quantify the outputs of fat, protein, and lactose in the milk. Although, many benefits have been observed in a research environment, their application on-farm has been limited firstly through computational requirements and more recently due to the esoteric nature of the specialist modelling software. However, this research has used mixed language programming as an alternative to the Advanced Continuous Simulation Language, in order to allow non-specialist users to interact with an extensible rumen model. The model and the numerical integration routines were coded in FORTRAN 95 and the Graphical User Interface (GUI) was written using Visual Basic (VB) 6.0. The interface between FORTRAN and VB was handled with C routines, with code optimized for Pentium 4 processors. The GUI facilitates use by different user groups from farmers to scientists, each with their own information needs. A “drill-down” menu system prevents the user becoming overwhelmed with non-relevant information. Data are displayed graphically or in tabular form, at the discretion of the user. There are many advantages to the programming techniques used other than the ability to reach a wider audience. There are improvements in speed of processing, and the ease with which model simulations can be run. This project demonstrates the principles for developing a nutrient based feed evaluation system for dairy cows that can be applied on-farm.

**Key Words:** Model, Rumen, Programming


The purpose of this study was to evaluate the effects of different feed additives on rumen fermentation and performance of dairy cows fed springtime fresh cut alfalfa pasture. Eight Holstein lactating cows, four primiparous rumen fistulated (60 DIM) and four late lactating multiparous cows were used in two 4x4 Latin square designs (4 wk periods). The treatments were the following: a controlled diet (Control) with no feed additives; a dietary buffer (DB) 200 g/cow/d comprised of a mix of sodium bicarbonate, magnesium oxide, calcium carbonate and bentonite; antibiotics (M+V), 300 mg monensin + 30 mg virginiamycin per cow per day and a yeast culture commercial preparation (YC) 15 g/cow/day. A basal diet containing fresh alfalfa (pre-bloom, 16.4% DM, 25.9% CP and 33.9% NDF) was fed ad lib to each cow in individual pens. Fresh alfalfa was cut twice daily and supplied to each cow at 9 a.m. and 5 p.m. Intake, in-vivo digestibility, milk yield and composition was measured in multiparous cows. Rumen fluid samples from fistulated cows were collected at pre- and 2, 4, 6 hours post-feeding and analyzed for pH, NH3, VFA and concentration of amylolytic and celulolytic bacteria. Dry matter intake (DMI), organic matter digestibility (OMD), milk yield, milk composition and ruminal pH were not affected by the treatments. Ammonia was decreased by M+V and YC. Also, M+V had lower concentrations of total VFA and cellulolytic microorganisms (1.34 vs 1.25 log10 CFU/ml) compared to those under other treatments (avg 2.36 MPNx109/ml) Based on these results future experiments under grazing could be defined

**Key Words:** Rumen fermentation, Alfalfa pasture, Feed additives


The objective was to test the efficacy of gypsum-coated calcium chloride (GCC) as an anion source for altering dietary cation-anion difference (DCAD; mEq ([Na+(K+)-(Cl+S)])/kg DM) and urine pH of transition dairy cows. In experiment one, six dry, non-pregnant Holstein X Friesian cows were used in a balanced 6 x 4 Latin Square experiment with 10 d periods. Treatments were a control, maize silage-based diet (DCAD = 113) or the control diet plus either GCC, liquid hydrochloric acid (HCl) or hydrochloric acid bound to diatomaceous earth (HCl-Damolin). Anionic treatments reduced DCAD to <87. Anions reduced urine pH from 7.8 to less than 6.5 (P < 0.001), but DMI (7.7 kg/d) was unaffected. Urinary Ca excretion (g/d; estimated from urine creatinine) was increased (P < 0.001) by anions (2.55 versus 7.19, 7.15 and 7.18 for HCl, HCl-Damolin and GCC respectively). In experiment two, 26 multiparous Holstein X Friesian cows were assigned to one of three treatments three weeks prior to day 305 of gestation. Treatments were: a control maize silage-based ration (mean DCAD of 249; n = 10) or control plus GCC (n = 8) or a commercial anionic supplement (CAS) supplying chloride anions and micronutrients (n = 8). Anions reduced DCAD to a mean of -91. Blood and urine samples were taken weekly until calving. DMI (kg/d) was not affected by anions, but was lower (P < 0.06) for GCC versus CAS (11.1, 12.2, and 10.4 for control, CAS, and GCC, respectively). Anions decreased (P < 0.001) blood (7.45, 7.43 and 7.38) and urine (8.52, 6.16 and 5.62) pH (shown for control, CAS and GCC, respectively), but GCC lowered blood (P < 0.004) and urine (P < 0.016) pH more than CAS. Estimated urine Ca excretion (g/d) was increased by anions (1.70, 7.60 and 8.31 for control, CAS and GCC respectively; P < 0.003). The low urine pH on the GCC treatment indicates more efficient use of anions in this product. Reducing the dose of GCC may overcome the decrease in DMI. However, dose-response relationships need to be developed.

**Key Words:** Anionic salts, DMI


Our hypotheses were that development of fatty liver differs between heifers and cows and that cows experiencing moderate feed restriction would be less susceptible to fatty liver during severe feed restriction. Twenty Holstein cows and 10 heifers were blocked by expected date of calving, each block consisting of two pregnant multiparous cows and one pregnant nulliparous heifer. Each of the multiparous cows were randomly assigned within the block to one of two treatments and fed a diet providing either 160% (MH) or 80% (ML) of their estimated maintenance energy needs. Nulliparous heifers were fed at 80% of estimated energy requirements for maintenance and growth (NL). All animals were fed a control diet ad libitum from 75 to 60 days prepartum during which covariate measurements were made. Treatment diets were fed from d 61-
to d-40. On d-39 through d-32, all animals were fed an estimated 30% of maintenance energy needs to induce fatty liver. DMI for MH, ML, and NL were 12.7, 7.9, 8.0 kg/d from d-60 to d-39 and 2.8, 2.9, 3.5 kg/d from d-39 to d-32, respectively. There was a tendency for cows to have higher liver TG on d-32 and a larger change from d-39 to d-32 than heifers. At d-39, plasma non-esterified fatty acid (NEFA) concentrations were higher in ML compared with MH and blood glucose concentrations were higher in NL compared with MH and ML. This data suggests that cows are more susceptible than heifers to fatty liver development during feed deprivation and that prior energy intake did not influence development of fatty liver in multiparous cows. Values below are LSM ( SE).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>MH</th>
<th>ML</th>
<th>NL</th>
<th>MH vs. NL</th>
<th>MH vs. ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Energy Intake$^1$</td>
<td>140</td>
<td>83</td>
<td>75</td>
<td>P$^=$</td>
<td></td>
</tr>
<tr>
<td>d-39 Liver TG, %DM</td>
<td>1.3 (0.2)</td>
<td>1.8 (0.2)</td>
<td>1.3 (0.2)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>d-32 Liver TG, %DM</td>
<td>16.7 (3.5)</td>
<td>15.3 (3.1)</td>
<td>7.8 (3.8)</td>
<td>0.08</td>
<td>NS</td>
</tr>
<tr>
<td>Liver TG Change</td>
<td>15.61 (3.4)</td>
<td>14.2 (3.4)</td>
<td>6.5 (3.8)</td>
<td>0.08</td>
<td>NS</td>
</tr>
<tr>
<td>Liver TG</td>
<td>146 (30.8)</td>
<td>279 (31.1)</td>
<td>238 (38.8)</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>NEFA, mg/dl</td>
<td>64.6 (1.2)</td>
<td>64.5 (1.2)</td>
<td>68.9 (1.5)</td>
<td>0.02</td>
<td>NS</td>
</tr>
<tr>
<td>d-39 BHBA$^2$, mg/dl</td>
<td>3.6 (0.5)</td>
<td>4.2 (0.5)</td>
<td>3.0 (0.6)</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Key Words: Parity, Energy intake, Fatty liver


The coordinated changes in metabolism that initiate lactation imply that ketosis problem should be approached in a dynamic way to account for the non-steady state conditions of periparturient cows. A dynamic mechanistic model was constructed to study the mechanism of ketosis, and evaluated with regard to its ability to simulate published experimental data for the development of ketosis in transition cows. In the model, it was assumed that glucose was the limiting nutrient, and lactose synthesis in mammary gland was assigned to the highest priority according to the concept of homeorhesis. The driving variables for the model were dry matter intake, feed composition, milk production, and initial body fat content. For the developmental data set, the model simulates the adipose tissue loss and the changes in plasma glucose, nonesterified fatty acids (NEFA), and beta hydroxybutyrate (BHBA) during the first four weeks postpartum. The model predicted blood glucose, NEFA, and BHBA concentrations with a root mean square prediction error (RMSPE) of 3.4, 0.5, and 1.0 mmol/l, which represented 10.1, 18.4, and 41.5% of mean predictions respectively. The maximum mobilization rate of adipose tissue occurred at around 5 d postpartum while blood BHBA level peaked at about 12 d after calving. The evaluation of the model by behavioral and sensitivity analysis revealed that glucose availability played an important role in the development of ketosis. Comparison of model predictions to data from three published studies showed that the model under-predicted glucose concentrations by 9.6% of mean prediction, and over-predicted NEFA and BHBA by 32.6 and 82.7% respectively (p < 0.05). The prediction errors for NEFA decreased as predictions increased (p < 0.05). The model predicts that ketosis in transition cows can result from the homeorhetic states of glucose and fat metabolisms, and from the interaction between these two metabolisms.

Key Words: Mechanistic model, Ketosis, Transition cows


The aim of this work was to evaluate the effect of different feed additives on milk fatty acids (FA) profile of lactating dairy cows fed fresh cut alfalfa pasture. Four late lactating multiparous Holstein cows were used in a 4x4 Latin square design (4 wk periods). The treatments were the following: a controlled diet (Control) with no feed additives; a dietary buffer (DB) 200 g/cow/d comprised of a mix of sodium bicarbonate, magnesium oxide, calcium carbonate and bentonite; antibiotics (M+V), 300 mg monensin + 30 mg virginiamycin per cow per day and a yeast cultures commercial preparation (YC) 15 g/cow/day. A basal diet containing fresh alfalfa (pre-bloom, 16.4% DM, 25.9% CP and 33.9% NDF) was fed ad lib to each cow in individual pens. The alfalfa pasture was cut twice daily and supplied to each cow at 9 a.m. and 5 p.m. Three milk samples of each cow per period were frozen at -20°C. At the end of the trial, milk samples were thawed and mixed as a compound sample by cow per period and analyzed for FA profiles. Lipid extraction was performed according to the Folch method, followed by acid methylation. Fatty acid methyl esters were separated by gas chromatography with a CP-SU 88 capillary column (150m x 0.25 mm i.d.). There were not significant effects (P > 0.05) of the treatments on the milk FA composition. The results are reported as percentage of total FA, as follow:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>MH+ML</th>
<th>MH vs. NL</th>
<th>MH vs. ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake$^1$</td>
<td>140</td>
<td>83</td>
<td>75</td>
</tr>
<tr>
<td>d-39 Liver TG, %DM</td>
<td>1.3 (0.2)</td>
<td>1.8 (0.2)</td>
<td>1.3 (0.2)</td>
</tr>
<tr>
<td>d-32 Liver TG, %DM</td>
<td>16.7 (3.5)</td>
<td>15.3 (3.1)</td>
<td>7.8 (3.8)</td>
</tr>
<tr>
<td>Liver TG Change</td>
<td>15.61 (3.4)</td>
<td>14.2 (3.4)</td>
<td>6.5 (3.8)</td>
</tr>
<tr>
<td>Liver TG</td>
<td>146 (30.8)</td>
<td>279 (31.1)</td>
<td>238 (38.8)</td>
</tr>
<tr>
<td>NEFA, mg/dl</td>
<td>64.6 (1.2)</td>
<td>64.5 (1.2)</td>
<td>68.9 (1.5)</td>
</tr>
<tr>
<td>d-39 BHBA$^2$, mg/dl</td>
<td>3.6 (0.5)</td>
<td>4.2 (0.5)</td>
<td>3.0 (0.6)</td>
</tr>
</tbody>
</table>

Key Words: Phosphorus excretion, Phytase, Lactating cows

M189 Effect of an exogenous phytase enzyme blend and dietary phosphorus content on P excretion in lactating cows. K. F. Knowlton*1, J. M. McKinney1, K. F. Wilson2, and C. Cobb2, 1Virginia Polytechnic Institute and State University, 2Loveland Industries, Inc.

The effect of an exogenous phytase blend and dietary P content on P partitioning and excretion was evaluated in 9 early lactation cows (6 ruminally cannulated; mean = 27 DIM). Cows were assigned to treatments in 3, 3x3 Latin squares. Squares were balanced for residual effects of diet, and each cow received each treatment sequentially in 3, 21 d periods. Diets were 45% forage (all corn silage), 17.3% CP, 25.9% NDF, and 0.95% Ca, and included supplemental P (High P; 0.47%), no supplemental P (Low P; 0.32%), or no supplemental P with exogenous phytase (Low P-phytase; 0.32%). Pre-planned contrasts were used to evaluate the effect of dietary P (High P vs. Low P and Low P-phytase) and phytase addition (Low P vs. Low P-phytase). Total collection of milk, urine, and feces was conducted on d 19-21 of each period. Neither dietary P content nor exogenous phytase affected DMI (21.8 kg/d); milk yield (39.6 kg/d), or milk composition. Excretion of feces (5.85 kg/d; DM and 37.9 kg/d wet) were unaffected by diet, but urine excretion was lower by cows fed the low P diets than cows fed High P (16.5 vs. 21.3 kg/d; P < 0.01). Compared to cows fed High P, cows fed the low P diets had reduced P intake (68.1 vs. 103.9 g/d; P < 0.01), reduced fecal (34.4 vs. 51.3 g/d; P < 0.01) and urinary P excretion (2.8 vs. 9.2 g/d; P < 0.01), and lower P balance (-8.0 vs. 4.4 g/d; P < 0.01). Milk P secretion as a percent of P intake was higher in cows fed the low P diets than in cows fed high P (51.5 vs. 34.9%; P < 0.01). Addition of exogenous phytase did not affect P intake, milk P, fecal P, or urinary P excretion, but apparent P digestibility tended to be higher in cows supplemented with phytase (50.1 vs. 40.5% for Low P-phytase and Low P; respectively; P < 0.11).

Four mid-gestation, ruminally cannulated Hereford cows (629 ± 10.5 kg) were fed, at maintenance, full bloom Timothy hay plus 0% fat (control), 6% beef tallow (T), 6% yellow grease (YG) or 3% T and 3% YG in a 4:0-13:0 were fed, at maintenance, full bloom Timothy hay plus 0% fat (control), 6% beef tallow (T), 6% yellow grease (YG) or 3% T and 3% YG in a 4:0-13:0... 

M192 Leucine metabolism in skeletal muscle of lactating dairy cows. K. A. Cummings* and D. R. Mulvaney, Auburn University, AL.

A study was designed to assess the effect of transition into lactation on skeletal muscle oxidation of branched chain amino acids. Muscle biopsies were taken from the semi-tendinous muscle of 5 multiparous Jersey cows at -14, 5, 50, and 150 DIM. Biopsies were taken under local lidocaine anesthesia. Muscle fibers were separated from surrounding tissue while still attached at each end and held under tension using a system of clips. TriPLICATE samples were then removed from the muscle and incubated in a Krebs-Ringer buffer system containing either 10 mM leucine labeled with carbon 14 at the 1 position or keto-isocaproate (the transamination product of leucine) labeled in the same manner. After 60 min incubation, carbon dioxide released from oxidation of leucine was trapped in KOH, and then carbon dioxide was non-enzymatically cleaved from any keto-isocaproate formed from the action of leucine aminotransferase but not further metabolized. This carbon dioxide was then trapped. The cows were fed corn silage-based TMRs throughout the study that were 16% CP and 1.72 Mcal/kg DM basis until 90 DIM, then 15% CP and 1.66 Mcal/kg DM. Mean production during the study was 5570, 281, and 211 kg of milk, fat, and protein, respectively. Milk production over the entire lactation for the 5 cows ranged from 5198 to 6253 kg. Milk production at 50 and 150 DIM was 27.5 and 21.1 kg/d, respectively. Transamination of leucine was 13, 11.2, 11.3, and 6.7 pMol/mg protein per minute at -14, 5, 50, and 150 DIM, respectively. Subsequent decarboxylation of keto-isocaproate formed from leucine was 2.0, 1.9, 2.1, and 1.2 pMol/mg protein per minute at -14, 5, 50, and 150 DIM, respectively. No differences were found with stage of lactation for either metabolite (P > 0.1). However, decarboxylation of keto-isocaproate provided directly to muscle strips was 7.4, 33.6, 31.5, and 20.5 pMol/mg protein per minute at -14, 5, 50 and 150 DIM, respectively. Onset of lactation resulted in an increase in metabolism of keto-isocaproate (P < 0.1). Skeletal muscle of lactating dairy cows appears to develop the capacity to metabolize large amounts of leucine after the onset of lactation but control mechanisms associated with initial transamination prevent this occurrence.


Three-day drenching strategies of postparturient cows with propylene glycol (PG) have effectively decreased circulating concentrations of NEFA and BHBA during early lactation. Our objective was to determine whether a single-day drench of PG before and at parturition would affect milk yield and circulating BHBA concentrations of dairy cows on commercial dairy farms. Holstein cows (n = 457) on three commercial dairy farms were assigned to a control (no drench) or a PG treatment (500 ml) administered on the day of parturition and the subsequent two days. Performance data were collected during the first four monthly test days of lactation. Milk yield (422 vs. 420 vs. 40.9 kg/d), milk fat percentage (3.52 vs. 3.54%), milk fat yield (1.52 vs. 1.48 kg/d), milk true protein percentage (2.80 vs. 2.84%), and milk true protein yield (1.22 vs. 1.18 kg/d) were not different (P > 0.15) between controls and PG-drenched cows, respectively. A trend (P < 0.15) for a treatment by month interaction existed for body condition score such that cows drenched with PG maintained slightly increased body condition score during early lactation. Concentrations of BHBA in plasma samples collected from each cow during 5 d to 10 of lactation were not different between treatments (8.8 vs. 8.7 mg/dl; P > 0.15). Cows assigned to the two treatments had similar reported incidences of ketosis, milk fever, displaced abomasum, and metritis; however, cows drenched with PG had decreased (P < 0.05) incidence of retained placenta. Overall, results from this experiment indicate that routine short-term drenches with PG beginning at parturition do not affect cow performance and most health variables. Further research should investigate herd-based factors that would be predictive of response to PG.

M194 A commercial blend of essential oil components reduces ruminal degradation of protein supplements in ruminants. R. Molero*, M. Ibarra1, S. Calsamiglia1, A. Ferret1, M. Frehner2, P. Williams3, and R. Losa1, Universitat Autonoma de Barcelona, Bellaterra, Spain, 1 Crina S.A. 2 Akzo Nobel, Gland, Switzerland, 3 Akzo Nobel, Davis, CA.

A proportion of the dietary crude protein (CP) is degraded during its transit through the rumen; thus only the undegraded proportion remains available for direct absorption in the small intestine. Essential oils (EO) can modulate rumen fermentation. In the present experiment (exp), the effect of the feed additive Crina rumins (commercial blend of EO components, BEOC) was estimated in situ on the rumen degradability of different raw materials. In 2 exp, degradation of test materials (TM) was determined after incubation in Dacron bags in the rumen of 4 fistulated Holstein heifers used in a 4 x 4 Latin Square. Treatments were assigned in a 2 x 2 factorial design (diet: exp 1: 15F [85/15, concentrate/straw] or 60F [60/40, alfalfa hay/concentrate] and exp 2: 65F [65/35, forage/concentrate] or 40F [40/60, forage/concentrate]; BEOC: exp 1 & 2: with or without 0.7 g / day of BEOC). Adaptation was 10 and 28 days in exp 1 & 2, respectively, prior to TM incubations. TM (soybean meal, SBM; corn gluten feed, CGF; lupin seeds, LS; green peas, GP; sunflower meal, SFM; fish meal [exp 1] or alfalfa hay [exp 2]) were incubated in the rumen for up to 72 h. Results were analyzed with the PROC MIXED (SAS, 1989) and differences significant at P ≤ 0.05. Exp 1: In heifers fed 15F, CP degradation was lower than in those fed 60F (average 72.8 vs 77.9%). BEOC in 15F reduced CP degradation at 50 and 150 DIM was 27.5 and 21.1 kg/d, respectively. Transamination of leucine was 13, 11.2, 11.3, and 6.7 pMol/mg protein per minute at -14, 5, 50, and 150 DIM, respectively. Subsequent decarboxylation of keto-isocaproate formed from leucine was 2.0, 1.9, 2.1, and 1.2 pMol/mg protein per minute at -14, 5, 50, and 150 DIM, respectively. No differences were found with stage of lactation for either metabolite (P > 0.1). However, decarboxylation of keto-isocaproate provided directly to muscle strips was 7.4, 33.6, 31.5, and 20.5 pMol/mg protein per minute at -14, 5, 50 and 150 DIM, respectively. Onset of lactation resulted in an increase in metabolism of keto-isocaproate (P < 0.1). Skeletal muscle of lactating dairy cows appears to develop the capacity to metabolize large amounts of leucine after the onset of lactation but control mechanisms associated with initial transamination prevent this occurrence.

Key Words: Dairy , Transition, Muscle
of LS (84.6 vs 81.9%), GP (82.2 vs 76.9%) and SFM (80.3 vs 75.8%). There was no effect of BEOC in 60F. Exp 2: In heifers fed 40F, CP degradation of SBM and SFM was lower than in those fed 65F (64.5 vs 69.5% and 82.9 vs 84.1%, respectively). BEOC in the 65F diet reduced CP degradation of SBM (70.8 vs 68.2%) and SFM (85.1 vs 83.0%). The use of BEOC can reduce ruminal degradation of CP from raw material after a 10 day adaptation period when fed a high concentrate diet, or after a 28 day period when fed a high forage diet. Thus the use of BEOC could be economically interesting.

**Key Words:** Bypass protein, Rumen metabolism, Essential oil

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**M195 Methodology for estimation of Volatile Fatty Acid (VFA) kinetics in cattle. X. Markantonatos¹, J.W. Young², R. Tucker², L.F. Richardson³, and G.A. Varga¹. ¹The Pennsylvania State University, ²Elanco Animal Health,

Four rumen cannulated Holstein heifers weighing 380 kg ± 25 kg were used to develop methodology based on $^{13}$C stable isotope to quantify in vivo VFA production in the rumen. Heifers were fed either low (L) concentration (25%) or high (H) concentration (75%) diets at amounts to provide for 0.34 kg/d of BW gain. Isotopic tracers ($^{13}$C-14CO$_2$ or $^{13}$C-glucose) were used for the study. Heifers were fed every 4 h for 2 d followed by 2 h feeding intervals 1 d prior to and the day of sampling. Before tracer administration, cows were restricted from water to keep fluid volume of the rumen as constant as possible. Sampling times were -30, -20, -10, 0, 5, 10, 15, 20, 50, 60, 110, 140, 170, 200, 230, 260, 290, 320, 350, 380, 410, 440, and 480 min relative to initiation of tracer infusions. Tracer VFA concentrations were determined by GLC-mass spectrometry. The reported TTR values for the tracer were corrected (CTTR) for skewness, graphed, and the disappearance TTR for the primary tracer was converted to the natural log form. Endogenous Pool Size (EPS) for acetate (Ac) was significantly higher for the L vs H diet (1.94 moles vs 1.13 moles). However, heifers fed the H diet had a larger EPS for propionate (Pr) (0.21 moles vs 0.33 moles) and the slower rate constant (0.10%/h vs 0.97%/h) for Pr turnover. EPS of butyrate (Bu) was 0.34 moles vs 0.31 (L vs H), while comparable values for rate constant were 0.57%/h vs 0.51%/h, respectively. The plots of CTTR showed that there was only a trace of $^{13}$C transferred to Pr, but no evidence for meaningful transfer from Pr to other VFA. However, CTTR plots suggested a higher incorporation of $^{13}$C into Bu, presumably direct transfer from Ac, and small incorporation of $^{13}$C from Bu back to Ac. Results from the three $^{13}$C-VFA showed that each individual VFA acts kinetically as a single pool in the rumen. The study suggests that $^{13}$C, a stable and non-radioactive isotope, could be used to quantitatively evaluate VFA production of the three major VFA in cattle.

**Key Words:** $^{13}$C stable isotope, VFA kinetics

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**M196 Effects of supplemental amylase on in vitro fermentation by mixed ruminal cultures and the growth of pure cultures of ruminal bacteria. J. M. Tricario¹ and A. E. Kazenski, Alltech Biotechnology Inc. Nicholasville KY.

A series of studies was performed to evaluate the effects of a supplemental enzyme preparation containing amylase activity on fermentation of feed by mixed ruminal cultures and the growth of pure cultures of representative strains of ruminal bacteria. The addition of 60.0 units amylase to BEOC can reduce ruminal cultures fed a 30% forage-70% concentrate diet reduced the molar proportion of propionate (0.305 vs 0.291, P<0.05) and increased the molar proportion of butyrate (0.180 vs 0.206, P<0.05) after supplementation for 72 h and 96 h, respectively. Total VFA concentrations, molar proportion of acetate and pH did not differ in control or enzyme-supplemented cultures during the 5 d supplement period. Growth of Butyrivibrio fibrisolvens strains D1, 49, and A38, Streptococcus bovis strain S1, Megasphaera elsdenii strain T81, and Selenomonas ruminantium strain GA192 was evaluated on pure cultures incubated anaerobically on medium 10 broth containing 1 g L$^{-1}$ soluble potato starch. Enzyme treatment was applied immediately prior to bacterial inoculation to provide a final concentration of 60.0 units amylase L$^{-1}$. Microbial growth was estimated in each culture by measuring turbidity (600 nm) over time. The addition of supplemental amylase enhanced the growth rates of Butyrivibrio fibrisolvens strain D1 (0.007 vs 0.168 ODh$^{-1}$, P<0.05), Selenomonas ruminantium strain GA192 (0.004 vs 0.085 ODh$^{-1}$, P<0.05) and *Megasphaera elsdenii* strain T81 (0.012 vs 0.036 ODh$^{-1}$, P<0.05).

Supplemental amylase had no effects on the growth rates of *Streptococcus bovis* strain S1 and *Butyrivibrio fibrisolvens* strain 49 and reduced the growth rate of *Butyrivibrio fibrisolvens* strain A38 (0.131 vs 0.076 ODh$^{-1}$, P<0.10). We conclude that low concentrations of supplemental amylase enhanced growth of specific strains of ruminal bacteria and may be used to manipulate ruminal fermentation.

**Key Words:** Ruminant, Enzyme, Amylase

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**M197 Oxidation of glucose, glutamate, and glutamine by isolated ovine enterocytes in vitro is decreased by presence of other metabolic fuels. M. Obá¹, R. L. Baldwin², IV, and B. J. Bequette³. ¹Department of Animal and Avian Sciences, University of Maryland, College Park, MD, ²Bovine Functional Genomics Laboratory, ANRI, USDA-ARS, Beltsville, MD.

The objective of this study was to evaluate oxidative metabolism of glucose, glutamate, and glutamine by isolated ovine enterocytes in presence of other metabolic fuels in vitro. Mucosal enterocytes were isolated from crossbred wether sheep (n=6) fed a mixed forage-concentrate diet, and incubated for 90 min with 1 mM U-14C-glucose, -glutamate, or -glutamine and alternative substrates (AS) water as negative control, acetate, propionate, butyrate, glucose, glutamate, or glutamine) at concentrations of 0.1, 1.0, and 10.0 mM. Oxidation of labeled substrates to CO$_2$ and net production of lactate and pyruvate in incubation media were measured. Oxidation of glucose and glutamate to CO$_2$ was decreased by all AS except acetate, and the extent of reduction differed by type and concentration of AS in incubation media. Our observations that glutamine oxidation can be reduced by presence of AS is contrary to observations in the literature using enterocytes from non-ruminants, indicating that ruminant enterocytes might rely on glutamine to a less extent as an energy source. Total glucose utilization was reduced by propionate (10 mM) by 16% compared to control, but was not affected by other AS. Glutamate oxidation to CO$_2$ was reduced by the presence of propionate (10 mM) or glutamine (1.0 and 10 mM), but not by that of the other AS. Acetate did not affect oxidation of glucose, glutamate, and glutamine. Propionate reduced oxidation of glucose and glutamate only at the highest concentration (10 mM), indicating that the sparing effects of propionate on substrate oxidation is affected its concentration in the incubation media. These observations indicate that ruminant enterocytes can alter substrate preference for oxidative metabolism depending on type and concentration of available AS.

**Key Words:** Sheep, Enterocytes, Oxidative metabolism

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**M198 Effects of urea and ammonia treatment on nutritive value of corn silage. A. Davtalabzaghri, R. Valizadeh, and A. Naserian, Ferdowsi University of Mashhad, Khorasan, Iran.

Corn crop as a high energy cereal is cultivated and largely used in form of silage in Iranian dairy industry. Ammonia treatment has resulted: a) an economical source of crude protein b) Prolonged bunk life during feeding c) Less moulding and d) decreased protein degradation in silo. The objective of this experiment was to determine the effect of urea and ammonia treatment on the nutritive value of corn silage. Corn crop was harvested, chopped (2-5cm) from the Ferdowsi University Dairy Farm in September. Poly-propylene containers with capacity of 1-2 kg were used for the following treatments: a) The control (corn silage) b) corn silage + 0.7Corn silage + 0.4crop, mixed manually and filled into the silos with aid of a hydraulic tool. Ammonia was injected in equivalent amount of N H$\textsubscript{Cl}$. The pH of forages was increased up to 9 following treatment with urea and ammonia while the pH of control was 6.2. pH of treated silages was determined immediately. Dry matter, Crude Protein,ADF, NDF were measured by the methods of AOAC (1984). Ammonia$-$N was measured with sodium tetraborate (16g/L) and titrated with 0.1 N HCl. The pH of forages was increased up to 9 following treatment with urea and ammonia while the pH of control was 6.2. pH of treated silage remained higher at subsequent samplings. There were no significant differences between DM, ADF, NDF in different treatments and each time point. CP and N-NH$_3$ were significantly higher (P<0.01) in treated silages.

**Key Words:** Ammonia and urea, Nutritive value, Corn silage

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M199 Determining the relationships among milk urea nitrogen and milk production and milk components from lactating dairy cows in Texas. G. M. Goodall*, 1 M. A. Tomaszewski2, D. A. Knabe2, R. B. Schwartz2, J. W. Stuth3, and L. W. Greene3, 1 Goodall’s Consulting, College Station, TX/USA, 2 Texas A&M University, College Station, TX/USA, 3 Texas A&M Research and Extension Center, Amarillo, TX/USA.

The objectives of this study were to determine the relationship between milk urea nitrogen (MUN) and milk production, milk protein, and milk fat of lactating cows and to determine the feed cost benefit of using best management practices (BMP) to reduce excess nitrogen in the diet of dairy cows in Texas. The BMPs were routine analysis of the formulated diet and MUN testing. There were two feeding systems evaluated, grazing herds and total mixed ration (TMR) fed herds. There were 16102 individual cow records that were evaluated. Milk fat did not impact MUN concentration (P > 0.05) in either the grazing or the TMR fed herds. Milk production, lactation number, herd effects and test date significantly impacted (P ≤ 0.05) MUN concentration. The economic advantage of routine testing of MUN concentration and analyzing the diet was a daily feed cost savings of $2.42/cow.

Key Words: Milk urea nitrogen, Dairy cattle, Ration cost


One hundred-twenty Rambouillet feeder lambs with a mean initial body weight of 29.5 kg were used to compare the effects of double and single implanting Zeranol hormonal implants and no-implanting on lamb performance (average daily gain and feed to gain ratio) and carcass characteristics. The lambs were blocked by sex and randomly assigned to three treatments: no implant (treatment 1), single implant (treatment 2), and double implant (treatment 3). Lambs had ad libitum access to feed and water. On d 0, lambs were weighed, vaccinated for overeating, dewormed, and those lambs in treatments 2 and 3 were implanted. Lambs in treatment 1 were re-implanted on d 56. On d 28, 56, 84, and 112, lambs were weighed and slaughtered when end weights of 54 kg were reached. Backfat thickness, leg circumference, hot carcase weight, United States Department of Agriculture (USDA) yield and quality grades were recorded, and dressing percentage and calculated yield grade (CYG) were calculated. Average daily gain (ADG) was higher (P < 0.05) for treatments 2 and 3 versus non-implanted lambs on d 28, 56, 84, and overall. Days on feed for treatment 2 and 3 was lower (P < 0.05) than non-implanted lambs, and feed to gain ratio was reduced (P < 0.05) in both implanted lamb treatments on d 56, 84, and overall. No differences in hot carcase weight, backfat thickness, leg circumference, yield grade, and calculated yield grade were noted, but double implanted lambs had a lower (P < 0.05) dressing percentage. Treatment 3 ewe lambs had a lower (P < 0.05) percentage of choice grade carcasses and higher (P < 0.05) percentage of no grades than other treatments. Also, treatment 2 and 3 wether lambs had a higher (P < 0.05) value and profit margin than implanted ewes and control lambs based on actual purchase price, feed cost and carcass value.

Key Words: Lambs, Feedlot performance, Zeranol implants


An experiment was conducted to attempt to determine the rate of rumen papillae change when dairy cattle are exposed to diets containing higher levels of grain. Rumen canulas were placed into four Holstein heifers during their seventh month of gestation. Papillae absorption studies were conducted when heifers were fed the bred heifer ration, weekly for five weeks when fed the pre-freshening ration, and weekly for five weeks following freshening when fed the fresh cow ration. Papillae were biopsied at most of these same time periods. Biopsied rumen papillae were evaluated histologically; additionally, their size was determined with an image analyzer. A solution containing 1.9 g of Co-EDTA and 2 moles of valeric acid, diluted to 8.1 with and its pH raised to 6.0 with approximately 40 g of sodium hydroxide, was ruminally infused. Rumen fluid was then sampled at half-hour intervals over an 8 h time period. Valerate absorption was estimated by subtracting the ruminal clearance rate of cobalt from valerate.

Ruminal valerate absorption rates significantly increased during the pre-freshening period, with rates increasing over the entire five week time period. Changes in papillae surface area during the prefresh period were less clear. Histologically, the epithelium became thinner during this time period. There was considerable variation in all measurements for all animals during the five week post-fresh period. This variation may have been caused by health problems associated with freshening and the transition period. The epithelium increased in keratinization, and had a reduction in keratinizedy granules, during this time period. In conclusion, papillae absorptive capacity increased when animals were switched from the bred heifer to the prefresh ration. Both were balanced according to the 2001 Dairy NRC. The change in absorption rate occurred during the entire five week prefresh period. There were no clear trends in the measured papillae characteristics post-freshening, possibly due to transition health problems. Progress made in increasing papillae size and absorptive capacity during the prefresh period can be rapidly undone during the post-fresh period.

Key Words: Rumen papillae, Dairy cattle

M202 Nitrogen, phosphorus, and other minerals in Idaho dairy diets. A. N. Hristov*, R. P. Etter1, A. Melgar1, J. I. Szasz1, K. L. Grandeen2, S. Abedi1, J. K. Ropp1, D. Falk1, W. Hazen2, and R. Ohlenshie1, 1Department of Animal and Veterinary Science, 2Department of Animal and Veterinary Science, 3Department of Animal and Veterinary Science, 4Department of Animal and Veterinary Science, 1Texas A&M University, College Station, TX/USA, 2Texas A&M University, College Station, TX/USA, 3Texas A&M Research and Extension Center, Overton, TX/USA, 4Texas A&M University, College Station, TX/USA, 5Texas A&M University, College Station, TX/USA, 6Texas A&M University, College Station, TX/USA.

Rations from 21 dairy farms in South-Central Idaho were analyzed for mineral composition. Total number of cows fed in the participating dairies was approximately 31,000. Separate diets were fed to the fresh and lactating cows. Four samples per dairy were taken within a period of 4 months and analyzed for P, Ca, Mg, S, Na, Cu, Fe, Mn, and Zn. Bulk tank milk samples were analyzed for milk urea N (MUN) concentration. Average mineral content of the fresh cows diets was (DM basis, meanSE, min and max): 3.170.034%, 2.49 and 3.59% (N); 0.410.006%, 0.31 and 0.53% (P); 1.000.026%, 0.57 and 1.26% (Ca); 1.760.034%, 1.25 and 2.20% (K); 0.350.006%, 0.28 and 0.42% (Mg); 0.360.008%, 0.24 and 0.58 (S); 0.400.023%, 0.14 and 0.65% (Na); 21.7090 ppm, 9.1 and 33.1 ppm (Cu); 224.0103 ppm, 73.3 and 408.6 ppm (Fe); 60.1246 ppm, 33.2 and 94.2 ppm (Mn); and 99.86.8 ppm. Due to transition health problems. Progress made in increasing papillae size and absorptive capacity during the prefresh period can be rapidly undone during the post-fresh period.

Key Words: Phosphorus, Minerals, Dairy diets

M203 Pasture performance, feedlot gain, and carcass traits of Romosinuano crossbred, F-1 (Hereford x Brahman), and Brahman steers. F. M. Rouquette, Jr.1, R. D. Randel1, C. C. Long1, C. C. Chase, Jr.1, J. C. Paschal2, and R. K. Miller2, 1Texas A&M University Agricultural Research & Extension Center, Overton, TX/USA, 2Texas A&M University, College Station, TX/USA, 3Texas Cooperative Extension, Corpus Christi, TX/USA.

Romosinuano (ROMO) are tropically-adapted, non Bos indicus which are native to Columbia, SA, and were imported into the US in the mid-1990s by USDA at Brooksville, FL (STARS). Three ROMO sires developed from STARs were bred to F-1 Angus x Brahman, (A x B) dams.

The fall-born, half-ROMO (ROMX) steers (n=43) were grazed on rye-grass and clover pre-weaning. Steers had average birth weight of 35 kg, average height, and average age at weaning of 1.22 kg/d. Final weight of HXB steers (606 kg) was heavier (P<0.001) feedlot ADG with ROMX at 1.46 kg/d, HXB at 1.75 kg/d, and BRM at 1.22 kg/d. Final weight of HXB steers (606 kg) was heavier (P<0.01) than both ROMX (563 kg) and BRM steers (540 kg). Steers had similar dressing percent (63.7%), backfat (1.08 cm), marbling score (426), and age quality grade (700). The ROMX steers tended (P<0.08) to have better yield grade (2.53) compared to both HXB (2.90) and BRM (2.88). Warner-Brazier shear values showed that ROMX at 3.33 kg were less (P<0.02) than those of BRM (3.79 kg); whereas HXB steers were similar to both ROMX and BRM. Cooking loss was similar for ROMX (26.8%) and HXB (27.4%), and both were less than BRM (32.6%) steers.

Key Words: Rosomünano, Carcass, Feedlot


Twenty five Holstein and 27 Jersey cows were assigned 21 days before parturition to a randomized complete block design (parity and expected calving date) in a 2 X 3 factorial arrangement to evaluate the influence of three dietary cation-anion differences (DACD = +21, -5 and -3 meq (Na + K)/ (Cl + S) per 100 g diet DM) on urinary pH, serum Ca, K, Cl, and Na levels; milk yield in the first month of lactation and milk fever incidence. Prepartum basal diet (DACD = +21) contained (DM basis) 50.7% corn silage, 8.4% alfalfa hay, 8.2% oat hay, and 32.9% protein, minerals and vitamins supplement. Two low DACD diets (DACD = -5 and DACD = -3) were evaluated including 0.93% NH4Cl or 1.4% CaCl2 to the basal diet. Urine and blood samples were collected before treatments, within the 21 d before parturition and postpartum. There was no difference (P>0.05) between breeds in urinary pH and minerals serum levels throughout the trial and results were pooled to analyze diet effects. Serum Na and K levels at parturition were 378, 346 and 348 mg/dL (P<0.05) and 19.0, 16.8 and 21.3 mg/dL, respectively for cows receiving diets having DACD of +21, -5 and -3. Serum Cl level (mg/dL) reduced (P<0.05) at parturition for cows receiving DACD of +21 (348 mg/dL) and -5 DACD = -3 (394 mg/dL), but not for diets with DACD = -3 (454 mg/dL). Two Holstein cows presented milk fiver on diet with DACD = -5, and 4 cows (3 Holstein and 1 Jersey) fed with DACD = -5 diet retained placenta. There was a trend (P=0.14) for higher milk yield during the first month of lactation for cows fed basal diet (34.6, 31.5 and 30.4 Kg/d), for DACD = +21, -5, and -3, respectively. Diets with low DACD lowered urinary pH but had high incidence of milk fever and placenta retention.

Key Words: Dietary cation-anion difference, Urinary pH, Periparturient cow

M205 A field study of milk production and reproductive performance in dairy cows fed different levels of phosphorus. J. Fiorini1, L. D. Chase2, K. F. Knowlton3, Z. Wu1, and Z. Dou1.

On many dairy farms, long-term manure application has led to phosphorus (P) buildup in soils with enriched P losses from these soils to waters. One cost-effective approach to reduce potential P loss and improve water quality is to minimize manure P excretion through manipulation of dietary P to a level that equates with the actual needs of the lactating cow. Currently, P is being fed on many farms at levels that exceed requirements necessary for optimal performance, due largely to concerns of possible negative impact on milk production and reproductive performance if dietary P is reduced. This USDA funded project was initiated to collect and analyze data from commercial dairy operations in five states in the NE and Mid-Atlantic region (PA, NY, DE, MD, VA). A total of 100 herds were selected, these were visited on a quarterly basis. During each visit, feed and fecal samples were collected and subsequently analyzed in laboratories. Milk yields and reproductive parameters were also obtained quarterly from the respective DHIA records. Feed evaluation results showed dietary P levels ranging from 0.35% to 0.64% dry matter (DM). The farms were sorted into three groups according to their dietary P concentrations: low (0.35 to 0.40% P), medium (0.40 to 0.45), and high (0.45). Preliminary data analysis indicated that there were no statistically significant differences between any of the groups for the following reproductive parameters: conception rate, heat detection rate, pregnancy rate, days to first breeding, and days open. Also, milk production did not correlate with dietary P. In conclusion, results to date of this field project indicate that feeding dietary P in excess of 0.35% P does not enhance milk production or reproductive performance in lactating dairy cows.

Key Words: Phosphorus, Reproduction, Production


A collaboration by academic and industry participants assessed whole farm nitrogen (N) and phosphorus (P) efficiencies on seven Vermont dairy farms. Whole farm efficiency was calculated as ((exported milk + livestock + forage N or P)/ (imported bedding + forage + livestock + N fixation + fertilizer + manure + concentrate N or P))100. Feed nutrient efficiency represents ((retained nutrients in milk + tissue) / nutrient intake)*100. Crop N and P balance was calculated as (available nutrient supply from manure, soil, sod, and fertilizer) - (calculated requirement based on soil type, analysis and yield goal (where applicable)). Biweekly (weekly on one farm) data collection and diet evaluations by lactating group were made using Cornell Net Carbohydrate and Protein System v4.0.31 (CNCS) with intakes determined by two-day measured fed minus refused amounts; pasture intakes were CNCS predictions. Measured inputs for each CNCS simulation included milk production and components (monthly DHIA), silage and pasture analyses (NIR, wet chemistry minerals, n= simulation frequency), and ingredient analyses (n=variable). Results, weighted by cow days per diet or field, are tabulated below. Variation across and within farms suggests potential to improve efficiency of nutrient use.

Key Words: Nitrogen, Phosphorus, Efficiency
M207 Supplementation of FEB-200™ to Alleviate Endophyte Toxicosis in Steers. V. Akay1, M. Foley1, J. A. Jackson2, M. Kudupu1, and K. A. Dawson1. 1Alltech Biotechnology, Inc., Nicholasville, KY, 2University of Kentucky, Lexington, KY.

Twelve Holstein steers (240 to 324 kg) were blocked by body weight and assigned to one of four treatments to investigate the effects of FEB-200™ (modified glucomannan, Alltech, Inc., Nicholasville, KY) on the symptoms of fescue toxicosis in steers fed endophyte-infected (EI) or endophyte-free (EF) forage. Each steer received 1 kg of forage (18% dry matter) per day. All feeds and refusals were weighed and recorded daily. For each steer, serum prolactin and alkaline phosphatase levels were lower ($P_{<0.05}$) than the EF diet throughout the study. This study suggests that the use of FEB-200™ may alleviate some of the endophyte toxicosis associated with consumption of EI fescue.

Key Words: Endophyte, Modified glucomannan, Steers

M208 Influence of previous cattle and elk grazing on the subsequent quality and quantity of diets for cattle, deer and elk grazing late-summer mixed-conifer range-lands. D. Damiran1*, T. DelCurto1, S. L. Findahl2, G. D. Pulsipher3, and B. K. Johnson4, 1Eastern Oregon Agricultural Research Center, Oregon State University, University, 2Oregon Department of Fish and Wildlife, La Grande.

A study was conducted to determine foraging efficiency of cattle, mule deer, and elk in response to previous grazing by cattle and elk. Previous enclosures, in previously logged mixed conifer (Grand Fir) rangelands were chosen, and within each enclosure, three 0.75 ha pastures were either: 1) ungrazed; 2) grazed by cattle, or 3) grazed by elk in mid-June and mid-July to remove approximately 40% of total forage yield. After grazing treatments, each pasture was subdivided into three 0.25 ha sub-pastures and 16 (4 animals and 4 bouts/animal) 20 min grazing trials were conducted in each sub-pasture using four steers, four tame mule deer, or four tame elk during August 1998 and 1999. A bite-count technique was used to determine foraging efficiency and composition of diet. Crude protein content of elk diets were not influenced ($P_{>0.10}$) for EI diet compared to EF diet. Addition of FEB-200 to EI diet increased ($P_{<0.05}$) DM intake compared to EI diet without FEB-200. In response to cattle grazing, steer and elk consumed more grasses and sedges; whereas elk consumed more ($P_{<0.05}$) grasses and shrubs. Kentucky bluegrass was the most prevalent forage species followed by forbs, grass-like (sedges and/or rushes), and shrubs. The highest percent disappearances of forage species was (83.7 - 92.7%) observed with quackgrass, western fescue, California brome, redtop, and heartleaf arnica. Though their initial contributions to the available forage were less than 5%. Timothy, elk sedge, red clover, and common snowberry were also preferred species and major components of the available vegetation. High levels of shrub utilization were observed from 20 through the end of the grazing period (45% for willow and 59% for alder). Forbs and shrubs did not vary in moisture content over the 30 d grazing period and across the years averaging 59% and 61%, respectively ($P_{>0.10}$). In contrast, the moisture content of grasses were over 50% at the beginning of the grazing period and declined to 34% by d 20. Likewise, forbs and shrubs were higher than grasses in CP (11, 14, and 6%, respectively) across the years averaging 59% and 61%, respectively ($P_{>0.10}$). Addition of FEB-200 to EI diet decreased ($P_{<0.05}$) recalc temperatures compared to EI diet without FEB-200 (39.56 vs 40.11°C). Rectal temperatures were similar ($P_{>0.10}$) among EI+FE-200, EF and EF+FEB-200 diets. In conclusion, dietary supplementation of FEB-200 to cattle maintained on EI fescue may alleviate some of the endophyte toxicosis associated with consumption of EI fescue.

Key Words: FEB-200, Crude protein, Diet quality

M209 Changes in Forage Quantity and Quality with Continued Cattle Grazing in a Mountain Riparian Pasture. E. Darambazar1*, T. DelCurto1, C. J. Ackerman2, G. D. Pulsipher1, and D. Damiran1, 1Eastern Oregon Agricultural Research Center, Oregon State University, University, 2Department of Animal Sciences, Oregon State University, Corvallis.

The objective of this study was to evaluate changes in the quantity, quality, and moisture of available forage in a riparian pasture, and shrimp utilizing cattle during summer grazing period. A riparian pasture (44.7 ha) in northeast of Oregon was grazed with 30 yearlings (491 kg, BCS = 5.05) and 30 mature cows with calves (499 kg, BCS = 4.65) from early August to early September in 2001, and from late July to late August in 2002. Sampling dates were d0, d10, d20, and d30. The forage availability before grazing was 1058 kg/ha and declined to 323 kg/ha at the end of the grazing period ($P_{<0.01}$). Grasses dominated the pasture, followed by forbs, grass-like (sedges and/or rushes), and shrubs. Kentucky bluegrass was the most prevalent forage species followed by timothy, sedges, and common snowberry. The highest percent disappearances of forage species was (83.7 - 92.7%) observed with quackgrass, western fescue, California brome, redtop, and heartleaf arnica, though their initial contributions to the available forage were less than 5%. Timothy, elk sedge, red clover, and common snowberry were also preferred species and major components of the available vegetation. High levels of shrub utilization were observed from d 20 through the end of the grazing period (45% for willow and 59% for alder). Forbs and shrubs did not vary in moisture content over the 30 d grazing period and across the years averaging 59% and 61%, respectively ($P_{>0.10}$). In contrast, the moisture content of grasses were over 50% at the beginning of the grazing period and declined to 34% by d 20. Likewise, forbs and shrubs were higher than grasses in CP (11, 14, and 6%, respectively) and IVDM (58, 49, and 42% respectively). In summary, our results suggest that cattle grazing late summer riparian pastures will switch to intensive shrub utilization when grasses decline in quality and quantity, and forbs decline in quantity.

Key Words: Riparian areas, Cattle, Utilization


Effects of whole corn versus cracked corn on the performance of growing-finishing Angus bulls in a 112-d growth study was conducted at the Angelo State University, Management, Instruction and Research Center in San Angelo, Texas. Forty spring-born Angus bull calves with an average weight of 317 kg were used. Bulls were blocked by live weight and divided into 8 pens (4 pens/treatment). Bulls were fed nutritionally identical diets containing either cracked or whole corn by hand to provide ad libitum consumption throughout the trial. Rations were formulated to meet or exceed nutritional requirements of growing finishing bulls. Chromium oxide was added to the rations as a marker for DM digestibility estimates. Bull weights and fecal samples were collected every 28 d. All feeds fed and refusals were weighed and recorded daily. Ration DM digestibility of cracked and whole corn diets was similar. Average daily gain and intake over the entire trial were similar for bulls fed whole or cracked corn. However, feed efficiency over the entire trial was improved with the whole corn diet. Data from this study indicate that cracked corn processing will not improve performance of growing bulls fed nutritionally similar diets with whole corn.

Key Words: Bulls, Performance, Corn

M211 Validation of a prediction equation for energy balance in Holstein cows and heifers. J. D. Brixey1, M. A. McGuire, and W. J. Price, 1University of Idaho.

Cows undergo substantial changes in energy balance (EB) during the transition from dry to lactating. An understanding of EB on animal health and production requires the ability to predict EB in animals without individual feeding. The aim of this study was to validate a theoretical prediction equation for EB in early lactating dairy cows. Fourteen cows and five heifers were assigned to 4 dietary treatment groups for individual feeding from 21 d prepartum until 70 d postpartum. Daily intakes and milk yields, biweekly composition, weekly body weights and
blood samples were collected. Blood was analyzed for NEFA concentrations. Energy balance was determined by the cows NEL intake minus the sum of NEL for maintenance and the NEL for milk output (NRC, 2001). The model (EB = -3.34 – 0.009×NEFA + 0.341×DIM - 0.002×DIM²) was developed previously in multiparous cows and subsequently used to predict EB in both cows and heifers. Cows and heifers reached nadir EB 5 to 10 DIM and reached positive EB by 18 to 23 DIM while increasing in DMI and milk yield. Cows reached peak milk production of 56 kg at 44 DIM, where heifers peaked at 57 DIM yielding 45 kg. For both cows and heifers, the model validation followed observed EB trends well. However, for cows the model did under predict EB over DIM and NEFA values. Clearly there is a demand for energy in early lactation where the cow is mobilizing body reserves. Understanding the significance of EB on animal health requires large animal numbers such that an indirect estimation of EB is needed. The prediction equation for EB after more extensive validation may provide the tool.

Key Words: transition, energy balance

M212 Incidence of Escherichia coli O157:H7 contamination in fecal, wool, and carcass samples from feedlot lambs. M. Long*, T. T. Ross¹, T. Edrington², J. D. Thomas¹, and K. Christensen¹,¹ New Mexico State University, 2 USDA ARS.

The present study examined the incidence of E. coli O157:H7 in feedlot lambs on the farm and at slaughter. We hypothesize that E. coli O157:H7 is prevalent in feces and on the pellet of feedlot lambs and the feces and pelt pose a potential source of carcass contamination. Fecal, wool, and carcass samples were examined for E. coli O157:H7 to evaluate potential carcass contamination sources. All fecal samples were enriched in a gram-negative broth prior to immunomagnetic separation and enrichment using anti-E. coli O157 antibody-labeled paramagnetic beads (Dynabead anti-E. coli O157, Dynal Inc., Lake Success, N.Y.). Wool and carcass swab specimens were enriched with sterile brilliant green bile 2% broth. Enrichments were plated onto a sorbitol MacConkey plate containing cefixime and potassium tellurite. Three sorbitol-negative colonies exhibiting typical E. coli colony phenotype were selected and cultured in MacConkey broth and tryptic soy broth. Broth cultures were heat killed at 100 °C and tested with an enzyme immunoassay for reactivity with anti-E. coli O157 monochonal antibody. A greater number of wool samples tested positive for E. coli O157:H7 than fecal samples. Of the eighteen wool samples, ten samples (56%) tested positive for E. coli O157:H7. Of the thirty fecal samples, twelve (40%) were positive for E. coli O157:H7. However, all carcass samples were negative for E. coli O157:H7 contamination. In conclusion, wool and fecal samples tested positive for E. coli O157:H7 and may be a potential source of carcass contamination. Furthermore, a positive wool sample did not always correlate with a positive fecal sample. This indicates that one animal shedding E. coli O157:H7 in its feces could contaminate the wool of multiple animals in the same pen and thereby increase the chance for carcass contamination. Additional research is needed to determine if E. coli O157:H7 was not transferred to the carcasses or if current techniques are unable to recover E. coli O157:H7 from the carcass.

Key Words: E. coli O157:H7, Feedlot lambs, Carcass

Forages & Pastures: Silages, forage supplementation

M213 In vitro dry matter digestibility and fermentation characteristics of sawdust-wheat bran mixtures fermented by Aspergillus oryzae, Formitella fraxinea, and Sarcodon aspratus. Y. K. Kim¹ and D. J. Schingoethe²,¹ Chungnam National University, Chungnam, Republic of Korea, 2 South Dakota State University, Brookings.

The objective of this research was to determine the effect of fermentation by the mycelia of fungal species Aspergillus oryzae, Formitella fraxinea and Sarcodon aspratus on the in vitro dry matter digestibility and fermentation characteristics of mixtures containing sawdust plus 20% wheat bran w/w, on a dry matter basis, as a means to recycle sawdust including fungal mycelium into a feedstock. The mixtures were unfermented (UFM) and fermented by Aspergillus oryzae (AOM) for 3 d and by Formitella fraxinea (FFM) and Sarcodon aspratus (SAM) for 2 wk at 29 °C in an incubator. Neutral detergent fiber (NDF) contents in mixtures were lower for SAM and UFM (80.4 and 82.2%) than for FFM and AOM (88.3 and 86.9%) (P < 0.05). In vitro DM digestibility after 48 h was higher for SAM (21.2%) than for UFM, AOM and FFM (17.9, 14.9, and 12.2%) (P < 0.05). The average pH was lower for SAM (6.44) than for UFM, AOM and FFM (6.87, 7.01, and 7.34) after 48 h of fermentation (P < 0.01). Concentrations of sugar in fermented fluid after 48 h were higher for SAM (0.71%) than for AOM, FFM and UFM (0.34, 0.31 and 0.27%) (P < 0.01). Concentrations of acetate and propionate (mole/100 mole) were higher for SAM (54.21 and 19.04) than for UFM (34.06 and 11.08), UFM (17.94 and 7.96) and FFM (10.31 and 4.96) (P < 0.05). Concentrations of butyrate were not different between SAM and UFM. It was concluded that the sawdust-wheat bran mixture fermented by Sarcodon aspratus (SAM) increased the DM digestibility of the mixture and improved the production of VFA in fermented fluid of the mixture compared with unfermented and fermented mixtures by other fungal species.

Key Words: Fungal fermentation, In vitro DM digestibility, In vitro fermentation characteristics

M214 Nutrient content and protein quality in grass silages. W. Heimbeck¹, M. Coenen², K. Suedekum³, L. Hogebrock², S. Hoeppken², and K. Eicken¹,¹ Degussa AG, Feed Additives, Hanau, Germany, ²School of Veterinary Medicine, Hannover, Germany, ³Christian-Albrechts University, Kiel, Germany, ⁴Veterinarian Practice, Ovelgoenne, Germany.

The quality of grass silage varies depending on botanical composition, harvesting conditions and the ensiling process. The protein fraction of grass silages may be subject to deterioration during storage. The goal of the present investigation was to study changes in the protein quality of silage during a complete winter season (October through March). Samples of grass silages, produced according to common practice, were obtained from 11 farms in Northern Germany in four week intervals and analyzed for major nutrients. Furthermore, the N-fraction was differentiates into true protein, amino acids, non-differentiable and indissoluble nitrogen. On average, pH of silages was 5.2, lactic acid varied between 1.2 and 133 mmol/kg, while acetic acid averaged 95 mmol/kg. The range for dry matter (DM) contents of the silages was between 232 and 788 g/kg, while crude fiber varied between 227 and 330 g/kg DM. Mean crude protein was 203 (130-282) g/kg DM. True protein was on average only 50% of CP (39-163 g/kg DM). In some samples, the percentage of crude protein that was true protein was less than 30%. This corresponds to the analyzed total amount of protein-bound amino acids in the silages. The low proportion of true protein in crude protein, and the corresponding lower amino acid content, mean that the real protein supply arriving at the intestine can be quite low for cows eating high quantities of such grass silages. Because of the variation in true protein and amino acids in grass silages, the non-differentiated data for rumen degradability (UDP) in feeding tables, as well as assumptions about degradability for dynamic models, seems to be questionable and may not reflect the real quantity of protein which is available at the small intestinal level.

Key Words: Grass silage, Protein quality, True protein


Treating silages with Lactobacillus buchneri are more stable when exposed to air because lactic acid is converted to acetic via a novel pathway. However, excessive production of acetic acid in silage could be detrimental and thus the objective of this study was to determine the effect of time of ensiling and effect of L. buchneri on fermentation profile of alfalfa silage. Wilted alfalfa (40% DM) was either untreated (U) or treated with L. buchneri 40788 (Lallemand Animal Nutrition, Milwaukee, WI, 400,000 cfu/g of fresh forage) (T) and ensiled in triplicate. Silages were harvested conditions and the ensiling process. The protein fraction of alfalfa silage is subjected to deterioration during storage. The goal of the present investigation was to study changes in the protein quality of silage during a complete winter season (October through March). Samples of grass silages, produced according to common practice, were obtained from 11 farms in Northern Germany in four week intervals and analyzed for major nutrients. Furthermore, the N-fraction was differentiates into true protein, amino acids, non-differentiable and indissoluble nitrogen. On average, pH of silages was 5.2, lactic acid varied between 1.2 and 133 mmol/kg, while acetic acid averaged 95 mmol/kg. The range for dry matter (DM) contents of the silages was between 232 and 788 g/kg, while crude fiber varied between 227 and 330 g/kg DM. Mean crude protein was 203 (130-282) g/kg DM. True protein was on average only 50% of CP (39-163 g/kg DM). In some samples, the percentage of crude protein that was true protein was less than 30%. This corresponds to the analyzed total amount of protein-bound amino acids in the silages. The low proportion of true protein in crude protein, and the corresponding lower amino acid content, mean that the real protein supply arriving at the intestine can be quite low for cows eating high quantities of such grass silages. Because of the variation in true protein and amino acids in grass silages, the non-differentiated data for rumen degradability (UDP) in feeding tables, as well as assumptions about degradability for dynamic models, seems to be questionable and may not reflect the real quantity of protein which is available at the small intestinal level.

Key Words: Grass silage, Protein quality, True protein

concentration of lactic acid in U (4.55 vs. 3.77%). The concentration of acetic acid was dramatically greater in T (6.85%) vs. U (2.05%), whereas the concentration of water-soluble carbohydrates was greater in U (1.43%) than for T (0.43%). In conclusion, treating alfalfa silage with L. buchneri 40788 increased the concentration of acetic acid by degrading lactic acid and the time of ensiling did not impact the quality of alfalfa silage treated with L. buchneri 40788.

Key Words: Lactobacillus buchneri, Silage, Fermentation


Some studies have shown that the increase in acetic acid in silage from Lactobacillus buchneri does not occur until after 4 to 6 wk of ensiling. In addition, the aerobic stability of silages treated with L. buchneri in the field has been observed, by some, as being worse when compared to untreated silages. Therefore, the objective of this study was to determine the effect of a microbial inoculant, containing L. buchneri, on the fermentation and aerobic stability of corn silage during the early stages of ensiling. Whole plant corn (37%) DM was ensiled in triplicate 20-L laboratory silos for 14, 28, 42, and 56 d. Fresh forage was either untreated (U) or treated with L. buchneri 40788 (400,000 cfu/g of fresh forage) and Pediococcus pentosaceus (100,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (T). After 14 d of ensiling, T had greater concentrations of lactic acid (5.07 vs. 4.79%), acetic acid (2.14 vs. 1.82%), and ethanol (0.66 vs. 0.34%) and aerobic stability was improved (117 vs. 79 h) compared to U (P < 0.05) although yeast counts were similar between treatments. The chemical composition and aerobic stability of both silages were similar after 28 and 42 d, however, the population of yeasts were lower in T compared to U at both time points (4.60 vs. 5.62 and 2.88 vs. 5.01 log10 cfu/g, 28 and 42 d, respectively). After 56 d of ensiling, T had a lower concentration of lactic acid (4.36 vs. 4.86%) and greater concentrations of acetic acid (2.73 vs. 2.05%), and ethanol (0.70 vs. 0.48%). The aerobic stability of T was greater than U (136 vs. 102 h), due to the lower yeast counts in T (P < 0.001) for HC in primiparous cows. Means for milk yield when brown midrib-3 corn silage or conventional corn silage cut at either 20 or 66 cm of height to early lactation cows. D. D. Dominguez*2 and L. D. Satter1,2,1. U.S. Dairy Forage Research Center, USDA-ARS, 2Dairy Science Department, University of Wisconsin, Madison.

The objective was to determine the impact on milk yield when brown midrib-3 corn silage (bm3, Cargill F-697) cut at 20 cm or conventional corn silage (Golden Harvest H-8250) cut at 20 (normal cut-NC) or 66 cm (high cut-HC) was fed to dairy cows during the transition period and early lactation. Sixty two Holstein cows (20 primiparous and 42 multiparous) averaging 24.8 days (±6.9) before calving were randomly assigned to trts. The silages were chopped at 0.95 cm theoretical length of cut, and stored in bunker silos. NDF content (% DM) of bm3, NC and HC silages were 40.6, 38.2 and 35.8. The precalving diets had 64.5, 64.5 and 69 % of forage for bm3, NC and HC trts, and postcalving diets had 61.5, 58.5 and 61.5 %. Corn silage accounted for 67 % of forage DM. The length of the experimental period after calving was 112 days. Statistical analysis was done by repeated measures analysis of unbalanced data. DM prepartum and postpartum was not affected by trts. Means for DMI postpartum for primiparous and multiparous cows for bm3, NC and HC trts were 18.5, 22.6; 18.1, 22.6; 16.6 and 21.8 kg/d. Milk yield was not affected by trts in multiparous cows, but it was decreased (P < 0.001) for HC in primiparous cows. Means for milk yield for primiparous and multiparous cows for bm3, NC and HC trts were 31.2, 39.3; 32.5, 40.8; 29.2 and 41.4 kg/d. PCM (5.5%) was not affected by trts in multiparous cows, but it was decreased (P < 0.001) in primiparous cows with HC. Means for FCM for primiparous and multiparous

Key Words: Lactobacillus buchneri, Silage, Inoculant


The objectives of this study were to determine the effects of amino acid fermentation liquor byproducts upon ensilage of corn plant and its aerobic stability. Fermentation liquors from production of glutamic acid (EFS) or lysine (KFS) or Urea were added to fresh chopped corn plant to equal added N at 0.5 or 1.0% of fresh forage in laboratory silos (4.5kg) and compared with a non-treated control. Byproducts EFS and KFS contain about 16% N on a dry basis, primarily as ammonium chloride or ammonium sulfate, respectively. Silages were sampled after 80 days of ensiling and exposed aerobically for 7 days. Results are shown in the table. Treatment N 0.5% added N 1.0% added N Item Control EFS KFS Urea pH d87 5.1 4.86 32.6 32.0 26.4 21.8 22.7 22.2 21.8 22.7 23.5 22.3 Temp. Co d87 32.6 32.0 28.9 28.3 28.3 28.9 29.5 29.1 29.5 29.1 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63 0.75 0.63

Key Words: Silage, Silage additive

M217 A summary of the effect of Lactobacillus buchneri on the fermentation and aerobic stability of silages. D. H. Kleinschmit* and L. Kung, Jr., University of Delaware, Newark, DE.

Lactobacillus buchneri has been shown to improve the aerobic stability of a variety of silages. We have summarized the effects of L. buchneri on silage fermentation and aerobic stability from 25 published studies with 49 comparisons versus untreated silages. In descending order of numbers of comparisons, corn, grass, small grain, and alfalfa silages comprised the data set. The effects of inoculation were summarized by separating the study treatments into the following categories: 1) untreated silage, nothing applied (U), 2) silage treated with L. buchneri at ≯ 100,000 cfu/g of fresh forage (LB1), and 3) silage treated with L. buchneri at > 100,000 cfu/g (LB2). The pH and DM recoveries of LB1 and LB2 were unaffected compared to U. When compared by treatment, the lactic acid concentration was 5.49% for U and was lower (P < 0.05) for LB1 (4.27%) and LB2 (3.95%). Treatment with LB2 (4.53%) resulted in silage with greater amounts of acetic acid than for U (2.10%) and LB1 (3.50%). The lactate:acetate ratios reflected the concentrations of these acids and was lower (P < 0.08) in LB2 (1.01) and LB1 (2.29) than for U (3.76). Inoculation also increased (P < 0.06) the concentration of propionic acid in silage treated with LB1 (0.33%) and LB2 (0.44%) when compared to U (0.11%). Untreated silages averaged 3.52 log10 cfu of yeasts per g of silage whereas yeasts were lower (P < 0.05) in LB1 (2.50), however, LB2 had less yeasts than U and LB1 (< 2.00). When compared to U (113 h), inoculation with L. buchneri improved the aerobic stability of silages in a dose dependent manner (255 and 355 h for LB1 and LB2, respectively). There was a negative correlation between the concentration of acetic acid and population of yeasts in silage (r2 = 0.34) and a positive correlation between the concentration of this acid and aerobic stability (r2 = 0.28). The application rate of L. buchneri was positively correlated with the concentrations of acetic acid in silages (r2 = 0.06) and aerobic stability (r2 = 0.23). In conclusion, inoculating silages with L. buchneri results in greater concentrations of acetic and propionic acids, which inhibits the growth of yeasts and improves the aerobic stability in a wide variety of silages. Furthermore, the degree of effectiveness is dose dependent.
Cows for bm3, NC and HC were 32.9, 44.3; 33.2, 45.0; 29.8 and 45.0 kg/d. Milk composition and body condition score were not affected by trts. Feed efficiency (kg milk/kg DM) was not affected by trts in primiparous cows, but was improved in multiparous cows with HC. Means for feed efficiency for primiparous and multiparous cows for bm3, NC and HC were 1.65, 1.78; 1.73, 1.84; 1.64 and 1.93.

**Key Words:** Corn silage, Brown midrib-3, Milk production

**M220** Forage intake and digestibility of tropical grass and rhizome perennial peanut hay (Arachis glabrata) supplemented with fish silage. H. Diaz*, A. Rodriguez, T. Ruiz, and R. Fuentes, University of Puerto Rico.

Two experiments were conducted to determine the effect of fish silage (FS) supplementation on forage intake and digestibility of tropical grass hay (80% Digitaria decumbens; 20% Panicum maximum; TGH) and rhizome perennial peanut hay (Arachis glabrata; RPP). Discarded fish were mixed with 20% cane molasses (w/w), a lactic acid producing bacterial-inoculant applied at 106 cfu/g fresh material and allows to ferment for 21 days. In experiment 1, TGH was offered as basal diet (Control) or was supplemented with FS at .45 % (T2) and .90 % (T3) of the animal LW daily. In experiment 2, RPP was offered as basal diet (Control) or was supplemented with FS at 0.225 % (T2) and .45 % (T3) of the animal LW. In both experiments, 9 rams were used as experimental units and submitted to 8 days of adaptation period and a 6-day data collection period. Data from both trials were analyzed according to a latin square design with three periods. In experiment 1, grass hay intake and digestibility increased (P<0.05) with supplementation at both levels of FS, but the positive response was greater in animals supplemented with 0.45% of LW. In Experiment 2, forage intake was similar in all treatments. However, dry matter digestibility was higher (P<0.05) for T2 than control animals, but was similar to that of rams of T3. In conclusion, animal response to FS supplementation differs between tropical grass and RPP hay. Fish silage increased tropical grass hay intake and digestibility regardless of level of supplementation, however, no effect on forage intake was observed when RPP was offered as basal diet but FS supplementation at the higher level increased dry matter digestibility.

**Key Words:** Fish silage, Supplementation, Tropical hay


A variety of traits and corn silage processing techniques are being promoted for high milk production through improved forage quality. In order to evaluate numerous experimental variables and their interactions involving different corn silage hybrids, scaled down mini-silos are necessary. Objectives of this study were to evaluate the influence of sample size on pH, NH3, and volatile fatty acid profile of eight corn silage hybrids, selected to vary in fiber digestibility, ensiled in vacuum-sealed polyethylene bags for 60 d and to assess the suitability of these mini-silos for detecting differences among hybrids. Hybrids were grown at the Teaching and Research Center located near Harford, NY, and harvested at a DM of about 32% in fall 2002. Three field replications of each hybrid were chopped and vacuum ensiled in bags with sample sizes of 50, 100, 200, 400, and 600 g. Increasing sample size resulted in decreased lactic acid, acetic acid, total acids, and NH3 (P<0.05). Most of the difference among sample sizes occurred between the 50 and 100 g sample size. Lactic acid:acetic acid ratio (3.1±0.13) and pH (3.9±0.08) did not vary (P>0.05) among sample sizes. There was no detectable butyric acid in the samples. Fermentation characteristics suggested that all samples were well ensiled, but that the fermentation profile of the 50 g samples differed the most from other sample sizes. There were no differences (P>0.05) among hybrids in DM (32.6±0.73%) or NH3 (0.64±0.16%). Hybrids did vary in lactic acid, acetic acid, lactic acid:acetic acid, total acids, and pH, however (P<0.05). Differences among hybrids were also noted for CP (P<0.05). It is possible to use vacuum-sealed plastic bags to ensile corn, with samples as small as 100 g, and to use these mini-silos to assess differences among hybrids.

**Key Words:** Corn silage, Fermentation, Laboratory silo

**M222** Intake and milk yield of cows fed diets containing L. bucheri-inoculated corn silage and high moisture corn or acetic acid supplement. D. K. Combs* and P. C. Hoffman, University of Wisconsin, Madison, USA.

Lactobacillus bucheri is a hetero-fermentative inoculant that increases aerobic stability of ensiled forages and grains. Silages inoculated with L. bucheri have higher concentrations of acetic acid relative to untreated silages. Acetate can depress intake when infused into the rumens of cattle, but has also been used as a potential rumen retained by cattle. Small improvements or losses in animal performance could influence the economic incentives for using L. bucheri. This study assessed how feed intake and milk production are affected by feeding diets that contain corn silage and high moisture corn that have been inoculated with L. bucheri or that have been supplemented with acetic acid. Three total mixed rations (TMR) were fed to lactating dairy cows. TMR was a diet of untreated corn silage and untreated high moisture shelled corn fed ad libitum. TMRB was formulated identical to TMRc, except that corn silage and high moisture corn were inoculated with L. bucheri at the time of ensiling. TMRc was a diet formulated to be isocaloric to TMRb and TMRc, but with untreated corn silage and high moisture grain and supplemented with 700 ml glacial acetic acid/cow/d. Corn silage was ensiled in two 2.5 m diameter horizontal plastic bags. One bag was filled with corn forage inoculated with 5 x 10^6 CFU/g of L. bucheri. High moisture shelled corn was ensiled in two concrete silos and L. bucheri was applied to one silo at 5 x 10^6 CFU/g fresh material. Eighteen multiparous Holstein cows were used in the experiment. The design was as a replicated 3x3 Latin square. Cows were randomly assigned to squares and treatment sequences randomly were allocated within squares. Milk yield was not different (P>0.05) between TMRc, TMRb and TMRa (41.3, 42.2 and 41.9 kg/d, respectively). Milk fat percentage was higher (P<0.05) when cows were fed TMRa (3.12%) than when fed TMRc (2.92%) or TMRb (2.83%). Fat corrected milk (35.0±0.5kg) and dry matter intake (21.2±0.4 kg) were similar (P>0.05) between treatments. Neither inoculation of corn silage and high moisture corn with L. bucheri or feeding acetate depressed feed intake or milk production in dairy cattle.

**Key Words:** Dairy, Silage inoculant, L. bucheri

**M223** Characterization of corn endosperm properties in 33 germplasm sources for potential improvements in ruminal starch degradability. D. Majewski*, R. D. Shaver, and J. G. Coos, University of Wisconsin-Madison.

Starch degradation in corn is influenced by several interrelated endosperm characteristics. The objective of this study was to characterize corn endosperm properties of 33 germplasm sources for future development of corn hybrids with high ruminal starch degradability. These included 17 lines from the Germplasm Enhancement of Maize (GEM) project at Iowa State University; six flint lines from North Carolina State University (NCSU) and CIMMYT; six near-isogenic inbreds of Oh43 carrying o2, f2, w2, ael, h1 and wtsu2 alleles that affect endosperm composition; an experimental breeding population developed for improved silage quality (WQS C2) and three check inbreds; BT3, Oh43, and W64A. Harvesting was done at milky (ML) and black-layer (BL) stages. The BL samples had higher (P<0.05) weight of 1000 dried seeds (252.5 vs. 209.7g; LSD=3.8). Dried kernels from middle portions of ears were used to determine % vitreousness (V) using a light box. Hardness was determined from a 20g sample using a Stenvert micro hammer-cutter mill that measured time to collect ground sample to a set receptor height (T); total column height (TH) and height ratio of course to fine (C/F) particles. The ML samples had lower %V compared to BL samples (66.9 vs 72.4%; LSD=0.8). Inbreds with softer endosperm (P<0.05) from BL samples were: o2(Oh43) (0% V; 11.2s T; 82mm TH; 0.02 C/F ratio); f2(Oh43) (0% V; 9.8s; 86mm; 0.01 C/F ratio); and h1(Oh43) (20%; 15.3s; 81mm; 0.04 C/F ratio), compared to inbred check BT3 (50%; 23.7s; 71mm; 0.37 C/F ratio). The remaining germplasm ranged from medium to hard (60-95% V and 0.47-0.90 C/F ratio). Correlations between %V and hardness factors were higher for BL samples compared to ML samples. TH (R2=0.79 vs. 0.39) and h1 (R2=0.67 vs. 0.67); and T (R2=0.66 vs. 0.42). These data show that a wide range of corn genetic material has potential for improving ruminal

starch degradability and that visual rating of vitreousness on corn harvested at BL stage can determine corn hardness properties with relative accuracy.

**Key Words:** Corn starch, Vitreousness

### M224 Nitrate leaching in silage maize production on sandy soils. M. Wachendorf*, M. Buechter, K. Volkers, and F. Taube, University of Kiel, Kiel, Germany.

As part of an integrated research project, dealing with nitrogen (N) recovery in specialized dairy farms, a field experiment with maize for silage (cultivar Naxos) was conducted to assess the effects of mineral nitrogen fertilization (0, 50, 100, 150 kg N ha⁻¹ yr⁻¹), slurry application rate (0, 20, 40 m³ ha⁻¹ yr⁻¹), and the use of an understorey of perennial ryegrass (cultivar Pennana) on the nitrate (NO₃⁻) leaching losses. Samples of leachate were taken by ceramic suction cups. Water fluxes were derived from water balance calculations. An increasing N supply with mineral fertilizer or slurry resulted in increased leaching losses, with fertilizer N showing greater effects than slurry N. A grass understorey sown at the end of May significantly reduced the losses. Only with excessive amounts of N supply (>200 kg N ha⁻¹), NO₃⁻ concentration in the leachate exceeded the European Union (EU) limit for drinking water (50 mg NO₃⁻ l⁻¹). Regression analysis showed, that NO₃⁻ leaching losses were positively related to the mineral N content in the soil at the end of the growing season, with leaching losses representing 50% of the mineral N in the soil on an average. At high levels of soil N content leaching losses were strongly reduced with a grass understorey, whereas no differences occurred at low levels. Leaching losses were positively related to the N balance at the field scale, which was calculated from the difference between N input (N from fertilizer and slurry) and N output (N removed with herbage mass). At a constant level of N surplus losses were smaller when maize was grown with an understorey. From the results obtained, it is suggested that, under the predominant soil conditions N leaching losses under maize can be estimated satisfactorily by means of mineral nitrogen content in the soil at the end of the growing season as well as by the calculated N budget. At fertilizer rates of 40 m³ slurry ha⁻¹ plus 50 kg mineral N ha⁻¹ as commonly applied in agricultural practice in northern Germany, no increased NO₃⁻ leaching losses occur.

**Key Words:** Silage maize, Nitrogen losses, Environment

### M225 Effects of forage quality and type of protein supplement on intake and digestibility in beef steers and performance of postpartum beef cows. J. J. White*, G. D. Pulipher, and T. DeCurto, Eastern Oregon Agriculture Research Center, Union, OR.

Two experiments were conducted to evaluate the effects of forage quality and supplemental UIP level on intake, digestibility, and performance of beef cattle. In Exp. 1, five ruminally cannulated steers (BW = 456 ± 6 kg) were used in a 6 x 5 incomplete Latin square with treatments in a 2 x 2 factorial plus two controls. Factors were hay quality, moderate (M, 8.0% CP, 62.1% NDF) and low (L, 4.0% CP, 81.5% NDF), and supplement type, high UIP (HUIP, 60% UIP, 48% CP) and low UIP (LUIP, 40% UIP, 49% CP). Supplement was provided daily to meet 100% of CP requirements. Intake and total fecal output were measured on d 15 to 19, and total rumen evacuations on d 21. Supplementation increased (P < 0.01) DM intake and digestibility and NDF intake in steers fed L forage. An interaction (P = 0.10) occurred for NDF intake. In steers fed L forage NDF intake was greater with HUIP supplement (2.6 kg/d) than with LUIP supplement (2.4 kg/d), but in steers fed M forage NDF intake was greater with LUIP supplement (3.1 kg/d) than with HUIP supplement (3.0 kg/d). Ruminal NDF fill and liquid volume were greater (P < 0.07) in steers fed L forage compared to M forage. In Exp. 2, 96 postpartum multiparous cows (BW 555 ± 8 kg) were blocked by calving date and assigned to treatments in a 2 x 2 x 2 factorial arrangement within a split plot design. The additional treatment factor in Exp. 2 was supplement intake level, low or high or 100% of CP requirements. Hay quality was L (6.3% CP 75% NDF) and M (8.6% CP and 74% NDF). Supplements were fed three times weekly to groups of four from calving to breeding. Cow BW and BCS were taken at calving and breeding. Cyclicality was determined prior to pregnancy, and pregnancy was determined at weaning. Cows receiving the high intake level of supplement lost less (P = 0.06, -29 kg) BW than cows on the low level (-33 kg). These results indicate that quality of forage and protein supplement type interact to affect intake, but not postpartum cow performance.

**Key Words:** Forage quality, Protein supplementation, Beef cows

### M226 Protein supplementation of Brangus stocker calves grazing winter Tallgrass Prairie. L. A. Appeddu¹ and M. A. Brown², ¹Southwestern Oklahoma State University, Weatherford, OK, ²USDA-ARS Grazinglands Research Laboratory, El Reno, OK.

In years when growing conditions are not favorable for establishment of fall wheat pasture in the Southern Great Plains, producers need cost-effective grazing alternatives for home grown calves until spring wheat pasture is available. The objective of this research was to evaluate the potential of wintering Brangus calves on perennial Tallgrass Prairie and offering limited amounts of a cottonseed meal (CSM) or feather meal (FM) based supplement. Two weeks after weaning in October 2000, calves were sorted by sex and placed on one of four pastures (Big Bluestem, Little Bluestem, Dropseed, Cheat; avg 49.5% ADF and 5.5% CP). Calves were supplemented by pasture with CSM (20 steers and 25 heifers) or FM (20 steers and 25 heifers) for 90 d. Measures included calf weight, hip height, serum metabolites and ADF digestibility using acid detergent insoluble ash as an internal marker. Supplements had 42% CP and similar in situ digestibilities. Calves lost weight during the first 40 d on pasture (−0.21 kg d⁻¹); therefore, daily supplement amounts were increased from 908 to 1362 g hd⁻¹. No differences in gain were detected between steer groups over the last 50 d (0.44 ± 0.038 kg d⁻¹), but heifers fed FM gained more (P < 0.001) than those fed CSM (0.42 ± 0.026 ± 0.034 kg d⁻¹). Calves fed FM vs CSM had a greater increase (P < 0.05) in hip height (3.3 vs 2.8 ± 0.23 cm). Steers had lower (P < 0.001) serum urea nitrogen levels than heifers (15 vs 21 ± 0.9 mg dl⁻¹). Serum glucose levels tended to be lower for steers fed CSM than FM (62 vs 73 ± 2.2 mg dl⁻¹), but similar between heifer groups (82 ± 2.0 mg dl⁻¹). By d 90, a higher ADF digestibility was found for heifers fed FM compared to heifers fed CSM and steers fed CSM or FM (56, 55, 51 ± 2.5%). Although supplying FM improve heifer utilization of winter Tallgrass Prairie, no differences were detected for subsequent 60 d gains (1.2 ± 0.06 kg d⁻¹) or pregnancy rates (66%) when heifers were placed on spring wheat pasture. Results suggest Brangus calves can be wintered on lower quality pasture with minimal inputs when annual cool season forages are not available.

**Key Words:** Forages, Protein Supplementation, Digestibility

### M227 Interseeding triticale with windrowed millet as a winter feeding program for developing heifers. W. S. Mackay*, J. C. Whittier, D. Couch, and D. N. Schutz, Colorado State University, Fort Collins, CO USA.

Sixteen weaned crossbred beef heifers were used to compare two winter feeding programs. Heifers were randomly assigned to one of the following treatments: 1) Millet Only (MO), heifers grazing windrowed millet only, and 2) Triticale and Millet (TM), heifers grazing windrowed millet and triticale seeded between the windrows. In May of 2001, dry fertilizers was applied to a field, and foxtail millet was seeded July 5-6 and then windrowed in the late dough stage September 5-7. The field was divided into three plots and triticale drill seeded between the windrows. By d 90, a higher ADF digestibility was found for heifers fed FM vs CSM (0.42 ± 0.001) than those fed CSM (0.42 ± 0.003 kg d⁻¹). Supplementation improved heifer utilization of winter Tallgrass Prairie, no differences were detected for subsequent 60 d gains (1.2 ± 0.06 kg d⁻¹) or pregnancy rates (66%) when heifers were placed on spring wheat pasture. Results suggest Brangus calves can be wintered on lower quality pasture with minimal inputs when annual cool season forages are not available.

**Key Words:** Forages, Protein Supplementation, Digestibility
a result of leaching of other compounds. This leaching, as evidenced by decreasing NDF, left more protein as a percent of the whole. In conclusion, seeding triticale between windrowed millet offers no benefit if the triticale is not able to provide a substantial portion of the diet. However, windrowed millet is a viable, low cost option for winter-feeding.

Key Words: Heifer calves, ADG, Windrow grazing

M228  Forage intake and in vivo digestibility of two rhizoma peanut genotypes harvested for hay in the tropics. T. Ruiz* and L. Rivera-Estremera, University of Puerto Rico, Mayaguez.

Rhizoma perennial peanut (RPP) is a forage legume that has shown high nutritive value and yield potential when grown in the tropics. Two genotypes, TARS line nos. 17033 (PI No. 276233) and 17097 (PI No. 262839) with the highest and second highest DM yield, respectively, have an excellent potential for commercial release in the Caribbean. The apparent digestibility and intake of hay from these lines was determined in a feeding trial with young sheep (25 kg), during November and December of 2001. Animals were fed ad libitum to stimulate maximum consumption of hay from the two RPP lines and coastcross no. 1 Bermudagrass. Intake and apparent digestibility of DM and organic matter (OM) were similar between RPP lines. Compared to Bermudagrass, intake of DM (1.01 vs .74 kg/d), OM (.92 vs .68 kg/d), and apparent digestibility of DM (57.7 vs 47.7%) and OM (59.8 vs 50.7%) were higher (P<0.01) for the RPP hays. The apparent digestibility of CP was higher in 17033 compared to 17097 (46.6 vs. 39.4%) legume hay. The CP digestibility in the RPP hays was close to being twice that of the Bermudagrass hay (33.9%). Despite differences in DM and OM consumption among the treatments, the experimental animals consumed similar amounts of NDF (.50 kg/d). It can be concluded that these two RPP genotypes show similar quality potential which is greater than that of Bermudagrass hay harvested at a similar stage of maturity.

Key Words: Tropical legume, Bermudagrass hay, Rhizoma perennial peanut

M229  Apparent digestible dry matter intake of ammoniated wheat straw diets in beef cows as affected by wheat middlings and biotin supplementation. R.D. Wiedmeier*1, P.R. Schmidt1, B.A. Kent1, and D.R. ZoBell1, 1Utah State University, Logan, Utah.

The objective of this study was to determine the effect of supplemental wheat middlings (WM) and biotin on intake and digestibility of ammoniated wheat straw (AWS) diets. Sixteen fall calving, lactating beef cows and their calves were stratified into six groups of four cows each and placed in four pens, four cows and calves/pen. Each pen had a creep feeding area for calves with alfalfa hay (AH) offered ad-libitum. Two pens received 4.58 kg of AH and 0.22 kg of vitamin-mineral premix/cow/d. The other two pens received 4.08 kg of WM and 0.19 kg of vitamin-mineral premix/cow/d. All pens received ad-libitum access to AWS with intake measured daily. After a 60 d adaptation period apparent nutrient digestibility was estimated twice at 30 d intervals, each with a 5 d diet

Key Words: Beef, Supplementation, Digestibility

M230  Influence of supplementing soybean hulls to steers consuming endophyte infected tall fescue pasture. R. Pugh*, J. B. Pulliam, J. C. Waller, and C. J. Richards, University of Tennessee, Knoxville TN.

Six steers (289 ± 2 kg BW) fitted with ruminal and duodenal cannulas were used in a crossover design to evaluate intake and site of nutrient digestion of fresh clipped endophyte infected tall fescue (Festuca arundinacea) pasture with or without soybean hull supplementation at 0.70% BW (DM basis). Steers were placed in metabolism units within an environmentally controlled room and provided with free choice access to fresh forage, water and a vitamin/mineral block. The spring growth of tall fescue was harvested daily for feeding during the experiment. Supplement was fed at 0700 with approximately 65% of the estimated daily forage. Additional forage was stored in a cooler and fed at 1900 to maintain a fresh forage supply. Periods were 21 d with 15 d of adaptation and six d of sample collection. Chronic oxide was dosed twice d starting on d nine for use as a digesta flow marker. Duodenal samples were taken 4 times d with times shifting one hour each d to represent all hours of a d. Soybean hull supplementation decreased (P < 0.01) forage intake from 2.6 to 2.2% BW, but increased (P < 0.01) total DMI from 2.6 to 2.9% BW. Apparent ruminal DM digestibility percentage (61%) was not affected (P > 0.10). Crude protein intake was not different (P > 0.10) between treatments, but duodenal CP flow for the supplemented treatment (775 g/d) was greater (P > 0.01) than the control treatment (563 g/d). Ruminal pH was not affected (6.5; P > 0.15) and ruminal ammonia nitrogen concentration was decreased (P < 0.01) from 3.7 to 2.3 mM with soybean hull supplementation. Supplementation of soybean hulls at a rate of 0.70% BW to calves consuming fresh tall fescue decreased forage consumption, but resulted in greater total intake, no change in percentage of ruminal dry matter digestion and greater flow of protein to the duodenum.

Key Words: Feed supplementations, Digestion, Forage

International Animal Agriculture

M231  Nitrogenous fractions of Pithecellobium dulce in tropical dry forest. T. Clavero* and R. Razz, Centro de Transferencia de Tecnología en Pastos y Forrajes. La Universidad del Zulia. Venezuela.

In an *Pithecellobium dulce* plantation located in the western part of Venezuela a trial was carried out to assess the content of the nitrogenous fractions in differing growing seasons. Three growing seasons were studied (maximum, P1; mean, P2 and minimum, P3; rainfall). The experiment was laid out as randomized block design with four replications. The data showed significant differences (P<0.05) for total nitrogen content (TN), rumen soluble nitrogen (SN) and non protein nitrogen of the soluble nitrogen (NPN/SN) in relation to growing season. The solubility of the total nitrogen ranged from 38.3 to 45%. The highest values of TN and SN were reported during the maximum rainfall. Nitrogen fixed to the cell wall of the insoluble nitrogen and nitrogen in fiber acid detergent (NFAD) were not affected for growing season. *Pithecellobium dulce* has an adequate content of TN, SN and NPN/SN and represent an alternative as source of nitrogen for ruminant in tropical conditions.

Key Words: Nitrogenous fractions, *Pithecellobium dulce*


The study aimed to evaluate the influence of molasses in ensiling *Leucaena* tops in western Venezuela. Chopped fresh plant materials of about 1 cm length were ensiled into laboratory silo and stored at 25°C. The experimental design was a completely random with a 3x3 factorial arrangement. Factors studied were three rates of legumes: molasses, 1:4, 1:8 and
The amino acid (AA) composition in commercial wheat samples was analyzed, and models were created to predict the AA content on the basis of the cereal crude protein (CP) content. One hundred and fifty samples of the cereal were collected at the field during the 2001 harvest. The CP value was obtained by multiplying the nitrogen content by the 5.65 factor. The samples were grouped in three lots based on the percentage of CP (high, medium, and low). Nine representative samples of each group were analyzed for AA. Correlation and regression analysis were performed between the contents of real protein (sum of the contents of all AA) and each AA. Glutamate and proline were the most abundant AA. A high variation in the crude protein and amino acids content (CV from 7.4 to 14.0%) was observed in the evaluated wheat samples. The non-essential AA were mainly responsible for this variation, apparently because of their higher content, as compared with the essential AA. Phenylalanine, isoleucine and leucine were the AA with the highest variations; arginine, histidine, methionine, threonine and valine were of moderate variation; lysine was the less variable AA. There was a high (r = 0.97) and significant (P<0.01) correlation coefficient between the real and the CP content in the cereals. The regression was significant for all AA. The prediction models for histidine, threonine, methionine and lysine had the lowest regression coefficients. The regression equations of the first limiting AA were as follows: Lysine = 0.15982 0.012 + 0.01709 0.001 (P<0.01; R 2 = 0.897); Threonine= 0.08364 0.011 + 0.02293 0.001 (P<0.01; R 2 = 0.952). These results show a great variation in the AA and the protein content in commercial wheat. Based on the regression analysis, it is concluded that protein content is a good estimator of the amino acid content in wheat, and that the regression models obtained from this study allow to save time and money in the analysis of the amino acid content in this cereal.

Key Words: Wheat, Prediction equation, Amino acids

M235 Effect of prepartum body condition and breed on production performance in crossbred dual purpose cows. O. Araujo-Febres* and J. A. Gutierrez, La Universidad del Zulia, Maracaibo, Venezuela.

Multiparous dual purpose crossbred cows (n = 28) were used in a randomized block design to determine the effect of prepartum body condition and racial predominance: of Holstein (H), Brown Swiss (BS) and Brahman (B) cows on milk production (MP) and calving to conception interval, in an tropical dry forest environment. Body condition is a useful tool to evaluate the energy status in cows. It was used on a scale of 1 to 5 to body score cows (1 = emaciated; 5 = obese). Data were collected every two weeks in six time periods: prepartum, at calving, postpartum, prebreeding, postbreeding and 120 days postpartum. Individual cows with multiple observations were included in the analysis as repeated measures (368). Cows were managed as a simple group. Body condition score changes were defined as BCS-final minus BCS-initial. Analysis of variance was conducted with GLM procedures of SAS. It was observed that the cows milk production was independent of precalving BCS, but cows that showed a greater milk production lost greater rank of BCS, obtaining a significant (P<.05) and negative correlation (r = -0.42). The B cows reached the greater average of MP and greater loss of BCS (9.50 L and -0.48, respectively); the BS cows were intermediate (8.94 L and -0.25) and the B were the inferior (8.28 L and -0.20). BCS had no influence on calving to conception interval, while racial predominance had influenced (P<.05) calving to conception interval (H = 86.8 days; BS = 101.6 d; and B = 183.0 d). It is concluded that BCS at the time of parturition is an important factor affecting subsequent milk production, while racial predominance affects either milk yield or calving to conception interval.

Key Words: Dual purpose cattle, Body condition, Milk production
Physiology: Nutrition-reproduction, gametes and uterus


Experimental objectives were to evaluate effects of supplemental high-linoleate safflower seeds on ovarian follicular development and hypophyseal LH, FSH, and GnRH-receptors. Beginning 1 d postpartum, 18 primiparous, crossbred beef cows (BW = 410 ± 24.2 kg) were fed foxtail millet hay at 2.13% of BW and either a low-fat control supplement (61.2% corn, 32.1% safflower seed meal, 3.7% liquid molasses; Control) or a supplement containing 94% cracked high-linoleate (67% 18:2) safflower seeds and 6.0% liquid molasses (Linoleate). Supplements were formulated to be isonitrogenous and isocaloric and the Linoleate diet was formulated to contain 5% fat. Cattle were slaughtered for collection of tissues after 35 d of experimental treatment. Average total number of follicles, number of follicles with in each size classification (1 to 4), and diameter of follicles were not influenced (P = 0.17 to 1.0) by dietary treatment. Treatment did not influence hypophyseal GnRH receptors (P = 0.42; 2.7 × 10⁻¹⁴ and 2.2 × 10⁻¹⁴ M/mg of protein for Control and Linoleate, respectively) or concentrations of LH (P = 0.14; 700 96.9 ng/mg) in the anterior pituitary gland. Conversely, concentrations of FSH in the anterior pituitary gland were greater (P = 0.02) for Linoleate (1100.6 ng/mg) than Control (805.1 ng/mg) cows. Fat supplementation enhanced stores of FSH in the anterior pituitary gland; however, increased hypophyseal FSH storage was not accompanied by increased ovarian follicular development. Overall, dietary fats high in linoleic acid do not improve development of ovarian follicles of primiparous cows early in the postpartum period either because of insufficient hypophyseal FSH secretion or decreased ovarian responsiveness to FSH.

**Key Words:** Beef cattle, Fat supplementation, Gonadotropin

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The objective of this project was to evaluate potential reproductive effects of feeding high-oleate or high-linoleate safflower seeds to ewe lambs. White-faced ewe lambs (BW = 34 ± 0.4 kg; n = 36) were fed a beet pulp, oat hay and soybean meal basal diet (CON). Safflower seeds were fed as isocaloric and isonitrogenous replacement in the basal diet so that Oleate (OLE) and Linoleate (LIN) diets contained 5% additional fat. Lambs were slaughtered when they reached a final BW of 61.3 ± 0.9 kg. Based on serum progesterone or the presence of a corpus luteum (CL), 6, 5 and 2 lambs reached puberty prior to slaughter in LIN, OLE and CON groups, respectively. Lambs fed LIN had more (P = 0.02) and OLE tended (P = 0.10) to have more CLs than CON lambs. No treatment effects were detected (P ≥ 0.18) for any other characteristics. Subsequently, data from only prepubertal lambs were re-analyzed. Within the prepubertal population, treatment did not influence (P ≥ 0.38) hypothalamic contents of GnRH, hypophyseal GnRH-receptors, ovarian weights, or number of large follicles. Hypophyseal concentrations of LH (P = 0.04) were, and FSH tended (P = 0.10) to be influenced by treatment. Concentrations of LH (P = 0.01) and FSH (P = 0.04) were the greater in OLE than CON, and intermediate (P ≥ 0.24) in LIN lambs. Uterine weight (P = 0.09) and number of small follicles (P = 0.10) tended to be influenced by treatment. Uteri from CON were heavier (P = 0.03) than those of OLE and were intermediate (P = 0.13) in LIN lambs. Similarly, numbers of small ovarian follicles were greater (P = 0.05) in CON than OLE and LIN lambs were intermediate (P = 0.11). Dietary fat supplied by safflower seeds may potentiate the onset of puberty in ewe lambs. It appears the response may be unique to the fatty acid composition of the supplement, but actions of other potential constituents of safflower seeds remains to be determined.

**Key Words:** Dietary fat, Lambs, Puberty

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**T3** Feed intake, serum leptin, and puberty in Brangus heifers sired by bulls with differing EPDs for growth and scrotal circumference. K. L. Shirley¹, M. G. Thomas¹, D. H. Keisler², D. M. Halford¹, D. M. Montrose¹, G. A. Silver³, M. D. Garcia¹, and L. A. Narro¹, ¹New Mexico State University, Las Cruces, ²University of Missouri, Columbia.

Spring-born Brangus heifers sired by bulls with differing EPDs for growth and scrotal circumference were evaluated for growth, level of feed intake, serum concentrations of leptin, and puberty from 12.5 to 15.5 months of age. Sire EPD and accuracy for weaning weight, yearling weight, and scrotal circumference were 36.2 (0.61), 61.0 (0.54), and 0.1 (0.42) for a large growth-moderate scrotal circumference sire (LG-MSC;
T5 Concentrations of antigonadotrophic decapeptide in ovine tissues, S. N. Sandstedte*, M. E. Wise, and D. M. Halford, New Mexico State University, Las Cruces, NM/USA.

Antigonadotrophic decapeptide (AGD) has been shown to inhibit secretion of GnRH and LH in several species. The mechanism of action of AGD is unknown but appears to be integral to the GnRH secretory process. The objectives of this study were to 1) develop a RIA to measure tissue concentrations of AGD and 2) determine which ovine tissues contained AGD. The AGD double antibody RIA utilized rabbit antiserum against AGD conjugated to KLH (Covance Res. Prod.) and synthetic AGD (Princeton Biomolecules) as the standard. The 125I-AGD was produced using chloramine T and purified using sephadex G-10 chromatography. No cross reactivity was detected for the following peptides: oxytocin, CRH, GHRH, TRH, ADH, SRIF, GNRH, and NPY. Detection limit was 0.3 ng, recovery of added AGD to tissue extracts was 108%, and the assay CV was 3%. Liver, kidney, skeletal muscle, and brain tissues were collected from six ewes, immediately frozen at -80°C, and subsequently homogenized in PBS. Tissues (0.02 to 1.0 g) were vortexed for 2 min using 3 mL of acid methanol (12% 2N HCl: 88% methanol; vol: vol) followed by centrifugation at 4100 x g for 10 min and dried at 40°C for 30 min. Using this procedure, an average of 82 ± 1.2% of added 125I-AGD was recovered. The dried extract was resuspended in 0.5 mL of PBS containing 1% BSA which was then assayed in duplicate for AGD. No AGD was detected in control tissues (liver, kidney, and skeletal muscle). Likewise, the decapeptide was not detected in brainstem, cortex, pituitary, anterior or posterior hypothalamus. The pineal gland averaged 8.0 ± 3.0 ng AGD/g tissue while the greatest concentration of AGD was detected in the median eminence (69.0 ± 19.0 ng/g). These data demonstrate development of a sensitive AGD RIA. This RIA reveals the presence of substantial concentrations of AGD in the ovine median eminence and pineal gland.

Key Words: Antigonadotropic decapeptide, Radioimmunosay, Neuropeptide

T6 Pituitary expression of ghrelin mRNA during the luteal phase of the bovine estrous cycle. H. C. Moore*, P. C. Gentry, R. J. Collier, and A. M. Turzillo, University of Arizona, Tucson, AZ.

Ghrelin, an endogenous growth hormone (GH) secretagogue, has been implicated as a regulator of metabolism and growth. Although predomnantly secreted by the stomach, ghrelin expression was recently reported in somatotropes, lactotropes, gonadotropes, and corticotropes of the human pituitary gland. The presence of ghrelin mRNA in various pituitary cell types indicates that ghrelin may modulate the release of pituitary hormones other than GH. The potential influence of ghrelin on synthesis and secretion of gonadotropins as well as potential feedback effects of steroid hormones on ghrelin actions are yet to be determined. The objectives of this study were to determine 1) if the ghrelin gene is expressed in the bovine pituitary gland, and 2) if pituitary ghrelin mRNA expression is modulated by progesterone (P4) during the luteal phase of the estrous cycle. Following estrous synchronization, ovarian follicular dynamics in beef heifers were monitored with ultrasound and pituitary glands were harvested on days 2, 4, 6, 8, and 10 (n=6) after initiation of the first follicular wave following ovulation. Blood samples were collected daily and serum concentrations of P4 were determined by RIA. As expected, concentrations of P4 increased from day 2 to day 10 (0.7, 1.9, 3.3, 5.7, and 7.3 ng/ml on days 2, 4, 6, 8 and 10, respectively) and were correlated with luteal development. Total cellular RNA was reverse transcribed and primers spanning bases 40-481 of bovine ghrelin were used to amplify ghrelin cDNA by PCR. Representative cDNA products were sequenced to verify identity. Ghrelin gene expression was detected in pituitary glands on days 2-10. However, preliminary analysis indicated that pituitary ghrelin expression does not change during the luteal phase of the estrous cycle. We conclude that pituitary expression of ghrelin is not regulated in an endocrine fashion by P4. Studies are underway to determine cellular sites of ghrelin expression in the bovine pituitary gland.

Key Words: Ghrelin, Pituitary, Bovine

T4 Intracerebroventricular infusion of Neuropeptide Y and leptin differentially influence the episodic secretion patterns of GH in well-fed ovariecrotomized cows. L. A. Narro*, M. C. Thomas1, M. D. Garcia1, D. H. Keisler2, M. Amstalden3, G. L. Williams2, and D. M. Halford1, 1 New Mexico State University, Las Cruces, 2University of Missouri, Columbia, 3Texas A&M University Agricultural Research Station, Beeville.

Anterior pituitary secretion of GH is regulated by hypothalamic secretion of somatostatin and GHRH. There are also appetite-regulating signals that modulate this axis at the level of the hypothalamus; however, these data are limited in cattle. Objectives of this study were to further evaluate the central effects of the orexigenic and anti-orexigenic peptides, neuropeptide Y (NPY) and leptin, on pituitary secretion of GH in cattle. Six Bos taurus x Bos indicus crossed cows were ovariecrotomized by paralumbar laparotomy and then surgically fitted with a third cerebroventricle cannula at least 3 wk before the start of the sampling period. Cows were fed a diet of hay and concentrate to maintain BW and condition. Body condition scores were 5.6 ± 0.3 (i.e., scale of 1 = emaciated to 9 = obese) throughout the experiment. Cows were fed a diet of hay and concentrate to maintain BW and condition. Body condition scores were 5.6 ± 0.3 (i.e., scale of 1 = emaciated to 9 = obese) throughout the experiment. Blood samples were collected twice weekly to evaluate serum concentrations of GH (19.0 ng/g). Neuropeptide Y, Leptin, Growth hormone pulses, but pituitary secretion of GH does not appear to be influenced by central administration of leptin.

Key Words: Brangus, Puberty, Leptin
To determine the influence of short-term fasting on reproductive function, normally cycling, crossbred cows were randomly assigned to one of three treatments: control (CONT; n = 8), CIDR (n = 9), or fasted (FAST; n = 9). CONT and CIDR cows were fed ad libitum while the FAST group was fasted from d 10 through d 14 (d 0 = estrus). On d 11, cows received an intravaginal CIDR (InterAg, Hamilton, NZ: 1.38 g progesterone (P4)) on d 11. On d 15, cows received PGF2α (Lutalyse®, 25 mg, i.m.) at 0600 h and CIDRs were removed at 1800 h. Body weights were obtained on d 10 and 15 at 0600 h. Blood samples were collected d 10 through 16 for determination of P4. To evaluate serum LH, samples were collected every 15 min for 4 h on d 10 and 14 and every 4 h on d 17 through ovulation. Ultrasonography was performed daily from d 0 through d of ovulation. On d 15, BW loss of FAST cows was greater (-29 kg) than CONT (-1 kg) and CIDR cows (0 ± 4 kg; P < 0.001). Mean P4 from d 10 through 14 did not differ among treatments (7.1, 7.6 ± 0.5 ng/mL, CONT, CIDR, and FAST, respectively; P > 0.05). Concentration of LH within treatments was similar between d 10 and 14 (CONT: 4.9 vs 4.2 ± 1.3 ng/mL; CIDR: 1.3 vs 1.8 ± 0.5 ng/mL; FAST: 3.5 vs 2.9 ± 0.6 ng/mL, d 10 and 14, respectively; P > 0.05). Time from PGF2α to P4 ≤ 1 ng/mL did not differ among treatments (30.0, 33.3, 26.3 ± 3.3 h, CONT, CIDR, and FAST, respectively; P > 0.05). No differences were observed in times from PGF2α to peak LH (79.7, 84.6, 127.7 ± 26.7 h; CONT, CIDR, and FAST, respectively; P > 0.05) and peak LH to ovulation (24.0, 16.0, 41.1 ± 9.8 h; CONT, CIDR, and FAST, respectively; P > 0.05). Time from PGF2α to ovulation was greater in FAST (255 h) than CONT (96 h) and CIDR (101 ± 55.3 h, P < 0.05). Short-term fasting did not affect serum P4 or LH during the luteal phase, P4 disappearance following PGF2α, or timing of the LH surge. However, short-term fasting increased BW loss and time from PGF2α to ovulation, suggesting an influence of short-term fasting on time of ovulation.

Key Words: Fasting, Ovulation, Reproduction


Reproductive performance is a key determinant of the efficiency of dairy production, especially for seasonal dairy production systems based on pasture. Studies in several countries have shown a gradual decline in reproductive performance. The objectives of this study were to benchmark current reproductive performance of dairy cows in New Zealand and to quantify the effects of various factors on reproductive performance. Data were collected from 101,185 cows over a 3-year period (414 herd-year groups). Pregnancy status was determined either by palpation per rectum and/or from calving information in the following calving season. The overall conception rate to first AI (CR1) for all cows with single ovulation had similar (P > 0.05) circulating progesterone on d 7 than single ovulators (53.0% (n=89,367) with a large variation among herds. The average CR1 for heifers in the top and bottom quartiles were 63.2% and 43.4%, respectively. The conception rate to AI after a natural estrus was 55.3% compared with 38.6% to AI after an estrus induced with hormonal treatment. Data were analyzed using the MIXED procedure of SAS and herd-year was included as a random factor. All following results are least squares means produced by the model. CR1 increased with age, from 2 (53.5%) to 4 years (59.2%) and then decreased with age to 46.7% in cows aged ≥10 years. Jersey cows had a lower CR1 (53.3%, P<0.0001) than Holstein-Friesian (56.1%) or crossbred cows (56.4%). Cows giving birth to twins had lower CR1 (47.0%, P<0.0001) than cows giving birth to a single (55.8%). Cows that had calving difficulty had a lower conception rate (50.3%, P<0.001) than cows that had no calving difficulty (55.8%). The relationship between the interval from calving to first AI and CR1 was curvilinear, with the linear (1.51), quadratic (-0.011) and cubic (0.000027) terms all being significant (P<0.01). The day of AI relative to the start of the breeding season also had a curvilinear relationship with CR1, with significant (P<0.01) linear (0.24), quadratic (-0.015) and cubic (0.0000106) terms. These results show that the conception rate of dairy cows in New Zealand is higher than that reported in many other countries. The large variation among herds in conception rate suggests tremendous scope for improving reproductive performance through management. (Supported by the Dairy Global Program)

Key Words: Reproductive performance, Conception rate, Risk factors


Holsteins from a breeding project initiated in 1964 to develop a stable control line (CL) that represents US breed average in 1964 and a select line (SL) that represents contemporary US Holsteins were used to determine effects of selection on corpus luteum function. Data on the number of heifers (25 CL, 30 SL) and cows (13 CL primiparous (CL-P), 28 CL multiparous (CL-M), 25 SL-P, 38 SL-M) was identical for both lines. Blood samples were obtained weekly from heifers from 240 d of age until first observed estrus and 3X weekly for 6 wk from the later of first estrus or 12 mo of age and weekly from cows during the first 10 wk postpartum (PP). Blood from heifers and cows was collected 10, 28 ± 3 and 42 ± 3 d post-insemination (AI), unless a subsequent estrus was observed. Post-AI sampling was repeated prior to 730 d of age (heifers) or 200 d PP (cows) until conception. Growth and production variables were determined. Growth rate, production data, day of first plasma progesterone (P4) greater than 1.0 ng/mL, estrous cycle length, and area under the estrous cycle P4 curve (AUC) were analyzed using PROC MIXED and body measures and post-AI P4 as repeated measures using PROC MIXED of SAS. Means differed when P < 0.05. From 8 to 18 mo of age, growth rate was greater (800 vs 730 g/d) but BCS consistently less (3.8 vs. 4.0 at 18 mo) in SL heifers. Daily 3.5% ECM yield through 17 wk PP was greater in SL-P (31.1 vs. 20.6 kg) and SL-M (43.8 vs. 29.7 kg) cows. Age at first P4 rise (291 vs. 302 8.0 d), cycle length (19.0 vs. 19.6 0.5 d), or AUC (85.3 vs. 82.6 4.4 ng/ml/d) were not affected by line. First P4 rise PP was delayed for SL cows (38.5 vs. 28.5 ± 2.3 d) and not altered by parity. Plasma P4 increased from 10 to 42 d post-AI (5.6, 8.8, 9.3 ± 0.2 ng/mL) but did not differ between lines. Corpus luteum function was not affected by greater growth rate of SL calves but PP alterations contribute to an increased interval of anestrus in SL cows.

Key Words: Selection, Progesterone


Based on the idea that oocyte integrity and early embryonic development are compromised in dairy cows, we tested the hypothesis that conception rate (CR) can be improved by ET compared with AI. During 365 d, 550 potential breedings were used from 243 lactating Holstein cows with average milk production of 34.9 kg/d. Cows were synchronized with a modified Ovsynch protocol (GnRH-7d-PGF2α-3d-GnRH) and were randomly assigned to receive AI immediately after the second GnRH injection (d 0) or to receive transfer of one embryo 7 d later (21.5 and 78.5% fresh and frozen embryos, respectively). Circulating progesterone and follicular and luteal size (by ultrasound) were determined on d 0 and 7. Cows with circulating progesterone ≥ 0.5 ng/mL on d 0 (n = 66; 12.0%), < 0.5 ng/mL on d 7 (n = 9; 1.6%), or without a responsive follicle to GnRH on d 0 (n = 76; 13.8%) were considered not synchronized. Pregnancy diagnosis was performed by ultrasonography on d 25 or 32, and pregnant cows were reevaluated on d 60-66. Synchronized cows with single ovulation had similar (P > 0.30) CR on d 25-32 with ET (n = 176; 40.3%) and AI (n = 166; 35.6%). Pregnancy loss between d 25-32 and 60-66 also did not differ (P > 0.20) between ET (26.2%) and AI (18.6%) cows. When single (n = 336) and multiple (n = 57) ovolators were compared, independent of treatment, multiple ovolators had greater (P < 0.001) circulating progesterone on d 7 than single ovolators (2.7 vs. 1.9 ng/ml) and there was a tendency (P = 0.07) for a greater CR for multiple ovolators (50.9% vs. 38.1%). However, there was no difference in CR between AI and ET cows with multiple ovulation (50.0% vs. 51.7%). The CR tended to be lower for AI than ET in single-ovulatory cows (25.7 ± 23.7 vs. 42.3% ± 42.3%), or larger (≥ 20mm; 34.3 vs. 51.0%; P = 0.13) follicles but not average ovulatory sized follicles (16-19 mm; 41.2 vs. 37.3%; P = 0.69). Thus, ET did not
improve overall CR in lactating cows but size and number of ovulating follicles may determine success with these procedures.

Key Words: Embryo transfer, Dairy cattle, Pregnancy


The effect of dry period length on reproductive performance of lactating dairy cows has not been previously evaluated. Sixty Holstein cows were assigned in a randomized block design to one of three treatments: 1) Traditional (T) dry period (56 d) with dry cows fed 28 d on low energy diet followed by 28 d on a moderate energy diet, 2) Shortened (S) dry period (28 d) with cows continuously fed a high energy diet, or 3) Zero (Z) dry period with cows continuously fed a high energy diet. Cows had ovaries evaluated by ultrasound and blood samples collected 3 times per week beginning from d 6 or 7 postpartum (PP) until 7 d after second ovulation. Average d from calving until the first 10 mm follicle were fewer (P < 0.05) in Z (6.1 d) and S (9.0 d) than T (10.5 d). Time from calving to first ovulation was earlier (P < 0.01) in Z (14.5 d) than T (28.9 d) with S (21.5 d) intermediate. A follicle of the first follicular wave ovulated in more (P < 0.01) Z (84%; 16/19) than T (43%; 9/21) with S (65%; 13/20) intermediate. Double ovulation rate at the first ovulation was greater (P < 0.02) in T (62%) than S (21%) with Z (35%) intermediate. However, there was no difference in double ovulation rate at second ovulation (15/60). There were no differences among treatments in size and volume of the ovulatory follicle or in luteal volume and serum progesterone concentrations on day 7 after ovulation for cows with single or double ovulation. Number of cows with persistent CL (>30 d; 18/60) was not different among groups; however, short luteal phases were greater (P < 0.05) in Z (21%; 4/19) than S (9%; 2/20). Days to first AI were shorter (P < 0.06) in Z (68.7 d) and S (68.0 d) than T (75.4 d). First service conception rate was greater (P < 0.06) in Z (58%; 11/19) than T (25%; 5/20) with S (29%; 6/21) being intermediate. Days open in pregnant cows were fewer (P < 0.05) in Z (80.7 d) than S (121.1 d) or T (114.4 d). Thus, shortening or eliminating the dry period leads to earlier PP ovulation and may improve reproduction in lactating dairy cows.

Key Words: Dry Period, Reproduction

T12 Relationship between milk production and estrous behavior of lactating dairy cows. H. Lopez1, L. D. Satter1,2, and M. C. Wiltbank1, 1Dairy Science Department, University of Wisconsin, 2US Dairy Forage Research Center, USDA-ARS, Madison, WI.

The objective of this study was to evaluate the association between level of milk production and duration of estrus as determined by mounting activity recorded by a radiotelemetry system. Holstein cows (n=267;50 DIM) were fitted with a transmitter that allowed 24h/d recording of mounting activity. Cows were housed in a free-stall barn with concrete flooring and milked twice daily with milk weights recorded. Ovulation was confirmed for all estrus (n=323) by ultrasonography. Average milk production for 10d before the day of estrus was correlated with estrous duration for 18.6 kg/d; n=31; P=0.004). Level of milk production was correlated with E2 concentrations (r=0.56; P<0.0001) and diameter of the preovulatory follicle (r=0.44; P<0.0001). Thus, high level of milk production decreases duration of estrus probably due to decreased concentrations of E2 at estrus.

Key Words: Dairy cow, Estrous behavior, Milk production

T13 Milk urea nitrogen and conception rate: a population study using test-day records. J. E. Vallimont1, G. W. Rogers2, L. A. Holden1, M. L. O’Connor1, J. B. Cooper2, C. D. Dechow2, and J. S. Clay3, 1Penn State University, 2University of Tennessee, 3Dairy Records Management Systems.

Reproductive failure is costly to dairy producers, and high milk urea nitrogen (MUN) levels are known to affect reproduction. Dairy Records Management Systems, Raleigh, NC, provided records for 15,191 test days with a first service within 30 d of a MUN test to determine the relationship between MUN and conception rate (CR) in Holstein cows. Conception rate data were included from October 1998 to December 2000; seasons were summer (April to September) and winter (October to March). Days to first service (DFS) was limited to 25 to 200 d. Herds were required to have a first service CR between 10% to 65%. Data were analyzed with SAS using the PROBIT model of PROC LOGISTIC. Analyses included wet chemistry alone (WC) and WC plus infrared (ALL). Variables in the final model were herd, year-season of insemination, parity group (1, 2, and 3+), and MUN as a continuous variable or MUN grouped (<6, 6 to 7, 8 to 9, 10 to 14, 15 to 16, 17 to 18, and >18 mg/dl). Milk yield did not change the impact of MUN on CR, and DFS was not significant. Milk urea nitrogen approached significance at the 0.10 level. Cows were 22% more likely to conceive if they had a WC MUN of 8 to 9 mg/dl (n=181) in the period of the week preceding or following a service compared to MUN of 10 to 14 mg/dl (n=1690, P<0.08). Cows with WC MUN 6 to 7 mg/dl (n=57) had a 22% better likelihood of conception than those with MUN 10 to 14 mg/dl (n=1638) when inseminated within a two-wk period after MUN test (P<0.09); cows with WC MUN <6 mg/dl or >18 mg/dl (n=14, n=621) were 27% and 13% less likely to conceive than those with MUN 10 to 14 mg/dl for the same period (P<0.09). The continuous MUN variable in WC and ALL models predicted conceptions outcome for services within two wk after MUN test, but was not significant for services within two wk before MUN sample date (P<0.06). Lower MUNs, with the exception of <6 mg/dl, at the time of insemination were associated with improved CR.

Key Words: Milk urea nitrogen, Conception rate

T14 The effect of daily drenching with propylene glycol during the transition period on LH pulsatility and the fate of the first follicle wave in dairy cows. S. T. Butler* and W. R. Butler, Cornell University.

The early postpartum period in high producing dairy cows is characterized by chronic severe negative energy balance, hypoinsulinemia, hypoglycemia, and inadequate LH pulse frequency resulting in a varying duration of anovulation. This experiment was carried out to determine if a daily transient elevation in insulin and glucose could ameliorate the detrimental effects of negative energy balance on LH pulsatility and the fate of the first follicle wave. Mature Holstein cows were drenched with either 500 ml of propylene glycol (PG; n=30) or water (CTL; n=29) daily from day -10 prior to parturition until day 25 postpartum. Transrectal ultrasound examinations of ovarian follicle development were carried out on 3 days per week from day 10 until day 30. Frequent blood samples (every 10 minutes) were collected via indwelling jugular catheters from a sample of 10 cows from each treatment group on day -10, 2, and 25 to assess the glucose and insulin response to the treatments. In addition, on day 10 postpartum blood samples were collected at 10 min intervals for 12 hours to determine treatment effects on LH pulse profiles. Both insulin and glucose were elevated on day -10, 2, 10 and 25 following PG administration (treatment vs. time, P<0.01). Our 10 day workup, the number of LH pulses (7.8 ± 0.5 vs. 7.1 ± 0.5 pulses per 12 hours; P<0.1), mean LH (0.56 ± 0.05 vs. 0.46 ± 0.10 mg/ml; P>0.1) and pulse amplitude (0.56 ± 0.07 vs. 0.50 ± 0.7 mg/ml [peak # base]; P>0.1) were not different between CTL and PG cows respectively. The proportion of dominant follicles that became ovulatory (10/29 vs. 11/30), non-ovulatory (18/43 vs. 15/30) and cystic (6/29 vs. 4/30) between day 10 and 30 postpartum were not different between CTL and PG cows respectively. The results indicate that daily drenching from day -10 to
25 relative to parturition with propylene glycol had little effect on LH pulsatility or on the outcome of the first follicle wave.

Key Words: LH, Ovary, Propylene glycol

T15  Reproductive and metabolic parameters associated with low postovulatory progesterone secretion in lactating dairy cows. G. E. Mann1, L. M. Hicking2, and D. Blache2, 1University of Nottingham, Sutton Bonnington, UK, 2University of Western Australia, Nedlands, Australia.

In dairy cows, inadequate progesterone secretion following mating is an important cause of early pregnancy loss though the reasons for this reduced secretion of progesterone are not known. The aim of this study was to determine the reproductive consequences of low postovulatory progesterone secretion and to identify parameters associated with this problem. Milk progesterone concentrations were determined on day 5 following first insemination in 96 lactating Holstein Friesian dairy cows. Low progesterone was empirically defined as a milk progesterone concentration of <0.15ng/ml while high progesterone was defined as any concentration greater than this value. Of the 96 cows sampled, 15 (15.6%) had low milk progesterone concentrations (<0.15ng/ml) and 81 cows (84.4%) had high milk progesterone. Mean milk progesterone concentration was 1.9±0.2ng/ml in the low group and 6.8±0.3ng/ml in the high group. Conception rate in the low progesterone group (13.5%) was significantly lower (P<0.01) than in the high progesterone group (58.8%). However, there was no difference between low and high progesterone cows in the days from calving to first insemination or in the day of initiation of first luteal activity. Milk yield in the low progesterone group (36.9±1.5 l/d) was not significantly different to that in high progesterone group (48.9±1.4 l/d). Body condition score (0 to 5 scale) in the low progesterone group (1.4±0.1) was significantly lower (P<0.01) than in the high progesterone group (1.8±0.1) as was plasma leptin concentration (1.4±0.2 vs 2.2±0.2 ng/ml; P<0.05). There were no significant differences in plasma concentrations of urea, beta hydroxybutyrate or glucose between the low and high progesterone groups. In conclusion, low day 5 progesterone resulted in a severely reduced pregnancy rate and was associated with reduced condition score and plasma leptin concentrations but was not associated with increased milk yield or altered blood metabolites.

Key Words: Milk progesterone, Cow, Pregnancy

T16  Effect of gossypol intake on plasma and uterine gossypol concentrations and on embryo development and viability in vivo and in vitro. M. Villaseñor1, J. H. Kirk1, B. Puschner1, and L.M.C. Pegoraro, 1University of California - Davis, 2EMBRAPA - Brazil.

Forty-eight postpubertal Holstein heifers (13 mo; 380 kg of BW) were blocked by age and BW and randomly assigned to one of three isocaloric and isonitrogenous diets differing in their free gossypol (FG) content: control (C; 0 mg of FG/kg of BW); medium (M; 20 mg of FG/kg of BW); and high (H; 40 mg of FG/kg of BW). Cracked Pima cottonseed was used as a source of gossypol. Heifers were fed diets for 30 d and then estrus was synchronized with an injection of GnRH (Cystorelin- Merial Ltda) and insertion of a progesterone implant (CIDR- Pharmacia Animal Health), followed 7 d later by an injection of PGF2a (Lutalyse-Pharmacia Animal Health). Heifers were ultrasonaged every 24 h during an entire estrous cycle. Follicle and CL development, and plasma progesterone concentrations were evaluated daily and plasma gossypol concentrations were evaluated once at the end of the cycle. Continuous data were analyzed by the GLM procedure of SAS (2001) and repeated measurements over time were analyzed by the MIXED procedure of SAS (2001). Emergence of first and second follicular waves (FW) were similar (P>0.15) for C (1.1 and 9.1 d), M (1.0 and 8.9 d), and H (1.9 and 8.8 d). Deviation of the dominant follicle (DF) was similar for C, M, and H (3.5 vs 3.5 vs 3.9 d). Deviation of the second FW (C=4.0 vs M=4.6 vs H=4.5; P=0.61) was not affected by treatments. Treatment had no effect on CL growth throughout the estrous cycle (P=0.68). Estrous cycle length, maximum follicular diameter for the DF and the second FW, period of follicle dominance for the DF of the first and second FW, and diameter of ovulatory follicle were not influenced by dietary gossypol intake. Results indicate that consumption of up to 40 mg of FG/kg of BW does not influence follicle and CL development in dairy heifers. A.C. Coscioni: Supported by CAPES, Brazil

Key Words: Gossypol, Heifer, Follicle development

T17  Effect of gossypol intake and plasma gossypol concentrations on follicle development and luteal function in dairy heifers. A. C. Coscioni1,1, K. N. Galvao1, M. Villaseñor1, J.E.P. Santos1, B. Puschner1, and L.M.C. Pegoraro2, 1University of California - Davis, 2EMBRAPA - Brazil.

Twenty-seven postpubertal Holstein heifers (13 mo; 380 kg of BW) were blocked by age and BW and randomly assigned to one of three isocaloric and isonitrogenous diets differing in their free gossypol (FG) content: Control (C; 0 mg of FG/kg of BW, N=8); medium (M; 20 mg of FG/kg of BW; N=9); and high (H; 40 mg of FG/kg of BW; N=10). Cracked Pima cottonseed was used as a source of gossypol. Heifers were fed diets for 30 d and then estrus was synchronized with an injection of GnRH (Cystorelin- Merial Ltda) and insertion of a progesterone implant (CIDR- Pharmacia Animal Health), followed 7 d later by an injection of PGF2a (Lutalyse-Pharmacia Animal Health). Heifers were ultrasonaged every 24 h during an entire estrous cycle. Follicle and CL development, and plasma progesterone concentrations were evaluated daily and plasma gossypol concentrations were evaluated once at the end of the cycle. Continuous data were analyzed by the GLM procedure of SAS (2001) and repeated measurements over time were analyzed by the MIXED procedure of SAS (2001). Emergence of first and second follicular waves (FW) were similar (P>0.15) for C (1.1 and 9.1 d), M (1.0 and 8.9 d), and H (1.9 and 8.8 d). Deviation of the dominant follicle (DF) was similar for C, M, and H (3.5 vs 3.5 vs 3.9 d). Deviation of the second FW (C=4.0 vs M=4.6 vs H=4.5; P=0.61) was not affected by treatments. Treatment had no effect on CL growth throughout the estrous cycle (P=0.68). Estrous cycle length, maximum follicular diameter for the DF of the first and second FW, period of follicle dominance for the DF of the first and second FW, and diameter of ovulatory follicle were not influenced by dietary gossypol intake. Results indicate that consumption of up to 40 mg of FG/kg of BW does not influence follicle and CL development in dairy heifers. A.C. Coscioni: Supported by CAPES, Brazil

Key Words: Gossypol, Embryo, Heifers

T18  Effect of gossypol intake on plasma and uterine gossypol concentrations and on embryo quality and development in superovulated Holstein dairy heifers. A. C. Coscioni1,1, M. Villaseñor1, K. N. Galvao1, R. C. Chebel1, J.E.P. Santos1, J. H. Kirk1, B. Puschner1, and L.M.C. Pegoraro2, 1University of California - Davis, 2EMBRAPA - Brazil.

Seventy-four postpubertal Holstein heifers (13 mo; 380 kg of BW) were blocked by age and BW and randomly assigned to one of three isocaloric and isonitrogenous diets differing in their free gossypol (FG) content: Control (C; 0 mg of FG/kg of BW, N=21); medium (M; 20 mg of FG/kg of BW; N=26); and high (H; 40 mg of FG/kg of BW; N=25). Cracked Pima cottonseed was used as a source of gossypol. Heifers were fed diets for 60 d prior to superovulation. Supercycle development with 8 decreasing doses of PSH started on d 9 of the estrous cycle. Heifers were inseminated twice, 12 h apart, with the first insemination when estrus was first detected. Heifers were flushed on d 7.0 after the initial AI and embryos evaluated. Blood and uterine flush samples were collected and evaluated for the gossypol concentration. Embryos graded as 1 to 3 were frozen and evaluated again after thawing. Continuous, binomial, and count data were analyzed by the GLM, LOGISTIC, and GENMOD procedures of SAS (2001) program. Number of embryos grades 1 and 2 was similar for C, M, and H and averaged 3.3 (P=0.29), but number of unfertilized oocytes, grade 3 and degenerated embryos was higher for H than C and M (5.6 vs 2.9 vs 0.5; P<0.01). Total number of cells in fresh frozen embryos were similar for C, M, and H (16.6 vs 14.8 vs 16.4; P=0.40). However number of live cells was higher for C compared to M, but did not differ from H (13.5 vs 10.4 vs 12.2; P=0.05). Similarly, percent of total live cells was higher for C compared to M, but did not differ from H (80.2 vs 72.2 vs 78.1; P=0.02). Hours of development in in vitro cultured embryos was reduced by GAA (77.1 vs 64.9h; P=0.05), but no interaction between heifer diet and culture medium was observed (P=0.56). An interaction between heifer diet and culture medium was observed for the proportion of live embryos after 96h of culture (P=0.10). Number of cells after culture was higher for C than M and H (23.1 vs 20.3 vs 14.6; P<0.01), but culture medium did not influence cell numbers (P=0.50). High gossypol diet and GAA in the medium influenced negatively embryo quality and development.
**T19** Enhancing ability of bovine sperm to survive cryopreservation with cyclodextrin and cholesterol. A. Kaya1,2 and J. J. Parrish1. 1University of Wisconsin Madison, Wisconsin, 2University of Selçuk Konya, Turkey.

Protection of plasma membrane integrity during cryopreservation of spermatozoa is important for their fertility ability. The objective of this study was to determine the optimal dose of cholesterol-loaded cyclodextrin (CLC) resulting in an increase in the post-thaw characteristics of bull semen. Sperm was initially diluted to 120 x 10^6 sperm/ml in a Na citrate buffer composed of 63 mM Na citrate, 55 mM glucose and at pH = 7.0. The CLC was dissolved in TALP medium containing 3 mg/ml of BSA. The solution was added to the sperm suspension at various doses of CLC (0, 1.25, 2.5, 3.75, 5 and 7.5 mg/100x10^6 sperm/ml) and incubated 15 min at room temperature. The sample was then processed by standard freezing procedures. Post-thaw sperm characteristics were evaluated for motility using time-lapse photography of fluorescently labeled sperm nuclei, sperm with intact acrosomes (wet mount, DIC) capacitation status in response to lysophatidicholine (LPC), sperm viability assessed using SYBR-14 and propidium iodide (PI) and functional integrity of sperm membrane using hypoosmotic swelling (HOS) test. The CLC addition to the extender did not differ significantly in sperm motility, intact acrosome and capacitated sperm rates (P>0.05). However sperm treated with 1.25 and 2.5 mg CLC had improved sperm viability (69.0% and 69.2% vs. 58.5%) and membrane functional integrity (59.8 and 51.8% vs. 36.5%) compared to control, respectively (P<0.01). Additionally, 3.5 mg of CLC also resulted in an increase in the response to the HOS test (47.8% vs. 36.5%; P<0.05). These results indicate that sperm treated with the lower doses of cholesterol-loaded cyclodextrin could modify sperm plasma membranes resulting in an increase post-thaw viability and osmotic responsiveness. Supported by State of Wisconsin and American Breeders Service Global.

**Key Words:** Cholesterol, Cyclodextrin, Sperm freezing

**T20** Wisconsin avian extender yields better post-thaw motility for rooster semen than Minnesota avian extender after cryopreservation. L. E. Enwall1, A. Kaya1, L. N. Geiger1, and J. J. Parrish1. 1University of Wisconsin Madison, Wisconsin, 1Selçuk University Konya, Turkey.

Reliable and consistent protocols for the successful freezing of avian sperm remain somewhat elusive especially in comparison to the success enjoyed by the bovine industry. We developed an extender, Wisconsin avian extender (WISA) and compared it to Minnesota avian extender (MNA) with differing final concentrations (6%, 11%, 14%, and 19%) of glycerol. WISA is a modification of a Tyrode’s based medium used to incubate bovine sperm in an air atmosphere. Sperm was pooled from 4-12 roosters, diluted 1:2 with extender, frozen in 0.5 ml straws over 24h, and then immersed in liquid nitrogen. Sperm was thawed in a water bath at 35°C for 1 minute then semen diluted 1:10 into the same base extender, either WISA or MNA. Two separate operators assessed motility of thawed semen visually. Sperm frozen without glycerol did not survive. At the lowest final concentration of glycerol, 6%, neither treatment yielded greater than 15% average motility and were not statistically different from one another although both were different from the WISA at 11%, 14%, and 19% glycerol concentrations (p<0.001). At final glycerol concentrations of 11%, 14%, and 19%, WISA demonstrated a far more significant (p<0.001) advantage in preserving sperm motility after thawing. None of the 11%, 14%, and 19% MNA/glycerol treatments exceeded 10% average motility while the comparable WISA treatments exceeded 30%, 40% and 40% motility respectively. Although motility is not necessarily indicative of fertility, these results indicate that WISA is a strong candidate for the cryopreservation of rooster sperm.

**Key Words:** Cryopreservation, Semen, Rooster


The objective of the study was to evaluate the effect of time and fluid volume on the rate of sperm settling using a commercial extender with special interest in uniform concentration distribution during semen dose preparation. To analyze sperm settling rate, three extended semen volumes (10, 80, and 1000 mL) were placed in each of six 15 ml conical tubes, each of 100 ml AL tube, and a 1000 ml glass beaker, respectively, were sampled from three areas of each container (top, middle, and bottom). Samples (0.5 ml) were drawn from each container at the three levels and each time point using a glass pipette. Samples contained 3.75 x 10^6 spermatozoa/ml from a pool of two boars of known fertility. Sperm concentration was determined with a hemacytometer, which was verified in an earlier study with a hemacytometer. Samples were taken at 0, 5, 10, 20, 40, and 80 minutes. However for statistical analysis, times were blocked into three groups, T1 = 0 and 5 min, T2 = 10 and 20 min, T3 = 40 and 80 min. Initial sperm concentration was similar among the three treatments volume. Furthermore, settling rate by volume interactions, as measured by sampling the top, middle, and bottom, areas was not present (P>0.1). However, semen concentration over time varied among the three areas sampled (p<0.01). Top, middle, and bottom concentrations were similar for T1, however, for T2, more sperm were recovered from the bottom than from the top (3.1 vs. 3.3 x10^6, respectively, p<0.01). Similarly, sperm numbers were different at T3 for the top, middle, and bottom (2.5 vs. 2.9 vs. 5.1x10^6, respectively, p<0.01). In summary, sperm settling appears to depend upon time, but not necessarily volume. Based upon these conditions, settling occurred between 10 and 20 minutes regardless of volume. The results of this experiment show that extended semen should be remixed before dose distribution if the semen is left undisturbed for more than 10 minutes.

**Key Words:** AI, Boar, Sperm concentration


Rozeboom et al. (Swine AI News Bulletin vol. IX. 2000) suggested a minimum requirement of 10 to 12% seminal plasma (SP) in semen diluted for AI use to maintain high fertility. As part of an ongoing study of ejaculate quality and boar fertility, the impact of differing percentages and absolute amounts of seminal plasma on fertility outcomes was examined. The first sperm rich fraction of ejaculates collected from nine boars twice weekly over 7- to 8-month periods was diluted to 1.5 billion morphologically normal sperm in 50 mL BTS extender, and used to breed at least 55 gilts. Boars differed consistently for pregnancy rate (73 to 98%; P < 0.0003) and farrowing rate (71 to 98%; P < 0.0003) and two boars (GI, R1) were identified as being less fertile. Total born was affected by both boar (8.8 to 12.0; P < 0.001) and time (9.5 to 11.1; P = 0.038), with no boar x time interaction. In contrast, a boar x time interaction (P < 0.0001) existed for percentage of SP (range 4.9 to 20.7%) and total volume of SP (range 2.5 to 10.3 mL) per AI dose, and a lack of significant correlations between SP inclusion and proven fertility suggests that even at low sperm numbers, the amount of SP per AI dose did not critically affect fertility. Unpublished data in the boar and other domestic species suggest that specific boar SP proteins make be related to differences in boar fertility. Our initial results indicate that although total protein concentration in raw semen SP was different among boars (19.13 to 37.97 mg/mL; P = 0.029), total SP protein in diluted semen did not differ among boars or times, and hence showed no meaningful correlations with proven differences in boar fertility. Associations with specific SP proteins are presently being evaluated.

**Key Words:** AI, Boar, Sperm concentration


The National Animal Germplasm Program’s (NAGP) charge is to develop cryopreserved collections of animal genetic resource. Effective implementation of sperm cryopreservation in the program requires freezing protocols that can be employed across genotypes. Therefore, semen was collected from Yorkshire (YK, n=4) and Composite (CP, n=5)
boars to evaluate three extenders: BF5, LEY and BF5 containing 2-hydroxypropyl-beta-cyclodextrin added (BF5CD). The literature has suggested adding cyclodextrin to boar semen extenders improves post-thaw viability. Post-thaw measurements were performed with computer assisted sperm analysis (CASA) for motility (MOT), cell area, track speed (VCL) and straightness of cell movement (STR). CASA readings were taken on each extender breed combination from post-thaw time 0 (T-0) and a subsequent reading at 105 minutes (T-105). Post-thaw CASA characteristics were evaluated using a mixed model (SAS, 2002).

Model main effects were: extender, breed and extender*breed as fixed effects, while boar nested within breed was random. For evaluating pre-freeze and post-thaw cell area the inverse of cell area was used to normalize the data. The effect of extender*breed for MOT and VCL were highly significant at T-0. The YK-BF5 combination caused the interaction by increasing MOT to 52.3% vs. 30.6% and VCL to 145.6 vs. 121.3 the mean for all other extender breed combinations. For the response variables STR and cell area the BF5 extender yielded better post-thaw performance (P<.01). Boar nested within breed was found to be significant at T-0, with MOT ranging from 4 to 70%. However, by T-105 boar within breed was not significant for any of the traits measured. At T-105 BF5 held a significant advantage over LEY and BF5CD. These results do not support previous work showing BF5CD as affording better cryoprotection when compared to BF5. Given these results the extender of choice for preserving boar semen in the NAGP repository is BF5. As new extenders become available additional testing of genotypes and extenders will be performed.

Key Words: Cryopreservation, Boars, Genetic conservation

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**T24** Effect of fetal bovine serum on the development of in vitro produced porcine embryos. J. N. Caamano*1, J. Mao1, T. C. Cantley1, A. R. Rieke1, R. Farwell1, C. Murphy1, B. A. Didion2, and B. N. Day1, 1University of Missouri, Columbia MO, 2Monsanto, St. Louis, MO.

The objective of the experiment was to assess the effect of adding Fetal Bovine Serum (FBS) to the embryo culture medium (NCSU-23) on days 3, 4 or 5 after in vitro fertilization (IVF) on embryo development of in vitro produced porcine embryos. In vitro maturation, fertilization and embryo culture were performed following established procedure (Abeydeera et al., 2000; Theriogenology 54:787-797) in our laboratory. In Experiment 1, embryos were selected and placed in a well after 72 h in culture. From this pool, embryos were randomly allocated to treatment groups. Groups of embryos were placed on day 3, 4 or 5 after IVF in NCSU-23 medium with the addition of 0.4% BSA or 10% FBS. Blastocyst formation was assessed on day 6 to 9 after IVF. Only excellent/good quality blastocysts were included in the analysis. Results are presented in Table 1. There was an advantage for FBS when added on day 4 or 5 to the culture medium but not when was added on day 3 after IVF. In Experiment 2, FBS/BSA were added on day 4 and blastocyst cell number was assessed on day 6 after IVF. Average embryonic cell number was higher (P<.05) in embryos cultured in the presence of FBS (41.6 ± 2.1) than in the presence of BSA (35.4 ± 2.2). It was concluded that FBS could exert a differential effect on embryo development depending on the day that it was included in the culture medium. Table 1: Embryo development of in vitro produced embryos in NCSU-23 with the addition of Fetal Bovine Serum or BSA

<table>
<thead>
<tr>
<th>Media</th>
<th>Day 6*%Total Blast.</th>
<th>Day 7*%Total Blast.</th>
<th>Day 7*%Hatched Blast</th>
<th>Day 8%Hatched Blast</th>
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</thead>
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<tr>
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<tr>
<td>NCSU-FBS 2</td>
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<td>NCSU-FBS 3</td>
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*Within columns, Least Squares Means without a superscript in common are different (P<.05). ** Within columns, Least Squares Means without a superscript in common are different (P<.01).

Key Words: Embryo culture, Porcine embryos, Fetal bovine serum

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The developmental competence of the oocyte is acquired progressively during late follicular growth. In conventional in vitro porcine oocyte maturation and fertilization procedures, immature oocytes are aspirated from 2- to 6-mm follicles. This experiment was conducted to test the hypothesis that the developmental potential of oocytes collected from different-sized follicles was different. Prepubertal gilt ovaries were obtained from a local abattoir. Oocytes were aspirated from three groups of follicles: 2.0-4.0 (small), 3.1-5.0 (medium), and 5.1-7.0 mm (large) in diameter. Oocytes were cultured in basic maturation medium (TCM199) supplemented with 0.5 μg/ml FSH and 0.5 μg/ml LH for 22 h, then transferred to TCM199 without hormones and cultured for another 22 h. After culture, oocytes were scored for cumulus cells and fertilization with cryopreserved ejaculated spermatozoa for 6 h. In part 1 of the experiment, oocytes were cultured until day 6 post-fertilization. Cleavage rate at 48 h and the percentage of blastocysts on day 6 was determined. Data were analyzed using SAS general linear model. The cleavage rate and proportion of oocytes developed to blastocyst stage on day 6 were 55.1 ± 2.5% (n = 290), 50.4 ± 1.5% (n = 969), and 44.8% ± 3.9% (n = 188). The polyspermic fertilization rate (3 or more pronuclei in the oocyte) was 42.9, 40.0 and 48.8% for the large, small and medium follicle groups (P<0.05). It was concluded that oocytes aspirated from medium- and large-size follicles are more competent compared those collected from 2-3 mm follicles. However, the incidence of polyspermic fertilization is not different among them.

Key Words: In vitro maturation, Follicular size, Porcine
Non-lactating cows were used to examine effects of bST on uterine proteins and gene transcripts encoding components of the IGF system. Cows (n=85) were injected on d10 (d0 = timed insemination [TI]) with bST (100 μg i.m., Lutalyse®) and monitored 74 h later for pregnancy diagnosis (estrus = d 0). Corpora lutea (n=5/treatment) were collected on d11, 13, 15, 20, 30 and 40 of pregnancy. Endometrial mRNA expression of Smad1 was lower (P = 0.03) on d15 after injection of PGF2α, GnRH (d-1) was administered, and 16 h later (d0) 55 cows were TI and 29 cows were not TI (cycling). On d0 and d11, cows received either bST (500 ng, n=52) or no bST (n=33). A follicular cyst was detected on d0 in 7 cows and on d 7 in 5 cows. CL regression prior to d16 was observed in 2 cows. These 14 cows were not slaughtered; 22 cyclic and 49 TI cows were slaughtered on d17. Uteri were flushed with 40 ml of PBS to recover uterine flushings and verify presence of a conceptus. Ligand Blot analyses for IGFBPs in uterine flushings were done on 19 cyclic and 18 pregnant cows. Endometrial tissues were collected from 14 cyclic and 16 pregnant cows for Northern blot analyses. Ligand blots revealed IGFBP-3, 4, 5 and molecular weight protein 28-29 kDa in flushings from all cows. IGFB-binding protein-3 (IGFBP-3) was higher in bST treated pregnant cows (P < 0.05) compared to pregnant control cows. The IGFBP-4, IGFBP-5 and molecular weight protein 28-29 kDa proteins were higher in cyclic versus pregnant cows (P < 0.01). Northern blot analyses detected IGF-1, IGFBP-3, IGF-II and IGFBP-2 mRNA sequences in endometrial tissues from all cows. However, growth hormone receptor (GHR), 1.5 mRNA was detectable in all cows. Interactions between status and bST (P < 0.01) were detected for the mRNAs encoding IGF- I, IGFBP-3, IGF-II and IGFBP-2. The mRNAs for IGF-1, IGFBP-3, IGF-II and IGFBP-2 increased in bST treated cyclic cows; furthermore, pregnancy increased IGF-II and IGFBP-2 in control cows. In conclusion, differential uterine responses were detected in response to bST and pregnancy status in non-lactating Holstein cows.

Key Words: Cycle-pregnancy, bST, IGF-family


Uterine capacity contributes to litter size in swine. Previous gene mapping analyses revealed a quantitative trait locus (QTL) for uterine capacity on chromosome 8. Comparison of porcine and human genomic maps suggests that the Smad1 gene is located near this region. Smad1 regulates signal transduction from TGF-β family ligands, including TGF-β and bone morphogenetic proteins. In addition, Smad1 mutation in mice causes defects in allantois formation. To further explore Smad1 as a candidate gene for the uterine capacity QTL, we 1) cloned and sequenced the full coding region for Smad1, 2) examined endometrial expression of Smad1 during the estrous cycle and early pregnancy, and 3) mapped the Smad1 gene. By iterative screening of a porcine expressed sequence tag library, we obtained 2161 and 2077 bp cDNA clones and 3′ untranslated regions while their coding regions were identical, suggesting differential splicing. The inferred amino acid sequence of Smad1 as a candidate gene for the uterine capacity QTL.

Key Words: Uterine capacity, Coding region, Mapping


Nitric oxide (NO) has emerged as a molecular messenger that mediates biological processes in several mammalian tissues. Nitric oxide is synthesized from L-arginine by one of three different NO synthase (NOS) isozymes, two constitutively expressed, endothelial (eNOS) and neuronal nitric oxide synthase, and one inducible (iNOS). Nitric oxide has been implicated in the regression of the corpus luteum (CL). Therefore, relative amounts of mRNA encoding eNOS and iNOS were examined in the bovine CL by real-time RT-PCR during the early- and mid-luteal stages and in response to PGF2α. Twenty cows were synchronized with 25 mg PGF2α (i.m., Lutalyse®) and randomly assigned to one of four treatments (estrus = d 0). Corpora lutea (n = 5/treatment) were collected via ovarioectomy during early-luteal (d 5; early), mid-luteal (d 12; mid), mid-luteal, 6 h after PGF2α injection on d 12 (mid-6), and mid-luteal, 24 h after PGF2α injection on d 12 (mid-24). Immediately after collection, CL were snap frozen in liquid nitrogen and stored at −80°C. Total RNA was extracted from each CL and amplified in duplicate by real-time RT-PCR. Corpora lutea collected in the early-luteal stage tended to have less mRNA encoding eNOS than those from mid-luteal stage cows (0.07 ± 0.22 ± 0.05 arbitrary units, early and mid, respectively; P = 0.09) whereas early and mid mRNA encoding iNOS did not differ (P = 0.90). When the CL in mid, mid-6, and mid-24 were compared for mRNA encoding iNOS, mid and mid-24 were greater than mid-0 (0.45, 0.14, 0.47 ± 0.09 arbitrary units, mid, mid-6, and mid-24, respectively; P = 0.03). A similar trend was also observed for eNOS (0.22, 0.02, 0.27 ± 0.09 arbitrary units, mid, mid-6, and mid-24, respectively; P = 0.14). Relative amounts of mRNA encoding iNOS were similar whereas mRNA encoding eNOS tended to differ in the early and mid-luteal bovine CL. Moreover, mRNA encoding iNOS differed, and eNOS tended to be altered, in response to PGF2α, suggesting that PGF2α may regulate amounts of mRNA encoding NOS in the bovine CL.

Key Words: Nitric oxide synthase, Bovine, Corpus luteum

T29 Factors affecting postpartum placental blood volume. A. L. Riddle* and H. D. Tyler, Iowa State University, Ames, IA.

The objective of this study was to determine factors affecting the volume of blood retained in the placenta following delivery of the calf. In addition, we developed a technique for accurately measuring the volume of blood retained in the placenta following delivery. Optimal delivery conditions can improve both the short term and long term health status of the calf. Fifteen Holstein cows and heifers were placed in a maternity barn approximately 3-4 d prior to their estimated delivery date. An electronic birth monitoring system was used to determine the initiation of stage 2 labor. The umbilical cord was clamped during the delivery process. Calves were separated into two groups: those with cords clamped prior to the first breath or simultaneous with the first breath (n=7) and those with cords clamped approximately one-minute after the first breath (n=8). The first breath was considered as the first inspiration (gasp) of air. Blood samples were collected from the jugular vein of the calf immediately after birth to determine hemoglobin concentrations. Placentae were evaluated within 12 h after expulsion. Cotyledon color, cotyledon number, hemoglobin concentration from all cotyledons, placental weight, and cotyledon weight were recorded. Blood remaining within the placenta was calculated using an algorithm that included cotyledony weight, cotyledony [Hb], and calf blood [Hb]. Multiple regression analysis was used to identify explanatory variables associated with each response variable. Response variables included placental blood volume and placental expulsion time. Factors that affected placental blood volume included cotyledon hemoglobin concentration (P < 0.001), placental weight (P < 0.01), and calf hemoglobin concentration (P < 0.01). The only factor that significantly affected placental expulsion time was the weight of the placenta (P < 0.01). These data suggest that placental blood transfer does not appear to affect placental expulsion time in cattle.

Key Words: Placenta, Placental blood volume
Previously, leptin and leptin receptor have been identified in the mammary gland and in mammary epithelial cells. To further investigate the developmental regulation of leptin and its receptor, quantitative real time polymerase chain reaction was used. Primers specific to leptin, long form leptin receptor, short form leptin receptor or glyceroldehyde-3-phosphate dehydrogenase (GAPDH, internal control) were synthesized. Female C57BL/6J mice were mated and mammary tissue excised at various stages of pregnancy or lactation. mRNA was extracted from mammary tissue, reverse transcribed and amplified in the presence of SYBR Green dye. Fluorescence was monitored each cycle and change in leptin, leptin receptor or short form leptin receptor assessed relative to GAPDH internal control. Leptin expression increased during early to mid pregnancy, reaching a maximum of 1.90.08 times non-pregnant control on day 15 of pregnancy. Leptin expression then declined during late pregnancy and was 1.10.08 at the initiation of lactation. Short form leptin receptor expression increased during early to mid pregnancy, reaching a maximum of 1.20.05 on day 15 of pregnancy, while a decline during late pregnancy was observed and was 0.80.05 at the initiation of lactation. Long form leptin receptor expression increased during mid to late pregnancy with a maximum of 1.40.1 on day 15 of pregnancy, with a resulting decline of expression at the initiation of lactation of 0.90.07. These results indicate that the expression of leptin and leptin receptor were altered during pregnancy, with the highest expression of each during mid pregnancy.

Key Words: Leptin, Leptin receptor, Mammary gland

T31 Impact of growth factors on expression of leptin and leptin receptor in cultured mammary epithelial cells. J. L. Smith and L. G. Sheffield*, University of Wisconsin, Madison.

To determine the impact of various growth factors on expression of leptin and leptin receptor in mammary epithelial cells, cultured murine mammary epithelial cells (NMuMG line) were serum deprived for 24 hours and treated with insulin, IGF-I or epidermal growth factor (EGF). mRNA was extracted, reverse transcribed and used for real time quantitative polymerase chain reaction. Primers specific for leptin, long form leptin receptor or short form leptin receptor were used to amplify their respective mRNAs, which were then compared to a glyceraldehyde-3-phosphate dehydrogenase (GAPDH) internal control. Maximum expression of leptin to insulin was 4.00.3 fold over control with 1 ng/ml at 3 hours. Maximum response of leptin expression to IGF-1 was at 3 hours was 5.40.5 fold over control with 10 ng/ml. Maximum response of leptin expression to EGF was at 0.5 hours was 6.90.7 fold over control with 1 ng/ml. Short form leptin receptor mRNA expression was maximized in response to 1 ng/ml insulin at 1 hour after treatment (3.20.2 fold over control). Maximum response of short form leptin receptor to IGF-1 was with 10 ng/ml at 1 hour (4.30.2 fold increase). Maximum response of short form leptin receptor to EGF was with 1 ng/ml at 6 hours (10.70.5 fold increase). Changes in long form leptin receptor were not as dramatic as leptin or short form leptin receptor, but were detectable. Insulin dose response studies indicated maximum response of a 1.40.3 fold change with 10 ng/ml at 6 hours after treatment. IGF-1 at 100 ng/ml gave a 1.40.2 fold increase at 1 hour after treatment, while EGF at 10 ng/ml gave a 5.10.4 fold increase at 0.5 hours. These studies indicate that leptin expression in the mammary gland is regulated by factors known to alter mammary development. Furthermore, they indicate that both long and short forms of the leptin receptor are regulated in mammary epithelial cells, although to a different extent.

Key Words: Leptin, Leptin receptor, Mammary gland

T32 Local ablation of leptin receptor inhibits mammary alveolar development. J. L. Smith* and L. G. Sheffield, University of Wisconsin, Madison.

Previously, mice lacking leptin and leptin receptor have been shown to have impaired mammary development and lactation. However, whether this defect is due to leptin requirements within the mammary gland or to alterations in systemic physiology is unclear. To determine if leptin receptor deficiency within the mammary gland but in the context of otherwise normal physiology impacts mammary development, mammary gland explants were transplanted from wild-type (Lepr+/+) or leptin receptor deficient (Lepr-/-) donors into gland-free mammary fat pads of 3 week old syngeneic (C57BL/6J) mice. After 7 weeks recovery, mice were mated and euthanized at various stages of pregnancy. Mammary gland development was assessed by whole mount. Basal development of the non-pregnant mammary gland was not different between Lepr+/+ and Lepr-/- mice. Subsequent duct development did not appear to be impaired in Lepr-/- mammary glands. However, alveolar development was dramatically inhibited. By day 15 of pregnancy, Lepr+/+ epithelium had extensive alveolar development, as would be expected at this stage of pregnancy in the mouse mammary gland. However, alveolar development was essentially absent in glands containing epithelium from Lepr-/- donors. Since the only tissue lacking leptin receptor was the mammary epithelium, this suggests that failure of mammary development in Lepr-/- and Lepr-/ mice is due at least in part to a leptin requirement by the mammary epithelial cells. Specifically, these results suggest a role for leptin in alveolar development.

Key Words: Leptin, Leptin receptor, Mammary gland

T33 Evidence for shifts in prolactin sensitivity in cows exposed to long or short day photoperiod during the dry period. A. G. Rius1, T. L. Auchtung1, P. E. Kendall1, T. B. McFadden2, and G. E. Dahl1, 1University of Illinois, 2University of Vermont.

Galactopoietic effects of photoperiod are well established in dairy cattle. Long day photoperiod (LDPP) increases milk production in lactating cattle, whereas dry cows exposed to short day photoperiod (SDPP) produce more milk in their subsequent lactation. Photoperiod also affects circulating prolactin (PRL); LDPP increases, whereas SDPP decreases PRL. While PRL effects are likely not involved in the lactation response, we hypothesize that PRL effects are critical to the dry cow response to photoperiod. The objective of this study was to characterize the effect of photoperiod on PRL and PRL receptor (PRL-r) mRNA expression during the dry period as an index of PRL sensitivity during the transition to lactation. Multiparous Holstein cows were dried off 62 days before expected calving and assigned to either LDPP (16L:8D; n = 19) or SDPP (8L:16D; n = 17). After parturition cows were exposed to ambient lighting conditions. Jugular blood samples were collected and immediately processed for PRL and PRL-r mRNA (in lymphocytes). With regard to production, milk yield was consistently greater in SDPP relative to LDPP cows for the initial 16 weeks of lactation (34.9 vs. 32.5 kg/d) and the difference was significant (P < 0.09) from week 3 to 8. Compared to LDPP, dry matter intake was greater (P < 0.06) in SDPP cows during the dry period (11.7 vs. 9.9 kg/d). Concentrations of PRL did not differ between groups at dry off (LDPP = 21.2 ng/ml; SDPP = 20.5 ng/ml), but were higher (P < 0.05) in LDPP cows at days 30 and 60 compared to SDPP cows (14.9 vs. 8.3 ng/ml). Long and short forms of PRL-r mRNA did not differ between groups at dry off but were higher (P < 0.06) in SDPP cows at days 30 and 60 compared with LDPP cows. In summary, SDPP exposure during the dry period increased PRL-r mRNA expression but decreased PRL relative to LDPP. These data support the concept that greater PRL sensitivity during the transition to lactation may result in the observed increase in subsequent milk yield.

Key Words: Photoperiod, Prolactin, Milk yield


Photoperiod has practical use on dairy farms as its manipulation can increase milk production in dairy cows. Cows on long day photoperiod (LD; 16 h light: 8 h dark) during their lactation have an increase in milk yield compared with cows on natural photoperiod. Studies have also shown that short day photoperiod (SD; 8L:16D) during the dry period increases milk yield of cows in the subsequent lactation. Interestingly, recent studies in hamsters have shown that immune function can be
influenced by photoperiod. The objective of this experiment was to determine if SD during the dry period alters immune function in cows. Multiparous Holstein cows (n = 40) started the experiment an average of 62 d prior to calving. After baseline blood samples were collected, cows were dried off and exposed to LD or SD until parturition. On d 0, 28, and 60 relative to dry-off, and d 2 post-calving, samples were processed for neutrophil chemotaxis and lymphocyte proliferation. Blood samples were collected twice daily from 5 d prior to, until 2 d after calving to assess the partial parietal prolactin (PRL) profile. The partial parietal prolactin surge was greater (P < 0.05) in LD animals relative to SD. Neutrophil chemotaxis was not different prior to treatment (P = 0.29) but subsequently differed (P < 0.05) at all time points measured, with cows on SD having greater chemotaxis than cows on LD. Lymphocyte proliferation was not different between the treatments at dry off (P > 0.20) but was greater (P < 0.05) in SD cows, compared to LD, at all subsequent time points. In conclusion, dairy cows subjected to SD when dry have a reduced partial parietal prolactin surge compared to LD cows. Neutrophils and lymphocytes were proliferated in SD cows compared to LD, suggesting an enhanced immune system in cows on SD when dry. Because, the partial parietal period is a time of increased risk for mastitis, the potential implications for dairy management merits further investigation.

Key Words: Cattle, Immune Function, Photoperiod

**T35** Milk fat decreases when lactating mice are fed selected trans fatty acid containing diets. B. B. Teter1, J. Samspuga1, R. A. Erden1, P. Yurawecz2, and D. Luchini3

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Lactating mice were used as a model to test the effects of trans fatty acid containing diets on milk fat and pup body weight. Diets were formulated based on the AIN-76 diet with fat at 20 % of energy. The control diet (C-9) oil contained cocoa butter, corn oil, olive oil and oleic acid. The test diets used the same mixture but some of the oleic acid was replaced by the isomers to be tested. Five isomer diets were formulated to include up to 5% of energy as the test isomer or isomer mixtures. The five diets were: trans-9, trans-11, cis-9, trans-10, mixed isomers from 0.10 to 3.15 g/100 g fatty acids and the desaturase index from 0.033 to 0.29. Milk yield, DMI and milk protein yield were unaffected by treatments. In contrast, the trans-10, cis-12 CLA supplement reduced milk fat yield by 27% (P < 0.01), whereas the supplement enrichment containing C18:3 conjugated trienes (treatment 3) had no effect on milk fat yield beyond that attributable to its trans-10, cis-12 CLA content. Abomasally infused trans-10, cis-12 CLA was transferred to milk fat with concentrations averaging 1.1 and 1.0 mg/g fatty acids for treatments 2 and 3, respectively. Abomasally infused C18:3 conjugated trienes were also transferred to milk fat, the concentration averaging 4.9 mg/g fatty acids for treatment 3 vs. trace amount in treatments 1 and 2 (<0.1 mg/g fatty acids; P < 0.001). Overall short-term abomasal infusion of C18:3 conjugated triene isomers (cis-6, trans-8, cis-12 and cis-6, trans-10, cis-12) had no effect on milk fat synthesis or other production parameters.

Key Words: CLA, Milk fat depression, Milk fat

**T38** Feeding increasing amounts of conjugated linoleic acid (CLA) progressively reduces milk fat synthesis immediately postpartum. C. E. Moore1, H. C. Hafliger II1, O. B. Mendivi1, D. Luchini2, D. E. Bauman2, and L. H. Baumgard2

1The University of Arizona, 2BioProducts, Inc., Fairlawn, OH, 3Cornell University, Ithaca, NY.

CLA decreases milk fat synthesis in later lactation, but the ability of CLA to cause milk fat depression (MFD) immediately postpartum remains questionable. Multiparous Holstein cows (n = 16) were randomly assigned to one of four rumen-protected (RP) CLA doses (0, 200, 400 and 600 g/d) with each dose providing equal amounts of fatty acids by replacing and balancing treatments with EnerChill® (a RP supplement of palm oil). Doses provided a total of 468 g fatty acids/d and either 0, 74, 148 or 222 g CLA/d, respectively. The CLA supplement contained a variety of CLA isomers as previously described. Each group received treatments from -10 to 21 d relative to calving. To improve palatability and ensure constant consumption, doses were mixed with equal amounts of steam-flaked corn and dried molasses and half the supplement was fed at 0600 and the remaining at 1800 hr. Milk yield and feed
intake were recorded daily, and milk samples obtained from each cow every second day (at both milkings) starting on d 1. There were no overall differences in DMI (20.5 kg/d), milk yield (34.1 kg/d), protein% (3.75), lactose% (4.62) or yield of these milk components. CLA supplementation decreased overall milk fat% in a dose responsive manner (4.38, 3.98, 3.43 and 3.11, respectively) and milk fat yield showed the same linear pattern. The milk fat% dose response was evident during wk 1 (P=0.15) and became highly significant during wks 2 and 3 (4.51, 3.79, 3.03, 2.81 and 3.89, 3.17, 2.77, 2.31% for wk and dose, respectively). The milk fat response pattern was similar with the highest CLA dose decreasing fat yield by 46% in wk 3. On d 21 the highest dose decreased milk fat% and yield by 49 and 56%, respectively. These data clearly indicate RP CLA can markedly (40-50%) induce MFD immediately postpartum without negatively affecting other production parameters and demonstrates the possibility of improving energy balance during the transition period.

Key Words: CLA, Milk Fat

Animal Health

T39 Differences in production traits between scrapie resistant and scrapie susceptible ewes. B. M. Alexander1, R. H. Stobart1, W. C. Russell1, K. I. O’Rourke2, and G. E. Moss1, 1University of Wyoming, 2USDA-ARS.

Scrapie is one of several transmissible spongiform encephalopaties (TSE) including bovine spongiform encephalopathy (BSE). The apparent transmission of BSE to humans in the United Kingdom resulted in a call for eradication of all TSEs in food producing animals. In the United States, scrapie has been detected only in sheep possessing alleles of the prion protein with glutamine (Q) or histidine (H) at codon 171, both reported as Q. Incidence of scrapie infection is rare when animals possess at least one allele for arginine (R) at 171. The objective of the present study was to determine if production traits differed between scrapie resistant (QR and RR) and scrapie susceptible (QQ) animals. Historic records from purebred Columbia (n=240), Hampshire (n=325), Ramboillett (n=227), and Suffolk (n=277) ewes with known genotype at codon 171 were analyzed for differences in birth-type, birth weight, adjusted weaning weight and total kg of lambs weaned per ewe lambing. In addition, influence of lamb genotype on birth weights and adjusted weaning weights was determined from the 2002 lamb crop (n=356). Suffolk ewes with QQ genotype gave birth to more (P<0.001) lambs than QR ewes (1.8 ± .06 vs 1.2 ± .13, respectively). However, QQ Suffolk ewes weaned less (P=0.07) total kg of lamb than QR ewes (63.2 ± 1.13 vs 70.2 ± 2.7, respectively). Although, birth weights from Ramboillett ewes tended (P=0.09) to be influenced by ewe genotype, differences were not noted at weaning or in total kg of lambs weaned. Production trends of Columbia and Hampshire ewes did not differ by ewe genotype. There was no influence of lamb genotype (P=0.34) on birth weight or adjusted weaning weight for any of the breeds analyzed. In conclusion, the scrapie resistance status of the ewe may influence birth-type and weight, but these differences do not appear to influence ultimate lamb production.

Key Words: Genotype, Scrapie, Sheep

T40 Effect of calving season oncolostrum quality and growth of dairy calves in a hot arid region. J. S. Saez∗1, L. Avendaño1, F. D. Alvarez1, T. B. Rentería1, J. F. Moreno1, M. F. Montaño1, and M. P. Gallegos2, 1Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico, 2Universidad Juárez del Estado de Durango, Durango, México.

The objective of the present study was to determine the effect of calving season on colostral immunoglobulin levels (CIL), colostral immunoglobulin transfer (CIT), calf birth weight (CBW), weight at 60 d (W60) and daily weight gain from birth to 60 d of age (DGG) of Holstein calves in a dairy herd located in a desert region of Baja California, Mexico. Calving season was grouped in summer (n=12), autumn (n=24), and winter (n=36). The CIL levels were measured using a colostrometer during the first four milkings postpartum. Blood samples were taken from the jugular vein of calves at birth, 24 and 48 h after partum in order to measure CIT using the ELISA procedure. Calves consumed 2 L of colostrum at 6 and 12 h of age and then 4 L of whole milk until 60 d of age. Calf starter was offered to all calves from the first week of age. Statistical analyses were performed using linear models through analysis of variance in SAS. In the first milking, cows calved during winter had higher (P<0.05) CIL than those calved during summer and autumn (99.2 ± 6.98 vs 85.2 ± 5.33 and 89.28 ± 4.93 mg/ml, respectively). During the following three milkings, CIL was higher for cows calved in winter and autumn than the cows calved during summer (47.5 ± 4.4; 20.0 ± 2.9; 5.83 ± 2.9 mg/ml, in three milkings, respectively). The CBW were higher (P<0.05) in cows calved during winter (35.6 ± 1.9 kg) than those calved during summer (29.6 ± 1.6), but similar (P>0.05) to those cows calved in autumn (32.8 ± 1.3 kg). Weights of calves at 60 d were similar (P>0.05) during summer (65.3 ± 2.91 kg), autumn (64.3 ± 3.23 kg) and winter (67.6 ± 3.36 kg). The DWG were also similar during summer, autumn and winter (0.593 ± 0.03, 0.524 ± 0.02 and 0.534 ± 0.04 kg, respectively). These results indicate that there is a significant effect of hot environmental temperatures on colostral quality and calf birth weight. However, no significant effect of calving season was observed in daily weight gain and weights at 60 d of age.

Key Words: Colostrum, IgG, Pasteurization

T42 The absorption of immunoglobulins from a plasma-based IgG supplement, A. L. Riddle1, H. D. Tyler3, M. L. O’Brien2, K. J. Touchette2, and J. A. Coaslon2, 1Iowa State University, Ames, IA, 2Merrick’s Inc., Union Center, WI.

Calves that fail to absorb adequate amounts of antibodies within the first 24 h after birth have increased susceptibility to infectious diseases and increased mortality rates. Colostrum supplements, such as plasma-based IgG supplements, are useful when colostrum is unavailable, of poor quality, or a potential disease vector. A plasma-based IgG supplement may provide adequate levels of passive immunity to the neonatal calf. The objective of this experiment was to compare the efficiency of uptake of immunoglobulins from three different sources; a plasma-based IgG supplement, the same plasma-based IgG supplement with
an added emulsifying agent, and from colostrum. Twenty colostrum-deprived newborn calves were used for this trial. Immediately following parturition, each calf was fed one of three treatments (colostrum (n=7), plasma-based IgG supplement (n=7), or plasma-based IgG supplement with added emulsifiers (n=6)). Blood samples were collected at 1 h, 6 h, 12 h, 18 h, 24 h, 36 h, and 48 h after birth to determine efficiency of antibody absorption. Calves were monitored for visual signs of illness including refusal of milk, body temperature, and scour scores. All 24 h blood samples were tested for IgG concentration. Peak concentrations of IgG were not different (P > 0.05) between treatments, although apparent efficiency of absorption was higher for the plasma-based products than for colostrum (P < 0.05). Although the emulsifying agent did not further enhance the uptake of immunoglobulins from this product, these data reinforce the value of plasma-based IgG products as a source of supplemental IgG for neonatal calves.

Key Words: Calf, Colostrum, Passive immunity

T43 Practical considerations related to installation and use of commercial pasteurization units for on-farm pasteurizing of milk and colostrum. L. Green, S. Godden, and J. Feirtag*, University of Minnesota.

The objectives of this study were to utilize in-lab experience and self-reported survey data to determine the issues and concerns of on-farm installation and use of two commercial pasteurization units (batch/vat and high-temperature short-time) for on-farm pasteurization of waste milk and colostrum. In-lab experiments, conducted at the University of Minnesota pilot plant, involved pasteurizing milk and colostrum in both a fully automated commercial batch pasteurizer and a manual commercial high-temperature short-time pasteurizer. Several issues arose when initially using both of the commercial pasteurization units. These issues included special set-up requirements with respect to water and electrical requirements, their ease in use of pasteurization of milk and colostrum and cleanliness of the units. Both of the units were successful at pasteurizing milk, while the batch unit had a higher success rate when pasteurizing colostrum. Our study is one of a few studies reporting on whether agglutination is a concern if pasteurizing colostrum in these new commercial available pasteurizers. A 33-question survey was mailed to dairy producers who have implemented either a commercial or homemade pasteurization unit in their operation for the purpose of collecting information on their experiences and degree of satisfaction in installation and day-to-day use of this technology. The questions focused on issues such as pasteurizer design, cost, set-up requirements, service, pasteurizing and feeding milk, and effects on calf health and performance. Twenty-two out of 51 (43%) of the surveys sent to dairy producers implementing pasteurizer units were completed and mailed back. Six farms had a batch/vat unit while 14 farms had a high-temperature short-time (HTST) unit. Overall, 91% (20/22) of the farms felt that they made a good decision in purchasing this technology and feeding pasteurized milk to their dairy calves.

Key Words: On-farm pasteurization, Batch pasteurizer, HTST pasteurizer

T44 Destruction of Mycobacterium paratuberculosis, Salmonella sp., and Mycoplasma sp. in raw milk by a commercial on-farm high-temperature, short-time pasteurizer. J. R. Stabel*, S. Hurd1, L. Calvente2, and R. F. Rosenbusch2, 1USDA-ARS-National Animal Disease Center, Ames, IA, 2Iowa State University, Ames, IA.

The 2002 NAHM’s Dairy Survey indicated that 87.2% of dairy farms had a batch/vat unit while 14 farms had a high-temperature short-time pasteurizer. Of these results suggest that HTST pasteurization of waste milk contaminated with these pathogens may be effective at generating a clean product to feed to young calves.

Key Words: Pasteurization, Neonatal calves, Pathogens

T45 Factors associated with transition cow ketosis incidence in selected New England herds. W. S. Burhans1, A. W. Bell1, R. Nadeau2, and J. R. Knapp2, 1Cornell University, Ithaca, NY, 2University of Vermont, Burlington, VT.

We conducted an observational field study of diet, facility, and management factors associated with transition disorders in 28 dairy herds in New England. From January to April 2002 dry cows (n=657) from a convenience sample of both Holstein (n=22) and Jersey (n=6) herds were enrolled either at entry into the close up dry group (CUD) or at 3 weeks before expected calving. Health events (incidences of clinical disorders and all preventive, therapeutic, and routine interventions or treatments) were diagnosed and recorded by farm personnel. Data on health, management, diets, and facilities during the CUD and FRESH (calving to 30 days postcalving) periods were collected at biweekly herd visits. Random effect (RE=farm) logistic regression and likelihood ratio tests were used to assess factor odds ratios (OR) for ketosis. Associations with ketosis were assessed separately for Diet and Facility by CUD and FRESH period to minimize collinearity. Reference groups were facilities with fixed opening to outside, without headlocks, and with trough waterers. Overall transition period health disorder incidence (any type) was 42.4%, and not different by breed. Ketosis incidence (unadjusted) was greater (P=0.036) in Holsteins (14.2%) than Jerseys (7.9%). Increasing NCP %DM and cNDF %DM was protective in both CUD and FRESH diets. CUD diet increases in metabolizable lysine were protective (OR=0.48, P=0.002); increasing CUD degradable protein raised OR (1,65, P=0.016). Selected factors tabulated below may increase odds by affecting intake. Additional factors associated with ketosis occurrence will be presented.

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<td>1.41-18.25</td>
<td>0.032</td>
<td>1.03-1.66</td>
<td></td>
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<tr>
<td>Waterbowl</td>
<td>2.82</td>
<td>0.073</td>
<td>1.09-7.31</td>
<td>0.016</td>
<td>1.01-214.84</td>
<td></td>
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</tbody>
</table>

Key Words: Ketonis, Health


Cows developing clinical hypocalcemia are known to experience biochemical and physiologic changes that predispose them to other diseases such as mastitis, retained placenta, displaced abomasum, and ketosis. For example, severe hypocalcemia results in higher plasma cortisol which may exacerbate the immunosuppression ordinarily present at calving; a greater decline in feed intake after calving exacerbating the negative energy balance; decreased secretion of insulin, preventing tissue uptake of glucose, and increasing lipid mobilization. Although milk fever is the clinical manifestation of severe hypocalcemia, an emerging concern is subclinical hypocalcemia. Cows suffering from subclinical hypocalcemia...
have few overt clinical signs. However, they may be more susceptible to secondary problems than normocalcemic cows. The objective of this study was to determine the occurrence of subclinical hypocalcemia in U.S. dairy operations. As part of the USDA’s National Animal Health Monitoring System (NAHMS) Dairy 2002 study, blood samples were taken from 1,446 cows within 48 hours of parturition, representing 480 dairy operations in 21 states. Serum was harvested and frozen within 24 hours of collection. The samples were divided in three groups: 1st lactation (n=442); 2nd lactation (n=424); >=3rd lactation (n=580). Subclinical hypocalcemia was defined as serum calcium <8.0 mg/dl. Subclinical hypocalcemia increased with advancing age and represented 25.3%, 43.9%, and 57.8% of 1st, 2nd and >=3rd lactation cows, respectively. Specific management data was also evaluated for association with hypocalcemia. In this study, 38.7% of the animals were identified as being on a DCAD program. Animals on the DCAD program suffered a significantly (P<0.01) lower incidence of subclinical hypocalcemia than those not being offered a DCAD program, with the biggest difference observed in the >=3rd lactation group. Animals with calcium values of >=8 mg/dl also had lower serum NEFAs than those that were <8 mg/dl, indicating that normocalcemic animals were in better energy status than those suffering from hypocalcemia. Subclinical hypocalcemia can induce some of the same secondary disease problems as clinical milk fever and should be viewed as an impediment to the health of a cow.

Key Words: Subclinical hypocalcemia, Anionic diets, Milk fever

T47 The relationship between disease occurrence, feeding management and return over feed.


Dairy producers of many countries throughout the world are becoming increasingly concerned with global competition. Therefore, it has become important to examine the many management factors that affect profitability of the dairy enterprise. The objective of this research is to examine the relationship between profitability as measured by The Ontario Dairy Herd Improvement Corporation’s (DHI) Return over Feed (ROF) index, and herd characteristics (herd size, TMR use, monensin use, facility type, dry cow therapy, and disease prevention). Producers (n=148) were identified through the DHI ROF and Management Club groups. The ROF was calculated from the difference between monthly milk revenue and feed cost. Percent dry matters were taken from provincial averages and herd average cow dry matter intakes were calculated. These intakes were multiplied by fixed market prices to generate feed costs per cow per day. Revenue was calculated based on the Dairy Farmers of Ontario multiple component pricing formula for milk. Herd management information was generated through a phone survey of all participants. In previous studies milk production was determined to have a significant effect on the ROF. However, this current research is focused on management factors used in a replicated 3x3 Latin Square design. For 4 d, cows were fasted and infused intravenously with a 20% TG emulsion derived from tallow, linseed oil, or fish oil. The emulsions were administered for 20 to 30 min every 4 h throughout the 4 d fast at a rate of 0.54 g TG/kg BW/d. Blood samples were taken every 8 h during the fast and liver biopsies were taken prior to and immediately following the 4 d fast. Cows were fed ad lib. for 24 d between the fasts. Infusion of linseed oil emulsion decreased plasma TG concentrations (P < 0.01) compared to tallow and fish oil treatments, which were similar (P > 0.10). There was no effect of treatment on plasma glycerol or glucose concentrations (P > 0.10). The infusion derived from linseed oil decreased plasma non-esterified fatty acid (NEFA) and β-hydroxybutyric acid concentrations (P < 0.05) compared to tallow and fish oil, which were not significantly different from each other (P > 0.10). Overall, plasma NEFA concentrations increased from approximately 100 μM at the start to 700 μM at the end of the fast (P < 0.001). Liver TG content increased 29.9, 16.3, and 44.1 ug/ug DNA during the fast for tallow, linseed oil, and fish oil treatments, respectively; all treatments were different from each other (P < 0.05). In summary, intravenous infusion of a linseed oil emulsion resulted in the lowest hepatic TG accumulation during a 4 d fast, which in part may have been due to lower plasma NEFA concentrations.

Key Words: Fatty liver, Fatty acids, Bovine

T49 Anti-diabetic potentials of Momordica charanta and Andrographis paniculata and their effects on estrus cyclicity of Alloxan-induced diabetic rats.


Momordica charanta and Andrographis paniculata are commonly used herbs by the diabetic folks in Pampanga, Philippines. While the anti-diabetic potential of M. charanta is well established, it is not known whether A. paniculata possesses anti-diabetic property. Moreover, the effects of these herbs on estrous cyclicity of diabetic rats are not known. Thus, in this experiment, we determined the anti-diabetic potentials of M. charanta and A. paniculata and their abilities to restore estrous cycle in Alloxan-induced diabetic rats. Extraction and decocation of M. charanta and A. paniculata, respectively, were administrated orally to Alloxan-induced diabetic rats from the day they showed diabetes through the blood and urinary glucose levels until the last day of the experiment. There were two groups of rats that served as positive (untreated Alloxan-induced diabetes) and negative controls. Rats treated with M. charanta and A. paniculata had higher body weight (BW) and lower feed and water intake compared with positive control start from day 16 (D16) to D26 (P<0.05), though lower BW and higher feed and water intake compared with negative controls (P>0.05). Urinary glucose could not be detected in the M. charanta-and A. paniculata-treated rats from D11 to D26. The blood glucose levels in M. charanta-and A. paniculata-treated rats were significantly reduced from D11 to D26 compared with positive controls (P<0.05) and comparable with negative controls (P>0.05). M. charanta and A. paniculata demonstrated potentials in the restoration of estrous cyclicity at about 8.4 days from the day it was disrupted. The reduction of blood glucose levels and restoration of estrous cycle in Alloxan-induced diabetic rats treated with M. charanta-and A. paniculata indicate that the herbs possess anti-diabetic potentials that could restore impaired estrous cycle.

Key Words: Diabetic, Herbs, Estrus
T50 Induction of apoptosis by butyrate correlates with increasing level of protein ubiquitination in bovine kidney epithelial cells (MDBK). C. Li* and T. Elsasser, USDA-ARS, Beltsville, MD.

While butyrate (BT) is largely regarded as the minor short-chain fatty acid ([butyrate]< [acetate] or [propionate]) formed during microbial fermentation in ruminants, an increasing body of evidence has clearly shown effects beyond those attributable to its function in nutrition. BT modulates cell proliferation, cell invasion, proteolysis, adhesion, proliferation, motility and in particular apoptosis. The body of information in the literature on these effects has concentrated on established cancer cell lines and on the epigenetic effects of physiologic concentrations of BT and other short-chain fatty acids. Effects of BT at the cellular and molecular level in normal bovine cells have not been studied thus far. The aim of this study was to investigate the effects of BT on the established bovine kidney epithelial cell line (MDBK) as a possible model for cell apoptosis. We also compared the effects of BT to those of a known inducer of apoptosis, the histone deacetylase inhibitor, trichostatin A (TSA). MDBK cells were obtained from the ATCC, grown in standard DMEM + 5% serum medium, passed once every 3 days in a 1:10 split, and used at 50% confluence. BT (0 to 10 mM) and TSA (0 to 200ng/ml) were added for an overnight incubation and cells were harvested for assessment of DNA fragmentation (agarose electrophoresis) and protein ubiquitination (western blot). Our results indicated that both BT and TSA induce apoptosis in MDBK cells in a dose-dependent manner (P<0.02, quadratic effect). Increased protein ubiquitination (P<0.05, linear) was detected in whole cell lysates from MDBK cells treated with BT and TSA suggesting a possible pathway through which cell apoptosis may be operating. These results indicate that the MDBK cell line is a useful in vitro model to study factors that impact apoptosis in the ruminant. The cells are responsive to butyrate in terms of both apoptosis and ubiquitination.

Key Words: Apoptosis, Butyrate, Epithelial cells

T51 Anthelmintic efficacy in a Maryland small ruminant flock. C. M. Fletcher, D. J. Jackson, and N. C. Whitley, University of Maryland Eastern Shore.

It was the objective of two EXP to determine anthelmintic efficacy in a flock of meat goats and hair sheep in Maryland. On d0 of EXP1, kids (n=27) and lambs (n=18) 112.9 ± 15.8 days of age were orally administered (n=15/treatment) two times the labeled sheep dosage of Ivermectin (IVM), Tramisol (TRA), or Valbazen (VAL) and fecal samples were collected to determine percentage fecal egg count reduction (FECR). In EXP2, mature does (n=69) and ewes (n=47) were orally administered either the labeled dosage (ewes and all does treated with Cydectin; CYD; n=63) or two times the labeled dosage (does of Safeguard (SGD; n=31) or Levasole (LVS; n=33)) and fecal samples were collected as for EXP1 (d0). On d10, fecal samples were collected to determine FECR. Overall in EXP1, IVM, TRA, and VAL was effective (> 95% egg reduction) in 33.3, 13.3, and 40.0% of the treated animals, respectively with no differences among treatments, indicating overall reduced drug efficacy. FECR for all animals averaged 66.6 ± 7.6%. Moreover, there was an effect of species in which pre-treatment FEC was higher (P<0.04) for goats (3532.2 ± 973.4 EPG) than for sheep (189.7 ± 1217.9 EPG), but there was no effect of species on FECR averaging 71.3 ± 9.4% for goats and 57.4 ± 13.3% for sheep. In EXP2, CYD (71.2 ± 7.7%) was effective in more animals (P<0.001) than LVS and SGD (29.8 ± 7.9% and 30.2 ± 7.7%, respectively) indicating reduced drug efficacy. In addition, FECR was greater (P<0.006) for CYD (92.7 ± 12.3%) than LVS (44.5 ± 12.6%) or SGD (38.3 ± 12.3%). FECR was less (P<0.001) for goats (37.4 ± 8.4%) than sheep (79.7 ± 12.9%). Also, deworming was effective in more sheep (63.9 ± 8.1%; P<0.0001) than goats (23.5 ± 5.3%). Results indicate parasite resistance to anthelmintics in this Maryland small ruminant flock as has been noted in other areas of the world. In addition, hair sheep were more resistant to parasite infection than meat goats under these grazing conditions.

Key Words: parasite, anthelmintic resistance, small ruminants


According to a 1999-2000 survey of cow/calf farmers in Arkansas, the majority of weaned calves are either not treated for internal parasites (30%), or given a broad-spectrum, topical parasiticide (32%). The remainder of the animals are administered an injectable (22%) or oral (16%) parasiticide. The current study was conducted to investigate the ramifications of the most popular practices, i.e. no treatment or topical endectocide. Crossbred weaned calves were grazed on replicated pastures of two herbage types (fescue and Bermuda) over a 119 day post treatment period (4 treatment groups x 2 herbage types x 2 pastures x 5 animals). The pastures were adjoining, and except for herbage characteristics, all were equivalent in regard to prior contamination, maintenance and size (1.6 hectares). The topicals used in the study were those which contained ivermectin (Ivomec® Merial), doramectin (Dectomax® Pfizer) and eprinomectin (Eprinex® Merial). In regard to fecal egg counts, (1) both doramectin and eprinomectin treatments provided significant reductions (P<0.05) from control calf levels through day 119 for animals on Bermuda grass, (2), ivermectin provided significant reduction only through day 82 when the animals were on Bermuda grass and (3), regardless of parasiticide, egg count reductions for fescue-grazed cattle were significant only through day 42. Fecal egg counts were higher for fescue than for Bermuda-grazed calves, with Cooperia and Ostertagia spp accounting for the difference. Contrastingly, Haemonchus placei eggs were of greater abundance from Bermuda than from fescue-grazed calves. For each herbage type, X parastidic combination, average daily gains for the 119 day trial were improved from control levels, albeit not significantly (P<0.09). Key Words: Parasiticides, Cattle

T53 The impact of tunnel ventilation cooling and brown mid-rib (BMR) corn silage on heat stress in lactating dairy cows. R. J. Williams1, A. M. Chapa1, T. O. Riley2, D. O. Pouge2, S. T. Willard1, and T. R. Smith1, Department of Animal and Dairy Sciences, Mississippi State University, North Mississippi Branch Experiment Station, Holly Springs, MS.

Four groups of 10 lactating Holsteins were used to measure the effects of tunnel ventilation cooling and diet on feed intake, milk production and the incidence of mastitis during periods of heat stress. Two groups were housed in a freestall barn equipped with tunnel ventilation cooling. The remaining two groups were housed in an outside freestall barn, cooled with fans and sprinklers. The maximum daytime rectal temperature in the tunnel barn averaged 6°C below that of outside freestall barns. Average exposure time to conditions of moderate heat stress (temperature-humidity index (THI) of 80-90) was reduced 6.75 h/day for cows housed in the tunnel ventilation barn. Maximal daytime rectal temperatures for cows housed inside averaged 0.28°C below (P<0.0001) those for cows housed outside. Furthermore, the maximal daytime respiration rate averaged 6.0 breaths/min lower (P<0.0001) for cows housed inside the tunnel barn than for cows housed outside. There were no significant differences in milk production, milk composition or the incidence of mastitis between housing units. To measure the effect of diet on dry matter intake (DMI) during periods of heat stress, one group in each barn received a diet based on BMR corn silage and the other group received a standard corn silage-based diet (Controls). DMI averaged 2.4 kg/hd/day and did not differ between the 2 dietary treatments. Cows fed the BMR silage averaged 0.5 kg/hd/day more milk than those fed the control silage, but the difference was not significant. Similarly, milk fat production was not affected by diet; however, milk fat percentage averaged 0.238% units lower (P<0.0001) in BMR fed cows than in controls, suggesting the improved milk production of BMR fed cows was real. These results suggest that tunnel ventilation cooling can be helpful in reducing the severity of heat stress on dairy cows in the southeastern U.S. BMR may be helpful to maintain production in heat stressed cows, however the BMR diet used in this study did not reduce the symptoms of heat stress.

Key Words: Heat stress, Tunnel ventilation cooling, Brown mid-rib corn

The effect of biotin supplementation on milk yield, reproduction and lameness in dairy cattle. J. K. Margerrison 1, B. Winker 1, G. Penny 1, and A. Packington 2.

1 University of Plymouth, UK, 2 Roche Vitamins, UK.

This study determined the effect of dietary biotin supplementation (0 or 22 mg/d) on the performance of Holstein-Friesian (n = 36) multiparous cows, with 18 supplemented with biotin (SB) and 18 cows not supplemented with biotin (NSB). Treatment diets were fed from 14 d prepartum and continued until 120 d in milk (DIM). Total dry matter intake (kg/d) was not significantly different between treatment groups, NBS 24.35 and BS 24.34 (SEM 0.50) cows. Biotin supplementation significantly increased (P < 0.001) milk yield (kg/d) NBS 37.2, BS 39.2 (SEM 0.32), fat corrected milk yield (kg/d) NBS 37.0, BS 39.4 (SEM 0.32) and total milk fat yield (kg/d) NBS 1.48, BS 1.58 (SEM 0.03). While milk fat content (g/kg) NBS 39.8, BS 40.2 (SEM 0.50), protein content (g/kg) NBS 33.0, BS 33.0 (SEM 0.20), total protein yield (kg/d) NBS 1.23, BS 1.2 (SEM 0.003) were not significantly different between treatment diets. Biotin supplementation had no significant effect on postpartum interval (PPI) to first ovulation (d) NBS 41.7, BS 38.8 (SEM 2.26), but first inter ovulation period (d) NBS 21.2, BS 24.5 (SEM 0.73) and mean inter-ovulation period, NBS 21.3, BS 23.7 (SEM 0.53) were significantly greater in cows supplemented with biotin. PPI to first insemination (d) NBS 64.2, BS 73.4 (SEM 3.61) or PPI to conception (d) NBS 68.7, BS 76.6 (SEM 5.32) were not different between treatment diets. Sole lesion score sole at 150d pp was significantly (P = 0.05) lower in cows supplemented with biotin (NSB). Treatment diets were fed from 14 d prepartum and continued until 120 d in milk (DIM). Total dry matter intake (kg/d) was not significantly different between treatment groups, NBS 24.35 and BS 24.34 (SEM 0.50) cows. Biotin supplementation significantly increased (P < 0.001) milk yield (kg/d) NBS 37.2, BS 39.2 (SEM 0.32), fat corrected milk yield (kg/d) NBS 37.0, BS 39.4 (SEM 0.32) and total milk fat yield (kg/d) NBS 1.48, BS 1.58 (SEM 0.03). While milk fat content (g/kg) NBS 39.8, BS 40.2 (SEM 0.50), protein content (g/kg) NBS 33.0, BS 33.0 (SEM 0.20), total protein yield (kg/d) NBS 1.23, BS 1.2 (SEM 0.003) were not significantly different between treatment diets. Biotin supplementation had no significant effect on either weekly change in body live weight or condition score.

Key Words: Dairy, Biotin, Reproduction


Growth potential, animal health, and meat quality are important parameters to describe the pork quality. Especially regarding the consumer expectation on production systems, animal health, welfare, and product quality makes it necessary to minimize the use of pharmacological active substances and replace them by biogenic substances as homeopathic substances are. We selected Engystol 14 (Heel GmbH, Germany) as a product known to improve health status and reduce stress fragility in animals. Pigs of the German Landrace were kept in four groups, two with a maximal number of pigs per pen concerning the German law (between 0.4 and 1 sqm. per pig depending on live weight), two groups below that density. One subgroup of each of them was treated with the biogenic substance Engystol 14 twice a week provided by drinking water for ten weeks. The trial started when pigs were 70 days old. The pigs were kept in a controlled environment piggery with partly slatted floor. Once a week the animals were weighted and a sample of saliva was taken. At the beginning and at the end of the treatment a blood sample of each animal was taken. With an age of about 170 days the animals were slaughtered and parameters of meat quality were determined. Differences between treated and not treated animals were found especially in the sub-groups with high population density. The not treated animals started tail biting after three weeks, the daily weight gain was reduced and the live weight was lower the in the treated sub-group. The carcass did show pleural and pulmonal alteration. No differences were found in the meat quality. Cortisol concentration in the saliva was higher in the control group of the highly occupied group compared to the treated highly occupied group. No differences were seen in the plasma cortisol concentration. The use of biogenic substances is one to improve animal health and welfare in a prophylactic or metaphylactic manner especially under conditions which are less suitable for animal (for instance high occupation density).

Key Words: Meat quality, Homeopathic substance, Pork

Effects of pretransit supranutritional levels of dietary selenium and α-tocopherol acetate on selenium content of specific tissues in wether lambs. J. B. Taylor 1, N. K. Choyce 3 and T. Theels 2. 1 Agriculture Research Service, Dubois, ID. 2 Texas Agriculture Experiment Station, Amarillo. 3 West Texas A&M University, Canyon.

Twenty-nine wether lambs (BW = 27.1 kg ± 0.36) were utilized to assess the effects of pretransit supranutritional levels of dietary selenium (Se) and α-tocopherol (TOCO) on Se concentrations in homologous tissues. Wethers were assigned to one of four treatments: adequate Se and no TOCO (CON; n = 9); high Se (HSE; n = 9); TOCO (HVE; n = 5); high Se and TOCO (SEVE; n = 6). Selenium was provided as high Se wheat (6.1 ppm) delivering 110 μg/kg BW, and TOCO was provided as a daily bolus delivering 3.8 IU/kg BW. Wethers were weaned (d 0), fed treatment diets from d 0 to 20, subjected to transit stress on d 21, and received a common diet similar in nutrient composition to CON for an additional 20 d (d 22–42). Four wethers from CON and HSE were withheld from the stress transit, euthanized (d 21), and blood, skeletal muscle and liver were collected. Likewise, at the end of the receiving period (d 42), all other wethers were euthanized and tissues collected. Pretransit dietary Se resulted in HSE having 60%, 80% and 42% higher (P < 0.001) Se concentration in muscle, liver and serum, respectively, than CON. However, this gain for HSE was followed by a 30%, 51% and 34% decrease (d 21 vs. d 42; P < 0.001), respectively, during the receiving period. When fed alone (HVE), TOCO had no effect (P > 0.05) on tissue Se concentration; however, in combination with high Se (SEVE), TOCO decreased (P < 0.05) Se concentration in liver, but increased (P < 0.04) Se in the skeletal muscle. Both HSE and SEVE had higher (P < 0.0001) concentrations of Se in liver, skeletal muscle, and serum than HVE and CON treatments. Feeding high Se wheat resulted in higher Se tissue concentrations both pretransit and post-receiving. D-α-tocopherol acetate seemed to affect level of Se incorporated and(or) retained in liver and muscle tissue.

Key Words: Selenium, Transit stress, α-Tocopherol

Silymarin PHOTOSOME® against AFB1 in broilers. D. Tedesco 1, S. Galletti 1, S. Steidler 1, M. Tameni 1, O. Sonzogni 2, and P. Morazzoni 1. 1 Department VSA, University of Milan, Italy, 2 Indena S.p.A., Milan, Italy.

Silymarin, the bioactive extract of Silybum marianum, is used as a natural hepatoprotector in man and is a potent anti-hepatotoxic agent. This study focused on determining the effect of silymarin PHOTOSOME®, a silymarin complexed form with phospholipids from soy, on reducing the toxic effects of aflatoxin B1 (AFB1) in broiler chickens. Toxic effects of AFB1 were studied in a batch of 28 male broiler chickens during their complete commercial growth cycle (from day 14 to day 51). Chickens were randomly allotted in four groups and treated as follows: group C control group fed on a basal diet alone; group B1 AFB1 at 0.8 mg/kg of feed; group B1 +SIL AFB1 at 0.8 mg/kg of feed plus silymarin at 200 mg/kg body weight; group B1 + Phyto AFB1 at 0.8 mg/kg of feed plus silymarin PHOTOSOME® at 600 mg/kg body weight. Chickens were weighed individually every week. Feed intake was recorded daily in the last two weeks of experimental period. At necropsy, liver weight was recorded for each animal and two animals for each group were randomly selected for histological studies on liver tissue. Considering the whole growth cycle, body weight gain and feed intake were significantly decreased in AFB1 treated animals with respect to control (P < 0.05). On the contrary, animals receiving AFB1 plus silymarin PHOTOSOME or silymarin grew at the same rate of the control animals and their body weight gain and feed intake were significantly different with respect to AFB1 treated animals (P < 0.05). No differences were noted on the weight or on macroscopic observations of the liver between groups. Histological liver sections of AFB1 treated animals showed multifocal portal infiltration and necrosis in zone 1. Those changes were less severe in silymarin PHOTOSOME and silymarin treated groups. In conclusion, our results suggest that silymarin PHOTOSOME can provide a protection against the negative repercussion of AFB1 on performance of broiler chicks. * PHOTOSOME is a trademark of Indena S.p.A.

Key Words: Aflatoxin B1, Silymarin PHOTOSOME, Broiler
T58 Inhibition of fungal growth with OmniGen-AF: a new anti-fungal feed additive. Y. Wang*, S. Puntenney, and N. Forsberg, Oregon State University.

Commercial livestock production is adversely affected by mycotic infection of feed and gastrointestinal tract and via invasive mycoses. Mycotic infections have potential to reduce performance, to potentiate disease, to adversely affect reproduction and to cause death. The goal of this study was to test the hypothesis that a new commercial feed supplement (OmniGen-AF), consisting of "GRAS products", inhibits fungal growth and thereby had potential as an anti-mycotic. A mixed fungal culture containing both Aspergillus fumigatus and A. flavus was obtained from a sample of millet run on a dairy farm which had experienced incidence of hemorrhagic bowel syndrome (HBS; also known as jejunal hemorrhage syndrome). The antifungal properties of OmniGen-AF were tested in four different experiments. In the first experiment, the fungi were cultured on a Sabouraud agar plate (with chloramphenicol and gentimycin present). Drops of the OmniGen-AF product were added directly to the fungal streaks and growth was observed over the next 48 hr. Addition of the product to the fungal streaks inhibited growth. In a second experiment, fungi were grown in Sabouraud liquid medium at 27 degrees C in the presence and absence of OmniGen-AF. Logrithmic growth was noted beginning at 20-24 hr post-incubation and maximal culture density was reached within 30-34 hours post-inoculation. Addition of OmniGen-AF directly to the culture delayed entry into log-phase growth by 4-6 hr; however, it did not prevent later fungal growth. In a third study, the OmniGen-AF product was added to a broiler feed during exposure time to conditions of moderate heat stress (temperature- moisture content of the feed was increased to 20%). Temperature of the feed was monitored over 1-month. The untreated feed increased in temperature (an index of fungal respiration) to 37 degrees C within 1 week whereas the OmniGen-AF-treated feed did not change in temperature until 1-month. Untreated feed accumulated clumps of A. fumigatus and A. flavus. Finally, efficacy of the product on clearance of a mycotic infection was evaluated in steers intentionally infected with A. fumigatus. Steers treated with OmniGen-AF product cleared A. fumigatus from blood more rapidly than untreated steers. Our data indicate that this product has potential to prevent mycotic growth in feed, in liquid culture and in vivo.

Key Words: Mycotic infections, Aspergillus fumigatus, Aspergillus flavus

T59 Effects of swainsonine on digestion in wethers consuming locoweed. M. M. Reed1, B. S. Obeidat1, J. R. Strickland1, C. K. Krehbiel1, J. B. Taylor1, C. A. Loest1, G. S. Bell1, W. D. Bryant1, J. D. Rivera1, and J. L. Jim1, New Mexico State University, 2Oklahoma State University, 3USDA, ARS, USSES.

A trial was conducted to study the effects of swainsonine (SW) on digestion. Mixed breed wethers were assigned to one of three treatments. Wethers received blue grama hay plus 1.6 mg SW/kg BW (n=5), 0.2 mg SW/kg BW (n=6), or no SW (control; n=6). Swainsonine was administered by feeding locoweed (428 mg SW/g dry matter). Blood was collected 12 h post feeding and DNA was extracted and amplified using the primers a1 and a2 forward primer 855 and reverse primer 18 to determine serum SW, alkaline phosphatase, and aspartate-aminotransferase activity. Rises (P<0.05) in alkaline phosphatase and aspartate aminotransferase activity indicated subclinical toxicity in treated wethers. Rumen samples were collected from 0 to 48 h in 8 h intervals to determine effects on ammonia and volatile fatty acid concentrations. Ammonia concentrations were lower (P<0.05) for controls than treated animals at 8 h and higher (P<0.05) at 24 and 48 h. Volatile fatty acid (VFA) concentrations were not affected (P>0.08) showing no time by treatment effect for all VFA except valerate. Valerate concentrations increased (P<0.05) at 8 h in 1.6 mg SW/kg BW wethers. In situ samples contained 5 g of treatment diets and placed into the rumen representing h 0, 3, 6, 9, 12, 24, and 48. Treatments were 0.2 mg SW/kg BW (n=4), 1.6 mg SW/kg BW (n=4), and 0.016 mg SW/kg BW (n=3), or no SW (n=3). Dry matter digestion was greatest (P<0.05) for both the 1.6 mg SW/kg BW and 0.016 mg SW/kg BW treatments. Organic matter, NDF, ADF, and CP showed no effects (P>0.1) on digestion. Duodenal and fecal flow rates were not changed (P>0.09). Enzyme and swainsonine activity levels in serum indicated subclinical toxicity. However, lack of consistent results in digestive parameters indicates limited effects of swainsonine on digestive processes.

Key Words: Swainsonine, Locoweed, Digestion

T60 Development of quantitative diagnostic assays for assessment of mycotic infections. N. Forsberg*, S. Puntenney, and Y. Wang, Oregon State University.

The goal of this research was to develop a quantitative PCR-based assay for the detection of fungal genomic DNA in tissues and blood of domestic animal species. We based our assay on published ITS-1 and -2 fungal genomic sequences which lie between the fungal 18S, 5.8S and 28S ribosomal genes. The ITS-1 and -2 sequences have shown sufficient variation across species that specific PCR methods may be used to detect individual species. Methods for two particularly pathogenic fungal species A. fumigatus and A. flavus were developed. Forward and reverse primers, which generated 62 bp and 55 bp products, were developed and used in a Syber Green real-time quantitative PCR assay. An ABI7900 thermocycler was used in all assays. Samples of DNA were extracted from blood and tissues using the "Tissue Method". Standard curves for both A. fumigatus and A. flavus were developed using purified genomic template DNA samples which were obtained from a commercial source in Belgium (Dr. F. Symoens). Following completion of thermocycling, the melting temperatures of the PCR products were examined. The melting temperatures of the A. fumigatus and A. flavus PCR products were 84 degrees C and 76 degrees C, respectively. Examination of the melt temperatures of individual reactions thereby allowed us to ensure reactions were specific. Both assays were very sensitive and specific. The assays were capable of detecting as little as 10 femtograms of Aspergillus fumigatus genomic DNA in a 25 ul sample of blood or 25 ug sample of tissue. Furthermore, the assays were species-specific. The A. fumigatus primers did not generate a PCR product using A. flavus or A. niger genomic templates. Similarly, the A. flavus primers did not generate a PCR product from the A. fumigatus or A. niger genomic templates. These methods may be used to assess mycotic infection and efficacy of anti-fungal treatments in livestock.

Key Words: Mycotic infection, Aspergillus fumigatus, Aspergillus flavus

T61 The impact of tunnel ventilation cooling and brown mid-rib (BMR) corn silage on heat stress in lactating dairy cows. R. J. Williams1, A. M. Chapa1, T. O. Riley2, D. O. Pogue2, S. T. Willard2, and T. R. Smith2, Department of Animal and Dairy Sciences, Mississippi State University, 2North Mississippi Branch Experiment Station, Holly Springs, MS.

Four groups of 10 lactating Holsteins were used to measure the effects of tunnel ventilation cooling and diet on feed intake, milk production and the incidence of mastitis during periods of heat stress. Two groups were housed in a freestall barn equipped with tunnel ventilation cooling. The remaining two groups were housed in an outside freestall barn, cooled with fans and sprinklers. The maximum daytime temperature in the tunnel barn averaged 6 °C below that of outside freestall barns. Average exposure time to conditions of moderate heat stress (temperature-humidity index (THI) of the Q10 was reduced 6.2 °C/h/day for cows housed in the tunnel ventilation barn. Maximal daytime rectal temperatures for cows housed inside averaged 0.28°C below (P<0.0001) those for cows housed outside. Furthermore, the maximal daytime respiration rate averaged 6.0 breaths/min lower (P<0.0001) for cows housed inside the tunnel barn than for cows housed outside. There were no significant differences in milk production, milk composition or the incidence of mastitis between housing units. To measure the effect of diet on dry matter intake (DMI) during periods of heat stress, one group in each barn received a diet based on BMR corn silage and the other group received a standard corn silage-based diet (Controls). DMI averaged 21.4 kg/ld/day and did not differ between the 2 dietary treatments. Cows fed the BMR silage averaged 0.5 kg/ld/day more milk than those fed the control silage, but the difference was not significant. Similarly, milk fat production was not affected by diet; however, milk fat percentage averaged 0.238 units lower (P<0.0001) in BMR fed cows than in controls, suggesting the improved milk production of BMR fed cows was real. These results suggest that tunnel ventilation cooling can be helpful in reducing the severity of heat stress on dairy cows in the southeastern U.S. BMR may be helpful to maintain production in heat stressed cows, however the BMR diet used in this study did not reduce the symptoms of heat stress.

Key Words: Heat stress, Tunnel ventilation cooling, Brown mid-rib corn
**Breeding & Genetics**

**T62** Meta-analysis to detect QTL in two connected F2 swine populations using simulation. B. R. Southey* and S. L. Rodriguez-Zas, University of Illinois Champaign-Urbana, Urbana, IL.

All F2 inbred or outbred populations developed to detect quantitative trait loci (QTL) using parent cross between two breeds or lines. Although these populations share one of the breeds and may have common ancestors, most studies assume independent populations and use models that do not combine the information. The benefits of combining the data from related F2 populations and using more complex models was evaluated in a simulation study. Different breed and genetic effect compositions were simulated on three parents mates to two groups of 18 granddams. Each population consisted of nine F1 sires, 36 F1 dams and 720 offspring. A single chromosome with 10 markers spaced 10 cM apart and one QTL fixed for different alleles in each grandparental breed was simulated. The markers have varying polymorphic information content with the frequency of the allele corresponding to the breed equal to 80% and the rest distributed among the other allele(s).

Different scenarios, characterized by the total QTL effect and breed-specific allele effects of the QTL were evaluated. A total of 1000 replicates per scenario were generated using PEDSIM (Mattis et al., 1998). The additive and dominance coefficients were computed every 1 cM using the procedure of Haley et al. (1996). Estimates of the QTL location and effect were estimated using models that contain or exclude breed differences. The statistical power to detect the QTL depended on the model considered, the magnitude of the QTL and the breed specific effects. The extended data and model permitted the accurate and precise location of QTL accounting for 5% or more of the phenotypic variance. Results from a model that excluded breed effect failed to detect QTL of any magnitude when the effect of the QTL allele of the sire breed was intermediate between those of the dam breeds. These results demonstrate the impact of the population stratification and model on the power to accurately map QTL.

Key Words: QTL, Simulation, Swine

**T63** Detection of SNPs on the ovine skeletal muscle specific calpain gene using PCR-SSCP analysis. H. Chung**, 1 S. Chen1, D. Yoon1, I. Cheong1, 2 S. Lee1, M. Davis2, and C. Hines2.

1 National Livestock Research Institute, Suwon, Korea, 2 The Ohio State University, Columbus, USA.

The ovine skeletal muscle specific gene, which is n-calpain or calpain 3, was screened with primers. The primer sequences were selected based on the bovine cDNA sequence (GenBank accession No. AF115744B). The forward and reverse primers were selected from exons 10 and 11 (CAPN3-1011, and exons 11 and 12 (CAPN3-1112). Approximately 55 purebred Polypay, 52 purebred Targhee, and 55 mixed breed sheep (Polypay, Targhee, Hampshire, Rambioullet, Dorset, and Suffolk) from the Ohio Agricultural Research and Development Center (OARDC) were used. Allele frequencies (A and B) were calculated as 0.53 and 0.47 for CAPN3-1011, and 0.69 and 0.31 for CAPN3-1112, respectively. Analysis of variance was conducted to investigate effects of the genotypes on weight traits including birth weight (BW) and weaning weight (WW). A total of 162 animals were examined. Calpain genotypes of the CAPN3-1011 (P=0.01) and CAPN3-1112 (P=0.02) segment were associated with BW. No significant influence of CAPN3-1011 and CAPN3-1112 genotypes on WW was observed.

Key Words: Calpain, Ovine, Weight

**T64** Relationships between DGAT1 and Pit-1 genes polymorphism and milk yield in Holstein cattle. S. Horishima and A. Barreras-Serrano*, Universidad Autonoma de Baja California, Mexicali, B.C. Mexico.

The objective of this study was to determine the relationships between diacylglycerol O-acyltransferase homolog 1 (DGAT1) gene and the growth hormone regulator gene Pit-1 with milk production. Moreover, genotypes and allele frequencies of them were determined in the population. Because the previous works suggested positive effects of genotypes of αs1-casein on total milk yield (BC>BB), we put as secondary objective to examine the effect of that in joint with DGAT1 and Pit-1 genotypes on milk production in the statistical analysis. 196 Holstein first lactation cows located in Tijuana B.C with the known genotype of αs1-casein were used. The detection of the polymorphisms was by standard PCR and RFLP method. Cleavage resistance to CflI and HinfI represent the lysine-232/alanine substitution (K232A) for DGAT1 and the A allele for Pit-1, respectively. Data was analyzed using procedures of SAS software. The frequencies of AA, AK, and KK genotypes for DGAT1 were .661, .318, and .021, respectively. Also, the frequencies of AA, AB, and BB genotypes for Pit-1 were .026, .527, and .471, respectively. Allelic frequencies for A in DGAT1 and Pit-1 were .32 and .55, respectively. AA genotype of PIT1 had significant effect on the total milk yield. Statistical analysis showed that interaction between DGAT1 and Pit-1 genes had significant effect on milk yield, with a positive and conditional effect of K allele in DGAT1. Substitution of A for K allele at DGAT1 locus resulted in an increase of 263.22 kg in milk production. The substitution effect was additive significantly on milk yield in animals with AA genotype for Pit-1 gene (296.28 kg). By contrast, no important effect of substitution of K allele in DGAT1 in the AB or BB genotypes at Pit-1 locus was observed. Additionally, BC genotype at αs1-casein showed the tendency of high milk yield in animals with both AA and AK genotypes at Pit-1 and at DGAT1, respectively. These results suggest in genetic improvement program of milk yield to selection animals with AA genotypes at Pit-1, which can also obtain the positive effect of DGAT1 in preference to increase in the population, animals with K allele.

Key Words: DGAT1, Polymorphism, Milk yield

**T65** Use of intra-ruminal monensin capsules in dairy cows under alfalfa grazing conditions. II. Reproductive performance. A. A. Abdala1, M. G. Maciél1, M. R. Gallardo2, M. E. Castelli1, A. Quatrín1, D. Lettieri1, S. P. Allasia1, N. Zanon1, and A. R. Castillo2.

1 Experimental Station Rafea, INTA, Argentina, 2 UC Davis Cooperative Extension, USA.

The objective of this experiment was to evaluate the effects of intra-ruminal capsules of monensin in reproductive performance and some blood parameters in dairy cows under alfalfa grazing. Fifty-six Holstein dairy cows (46 multiparous and 10 primiparous) were blocked in pairs (calving date; previous milk yield, body weight and lactation number) in a repeated measures randomized design and assigned to one of two treatments: Control and Monensin. Treated cows received the intra-ruminal capsules 30 days before the expecting calving date and 60 days after calving. All the cows were fed with the same diet, during the dry period a TMR and after calving, alfalfa pasture and supplemented with TMR. Corn silage, alfalfa hay, corn grain, cottonseed, mineral and vitamins composed the TMR. Mean quality of the diet pre and postpartum were: 57.8 and 45.6%; 12.7 and 18.8%; 1.51 and 1.65 Mcal/kgDM; 52.1 and 35.8% for DM; CP; NEF; and NDF respectively. The body condition score (BCS) evaluations were carried out a week before the treatment start and a two weeks intervals. All the cows were blood sampled at 21 days pre-calving, at calving and at 21 day post-calving to determine the concentration of glucose, non-esterified fatty acids (NEFA) and blood urea nitrogen (BUN). The reproductive performance was closely monitored during the experiment. Monensin treatment significantly (P<0.05) improved body condition score and reproductive performance in dairy cows grazing alfalfa. In addition, NEFA were lower and BUN was increased with no effect on blood glucose.
Estimation of additive and nonadditive genetic parameters in the Chilean multibreed dairy cattle population using restricted maximum likelihood procedures. M. A. Elzo¹, A. Jara², and N. Barria³, ¹University of Florida, Gainesville, ²University of Chile, Santiago, Chile.

Chile has imported Holstein semen from various countries (Canada, New Zealand, USA) for over 20 years. Most of the semen came from the USA. Chilean breeders have made a concerted effort to upgrade the original European Friesian cattle population to Holstein of US origin. This mating strategy created a complex multibreed population with more than 10 breed x country combinations. The objective here was to estimate heritabilities, interactibilities (ratios of nonadditive to phenotypic variances), and correlations (genetic, environmental, phenotypic) among 305-d ME milk yield (M), fat yield (F), and protein yield (P) from 54,035 first lactation records collected between 1990 and 2000. For simplicity, only two base breeds were defined: US Holstein (H) and Other Breeds (O). Fixed effects in the multibreed model were herd-year-season, and regression intrabreed additive and interbreed nonadditive group genetic effects. Random effects were sire and maternal grandsire additive genetic, regression intra and interbreed sire and maternal grandsire nonadditive genetic, and residual effects. Estimates of heritabilities for M, F, and P were lower for H (0.07, 0.12, and 0.26) than for O (0.17, 0.32, and 0.12), and had intermediate values for crossbred groups. Interactibility estimates were generally larger than heritabilities (0.12, 0.68, and 0.40 for H and 0.19, 0.59, and 0.12 for O). Additive correlations among the three traits were higher (0.7 to 1.0) than nonadditive correlations (0.4 to 0.8) and similar across breed groups. Environmental and phenotypic correlations tended to be lower than genetic correlations, and they were higher for H (0.84 to 0.96) than for O (0.11 to 0.92). The incompleteness of the diadel structure of the Chilean dataset produced multicollinearity not only among fixed effects, but also between random additive and nonadditive genetic effects. Thus, covariance estimates reported here should be considered as first approximations, particularly those for nonadditive genetic effects.

Key Words: Cattle, Milk, Heritability

Estimation of genetic trend for milk yield in two dairy herds involving inheritance of Holstein cows in baja california, mexico. A. Perez¹, J. Ponce¹, A. Correa¹, M. Montaño¹, J. Guerrero², and S. Cobos³, ¹Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico, ²University of California, Holville CA, USA.

The most accurate method of estimating genetic trend would be to predict the genetic value of all animals in the population and obtain the average for each year. Earlier evaluation procedures with varying bases and unspecified properties were not suitable. 1351 records of first, second and third complete lactations for milk yield of Holstein cows, daughters of 44 Holstein sires were analyzed by using a sire model. The objective was to estimate genetic trend for milk yield in two dairy herds involving inheritance of Hostein in Baja California, Mexico. The average milk yield values 305 2X in the two herds were 8862 and 8312 kg, respectively. The average values for milk yield were 81461310.90, 82461324.16 and 88961125.37, and 86901275.27, 92391173.33 and 95221142.91 kg to first, second and third complete lactations in herds 1 and 2 respectively. The average values of age at parturition were 24.9, 40 and 64.50, and 25.20, 39.60 and 73.70 month for cows of first, second and third complete lactations, in herds 1 and 2, respectively. The generational interval was 4.3 years. The average phenotypic mean values for milk yield and the projected milk yield to mature equivalent ME were 8587 and 10,838.64 kg, respectively. The estimates correlation of milk yield of first lactations cows to mature equivalent was 0.87. The estimates for annual genetic progress was 80.85 kg for milk yield, the estimated breeding value for milk yield was 421 kg. To increase actual progress to levels closer to optimum will require strict adherence to basic rules of selection, the most accurate methods of genetic evaluation and intense selection.

Key Words: Generic trend, Progeny test, Selection

Genetic evaluation of male and female fertility using longitudinal binary data. T. Averill² and R. Rekaya, The University of Georgia.

Long time selection for production responses has deteriorated some secondary traits such as fertility or health conditions. It is important to estimate male and female fertility simultaneously, such that both components are inferred correctly. With the current methodology such objective is not fulfilled. Not accounting properly for male fertility will bias the genetic evaluation of female fertility and compromises the improvement of reproduction performances. Furthermore, existing methodologies do not make use of all available information leading to less precise predictions. In some cases cows need more than one insemination per conception and at best, it is possible to account for only one of service bulls. Another issue of interest is the sequence of mate bulls used for cows having more than one insemination. For two cows having the same number of inseminations and sired by the same bulls but in different order is not accounted for with actual models, which may bias fertility estimation. A simulation study was carried out. The data set consisted of 6918 binary responses from 2796 cows. The pedigree file included 3100 animals. The simulation model at the liability scale included one systematic effect of 50 classes, one covariate on days between calving and insemination, service bull effect (30 bulls), cow effect and permanent effect. The correlation between true and predicted breeding values was 0.98 and greater than 0.99 between true and estimated service bull effects. No significant differences were noted between the true and estimated genetic parameters. To compare the proposed model with the actual methodology used for male and female fertility estimation, only first insemination records from the simulated data set were used. The correlation between the true and predicted breeding values from the second analysis was 0.82 and 0.84 between true and estimated service sire effects. These results indicate the incapacity of the actual methodology in estimating correctly both male and female fertility. The proposed methodology is being evaluated using real data.

Key Words: Male fertility, Longitudinal, Binary responses

Genetic relationships between ewe mature size and measures of lamb feed efficiency and postweaning growth in Targhee sheep. B. W. Woodward¹ and G. D. Snowder², ¹USDA-ARS, US Sheep Experiment Station, Dubois, ID, ²USDA-ARS, US Meat Animal Research Center, Clay Center, NE.

The purpose of this study was to estimate the genetic relationships between ewe mature size and measures of lamb feed efficiency and postweaning growth in Targhee sheep. Mature size (weight) was the average fall weight after weaning for ewes with records from age 3 to 6 yr born between 1977 and 1983 (n = 373). Overall average mature weight was 69.3 ± 0.39 kg. Ram and ewe lamb data collected from 1978 to 1984 were used to estimate residual and total feed intake, gain to feed ratio (952 records), and postweaning ADG (1,047 records). Approximately 21 d after weaning, lambs were group fed for 4 wk, and then individually fed for 6 wk before returning to group feeding for another 4 wk. Overall average total feed intake, gain to feed ratio, and ADG were 89.5 ± 0.5 kg, 0.116 ± 0.001, and 0.250 ± 0.002 kg/d, respectively. Estimates of heritabilities and correlations were obtained by running two-trait animal models using REML. The single-trait model heritability estimate for mature weight was 0.66, which was similar to two-trait model estimates (0.60 to 0.66). Genetic correlations of mature weight with residual feed

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<table>
<thead>
<tr>
<th>Blood parameters</th>
<th>Control</th>
<th>Monensin</th>
<th>Dif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose (mg/dL)</td>
<td>59.34</td>
<td>61.10</td>
<td>1.76</td>
</tr>
<tr>
<td>BUN (mg/dL)</td>
<td>18.14</td>
<td>20.43</td>
<td>2.29*</td>
</tr>
<tr>
<td>NEFA (meq/L)</td>
<td>0.54</td>
<td>0.47</td>
<td>-0.07#</td>
</tr>
</tbody>
</table>

Reproductive performance:

| % P 1st AI | 20.69 | 44.83 | 24.14 *|
| % P 6 weeks | 41.38 | 55.17 | 13.78|
| % P 12 weeks | 55.17 | 75.86 | 20.69 #|

BCS# 2.82 2.92 0.10 **

P = pregnancy, AI = artificial insemination, # = five point scale, # P<0.10, * P<0.05, ** P<0.01

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| T66 Estimation of additive and nonadditive genetic parameters in the Chilean multibreed dairy cattle population using restricted maximum likelihood procedures. M. A. Elzo¹, A. Jara², and N. Barria³, ¹University of Florida, Gainesville, ²University of Chile, Santiago, Chile. |

| Key Words: Monensin capsules, Dairy cows, Reproductive performance |

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| T68 Genetic evaluation of male and female fertility using longitudinal binary data. T. Averill² and R. Rekaya, The University of Georgia. |

| Key Words: Male fertility, Longitudinal, Binary responses |

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| T69 Genetic relationships between ewe mature size and measures of lamb feed efficiency and postweaning growth in Targhee sheep. B. W. Woodward¹ and G. D. Snowder², ¹USDA-ARS, US Sheep Experiment Station, Dubois, ID, ²USDA-ARS, US Meat Animal Research Center, Clay Center, NE. |

| Key Words: Cattle, Milk, Heritability |

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| T67 Estimation of genetic trend for milk yield in two dairy herds involving inheritance of Holstein cows in baja california, mexico. A. Perez¹, J. Ponce¹, A. Correa¹, M. Montaño¹, J. Guerrero², and S. Cobos³, ¹Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico, ²University of California, Holville CA, USA. |

| Key Words: Genetic trend, Progeny test, Selection |
intake, total feed intake, gain to feed ratio, and ADG were 0.22, 0.53, 0.50, and 0.63, respectively. Heritability estimates for these same traits from the two-trait models were 0.28, 0.32, 0.11, and 0.38, respectively. Environmental correlations were low (−0.23 to 0.14). Estimated genetic parameters suggest selection could improve feed efficiency and postweaning growth, with associated changes in mature size. Selection against residual or total feed intake would be accompanied by a corresponding decrease in mature size. Conversely, selection for increased gain to feed ratio and ADG would indirectly increase mature size. Appropriate use of selection pressure through a selection index, for example, could result in increased feed efficiency and postweaning growth, while maintaining mature size and(or) moderating the amount of change in mature size.

Key Words: Mature size, Feed efficiency, Genetic parameters

T70 Estimates of genetic parameters for reproduction and weight in the progeny of Nubian, French Alpine, Saanen, Toggenburg, and Spanish goats mated to Boer sires. A. Perez1,2, J. Ponce3, A. Correa1, M. Montaño4, and J. Guerrero5,6,1 Universidad Autónoma de Baja California, Mexicali, Baja California, Mexico, 2 Universidad de California, Hollville CA. USA.

Data came from a commercial goat stud at Imperial Valley California. The objectives were to compare the performance of the progeny of dams involving inheritance of Nubian(N), French Alpine (A), Saanen (S) Toggenburg (T), and Spanish (P) genotypes (n=160) and to estimate genetic parameters of growth traits. Traits analyzed were prolificacy (P), weight at birth (BWT) and weaning (WWT), and average daily gain (ADG) from birth to weaning. Separate analysis for each trait used least squares mixed model SAS (1992). The analytical model included: breed of dam, age of dam, sex of the kid, season of parturition as fixed effects; sire, sire x breed of dam interaction and the residual as random components. The overall mean for prolificacy was 1.310±0.72. The average values for prolificacy of dams were (1.270±0.71, 1.280±0.72, 1.330±0.74, 1.360±0.69, and 1.290±0.73) for N, A, S, T and P, respectively. The overall mean values for weight at birth and weaning were: 1.99 and 12.89 kg, respectively. The average values for weight at birth were (2.12±0.07, 2.11±0.06, 2.04±0.05, 1.95±0.06, 2.10±0.05 and 1.98±0.07, 1.97±0.06, 1.93±0.05, 1.83±0.05, 1.96±0.06) for males and females kids respectively. The average values for weaning weights were (13.99±0.37, 13.29±0.33, 13.25±0.34, 12.67±0.31, 13.51±0.43, and 12.50±0.29, 12.48±0.30, 11.98±0.29, 12.68±0.41 and 12.60±0.32 kg) for male and female kids, respectively. The estimated average daily gain from birth to weaning was 2200±32 g. The average values for daily gain were: 1360.36 and 127.43 g for male and female kids, respectively. The unadjusted survival rate at birth and weaning was (87.37±0.07) to produce the average daily gain (ADG). The estimates of correlation between age and scrotal circumference were positive (P ≤0.01) and positive (rsc=0.56 and rsc=0.52) respectively. The estimates of correlation between age and scrotal circumference diameter was positive (rsc=0.14) but non significant (P >0.05). A large range in testis size was observed within bucks.

Key Words: Escrotal circumferences, Correlations, Boer goat

T72 Calving ease of heifers bred to Angus and Simmental sires selected for decreased dystocia. H. C. Van Wagoner1, R. P. Anstotegui1, M. D. Ropp2, and R. J. Lipsey3, 1 Montana State University, 2 American Simmental Association.

The objective of this study was to compare birth weight, gestation length, and percent assisted births of calving ease Simmental and low birth weight Angus sires. Angus yearling heifers were bred in two consecutive years (1999 and 2000) at four locations by AI using semen collected from Simmental (n = 20) and Angus (n = 27) sires. Birth weights, gestation lengths, and calving ease scores (1 = unassisted, 2 to 4 = various levels of assistance) of 1,019 births in 2000 and 2001 were analyzed to determine sire breed effect. Calving ease scores were recorded so that the percentage of assisted births could be calculated. The statistical model included the fixed effects of year of birth, sire breed, calf sex, ranch, two-way, and three-way interaction. Sire breed affected (P <0.01) birth weight, gestation length, and percent assisted. Simmental sired calves were 2.13±0.37 kg heavier at birth, 2.90±0.48 days longer in gestation length, and assisted 1.44 more times than Angus sired calves. Calf sex affected (P <0.01) birth weight and gestation length. Bull calves were 2.77±0.25 kg heavier at birth and 1.30±0.27 days longer in gestation length than heifer calves. Furthermore, bull calves were assisted 2.51 and 1.36 times more than heifer calves, 2000 and 2001, respectively. In this study calf sex was the leading cause of dystocia, followed by sire breed.

Key Words: Dystocia, Angus, Simmental

T73 Odds ratios for failure to calve and wean for Senepol- and Tuli-Angus cows compared to Brahman-Angus cows. D. G. Riley1, K. S. Barling2, C. C. Chase, Jr.3, T. A. Olson3, A. C. Hammond4, and S. W. Coleman1, 1 USDA, ARS, STAR, Brookville, FL, 2 Texas A&M University, College Station, 3 University of Florida, Gainesville, 4 USDA, ARS, SAA, Athens, GA.

The objective of this study was to compare reproductive performance of F1, Senepol- and Tuli-Angus cows to that of F1 Brahman-Angus cows (bred to Charolais bulls) using calving (n = 640) and weaning (n = 633) records from 1996 to 2001. Traits evaluated were 1) failure to calve, and 2) failure to wean a calf. Cows failing to calve or to wean a calf in a given year were coded 1; otherwise they were coded 0. Traits were modeled as binomially-distributed using repeated measures, generalized estimating equations, and a logit link function to an assumed underlying normal distribution. Effects investigated included breed, year, cow age, cow birth year, and sire of cow. Clustering associated with cow age was modeled using repeated measures analysis with an unstructured covariance matrix. Odds ratios (OR) and 95% confidence intervals (CI) were generated to compare breeds. Cow bred, year, cow birth year, and breed × year interaction were highly significant in all analyses. Sire of cow (P >0.25) was excluded from final models. Senepol F1 s had significantly greater odds of failure to calve than Brahman F1 s in 1997, 1998, 2000, and 2001, as indicated by OR (CI) of 1.87 (1.09, 3.2), 3.81 (1.01, 14.32), 2.88 (2.47, 3.36), and 11.69 (9.49, 14.4), respectively. Senepol F1 s had greater odds of failure to wean a calf than Brahman F1 s in 1997, 1998, 2000, and 2001, as indicated by OR (CI) of 2.29 (1.66, 3.16), 4.88 (1.2, 19.82), 2.81 (2.3, 3.42), and 9.18 (3.41, 24.71), respectively. In contrast, Tuli F1 s were similar to Brahman F1 s, but had lower odds of failure to calve (OR = 0.09; CI = 0.04, 0.2) or wean (OR = 0.19; CI = 0.06, 0.58) than Brahman F1 s in 1999 and greater odds of failure to wean a calf than Brahman F1 s in 2000 (OR = 2.64; CI = 2.22, 3.13). Results indicate that the Tuli breed may be a viable source of non-Zebu adaptation to the subtropics.

Key Words: Brahman, Senepol, Tuli

The objective of this study was to determine effects of divergent selection for blood serum insulin-like growth factor I concentration does not change age of Angus heifers at puberty. A. Yilmaz1, M. E. Davis1, and R. C. M. Simmons2. 1Department of Animal Sciences, The Ohio State University, 2Department of Animal Science, University of Florida.

The the o b j e c t i v e of this study was to determine the effects of divergent selection for blood serum insulin-like growth factor I (IGF-I) concentration on age of heifers at puberty. Data were obtained from an ongoing divergent selection experiment involving Angus beef cattle at the Eastern Ohio Resource Development Center. Selection was based on the mean IGF-I concentration of blood samples taken at 28, 42, and 56 of the 140-d postweaning test, which were abbreviated as IGF28, IGF42, and IGF56, respectively. Data were analyzed using SAS. All models used in the analysis included line-season and the random effect of sire nested within line-season. Age of dam and on-test age of calf were added to the models as a fixed effect and a covariate, respectively. Blood samples were collected weekly for 17 wk from 61 heifers in each of the fall- and spring-calving groups during the postweaning test period. Mean on-test age of heifers in the spring- and fall-calving groups were 260 and 265 d, respectively. Progesterone concentration was determined using RIA. Puberty was assumed attained if the progesterone concentration exceeded 2 ng/mL in a single or 1 ng/mL in two consecutive blood samples. Age at puberty was obtained by subtracting 7 d from the first date progesterone exceeded 1 or 2 ng/mL. Ten heifers (five high and five low line) did not attain puberty during the period in which blood samples were collected. Higher mean IGF-I concentration in the high line heifers (50.0 ± 10.2 ng/mL; P < 0.004) did not result in a change in age at puberty (2.5 ± 2.2 d younger in high line; P = 0.71). Mean age at puberty was 356 d. Residual correlations of age at puberty with IGF28, IGF42, IGF56, and mean IGF-I were –0.27 (P = 0.10), –0.20 (P = 0.24), –0.31 (P = 0.009), 0.06, 0.08, and 0.003 for the cubic regression of age of heifers at puberty on IGF28, IGF42, IGF56, and mean IGF-I, respectively. These results suggest that changes in IGF-I concentration are not associated with changes in age of heifers at puberty, but some phenotypic relationships exist between these two variables.

Key Words: Insulin-like Growth Factor I, Age at puberty, Selection

Embryonic cloning can be a technique for producing multiple offspring from one embryo and can be used for a diverse range of comparative trials and performance tests. Embryonic clone testing could shorten the generation interval of traditional progeny testing and lead to efficiency improvements. The objective of this study were to investigate differences in growth and carcass traits to use embryonic cloning technique in Wagyu heifers at puberty.

Effectiveness of performance testing for beef carcass traits to use embryonic cloning technique in Wagyu. K. Kuchida1, M. Ogasawara2, S. Hidaka1, T. Sakai2, A. Minamihashi3, and Y. Yamamoto2. 1Obihiro University of A&VM, Obihiro-shi Japan, 2Hokkaido Animal Research Center, Shintoku-cho Hokkaido Japan.

Embryonic cloning can be a technique for producing multiple offspring from one embryo and can be used for a diverse range of comparative trials and performance tests. Embryonic clone testing could shorten the generation interval of traditional progeny testing and lead to efficiency improvements. The objective of this study were to investigate similarities for shape of muscle, fat area ratio to the muscle area (FATPER), and coarseness of marbling particle with computer image analysis on the quadruplicates and quintuplets derived from each embryo, and on two sets of traditional progeny testing. Blastomeres obtained from Japanese Black donors were collected, and male clones were produced by cell fusion with electro-stimulation using enucleated oocytes from ovaries of Holsteins. Four and five clones were fattened with the method of Wagyu progeny testing until 21 mo of age. The number of half-sib steers from two sets of progeny testing were treated as control. The areas of M. longissimus dorsi, M. trapezius, M. rhomboideus, M. semispinalis capitis, M. semispinalis dorsi, M. anterior serratus and M. ilio-coxalis at the 6th and 7th rib, and FATPER of those muscles were measured by image analysis. Coarseness of marbling particles of M. longissimus dorsi was calculated by image analysis method. The ranges of carcass weight (CWT) and area of M. longissimus dorsi (RIBEYE) for two sets of embryonic clones were 369 to 435 kg and 336 to 393 kg, and 48.2 to 63.6 cm2 and 38.5 to 50.4 cm2, respectively. The ranges of CWT and RIBEYE for two sets of traditional progeny testing were 312 to 406 kg and 277 to 392 kg, and 38.0 to 54.8 cm2 and 35.0 to 47.2 cm2, respectively. This indicates that the degree of similarities for CWT and RIBEYE between embryonic clone steers were not high. The ranges of FATPER of M. longissimus dorsi were 35.0 to 37.6 % and 27.2 to 28.4 % for two sets of embryonic clones, and those for two sets of traditional progeny testing were 22.6 to 45.3 % and 25.4 to 40.9 %. This shows that the similarity of FATPER of M. longissimus dorsi on embryonic clones was high compared with that on half-sib progeny. The same trend was recognized for other muscles. Low similarity was recognized for the coarseness of marbling particles on embryonic clones as well as on half-sib steers.

Key Words: Embryonic clone, Wagyu, Image analysis

Nonruminant Nutrition

Effects of supplemental pantothenic acid during all or part of the grow-finish period on growth performance and carcass composition. J.S. Radcliffe*, B.T. Richert, L. Peddireddi, and S.A. Trapp, Purdue University, West Lafayette, IN.

Ninety barrows and 90 gilts were used in a 15-wk experiment to study the effects of supplemental pantothenic acid (PA) to the diet during all or part of the grow-finish period. Pigs were blocked by sex and weight (initial BW=29 kg), randomly assigned to pens (30 pens, 6 pigs/pen), and fed four phases of split-sex diets during the grow-finish period. Treatments included: 1) Control (13.2 ppm PA), 2) Control + 30 ppm PA added in the grower and finisher phases, and 3) Control + 30 ppm PA added in the finisher phases only. Pig BW and pen feed intake were recorded biweekly. Ultrasonic scans of tenth rib loin eye area (LEA) and backfat thickness were performed at 4-wk intervals on 3 pigs/pen. At the end of the experiment, pigs were harvested at a commercial slaughter facility and individual hot carcass weights, Animal Ultrasound System (AUS) backfat, and loin muscle depths (LMD) were recorded. There were no treatment x sex interactions (P>0.10), and therefore, only the main effects of treatment are presented. Supplementation of PA did not affect (P>0.10) ADG or feed efficiency. Overall ADFI was higher (P<0.05) for pigs fed PA during the finisher phase only compared to pigs fed PA during the grower and finisher phases. However, overall ADFI was not different between the PA treatments and control fed pigs. Ultrasound LEA were larger (P<0.003) at the end of the grower phase for pigs fed diets supplemented with PA. However, there were no differences (P>0.10) in LEA at the end of the experiment. Tenth rib and last rib ultrasound backfat depths were not different (P>0.10) between control fed pigs and PA supplemented pigs. Tenth rib carcass fat depths were numerically lower for pigs fed diets with supplemental PA, but differences were not significant (P>0.10). Likewise, there was no effect of PA supplementation on carcass tenth rib LMD (P>0.10). Carcass lean percent tended to be higher for pigs fed PA during the growing and finishing periods compared to control fed pigs. However, carcass weights were approximately
0.2 kg lighter ($P<.05$) for pigs fed supplemental PA during the grower and finisher periods compared to control fed pigs.

Key Words: Pig, Pantothenic acid, Growth

**T78** Effect of supplemental myo-inositol in diets for weanling pigs, S. E. Crowe*1, K. R. Roneker, M. Villa-García, and X. G. Lei, *Cornell University, Ithaca, NY USA.*

Myo-inositol was considered an essential nutrient in 1950s and plays vital roles in metabolism. It is still unclear whether fast-growing animals such as young pigs could synthesize sufficient myo-inositol in the body to meet their physiological needs. The objective of this experiment was to determine whether supplementing myo-inositol in the diets for young pigs could improve their growth performance. A total of 24 weanling pigs (3-wk old, 7.1 kg body weight) were divided into three groups (n = 8) and fed a corn-soybean meal based diet supplemented with myo-inositol (99% pure) at 0, 400, or 800 mg/kg of feed. Individual growth performance including average daily gain, average daily feed intake, and gain to feed ratio, and plasma inorganic phosphorus concentrations were monitored weekly for 4 wk. Examination revealed no significant difference among the three treatment groups in either growth performance or plasma inorganic phosphorus concentrations. In conclusion, addition of myo-inositol to the corn-soybean meal diets for weanling pigs at 400 or 800 mg/kg did not appear to provide a beneficial effect over the control diet.

Key Words: Myo-inositol, Pig, Supplement

**T79** Influence of dietary δ-Aminolevulinic Acid on growth performance and skin color in weaned pigs, J. W. Hong1, I. H. Kim1, B. J. Min1, O. S. Kwon1, J. H. Lee2, J. H. Kim3, W. B. Lee3, and K. S. Son1, 1Department of Animal Resource & Sciences, Dankook University, 2Easybio System, Inc., Seoul, Korea, 3Agribands Purina Korea, Seoul, Korea.

A total of ninety six pigs (7.12±0.03kg average initial body weight) were used in a 28-d growth assay to determine the effects of dietary δ-aminolevulinic acid on growth performance and skin color in weaned pigs. Dietary treatments included 1) NC (without antibiotic), 2) PC (NC diet + 110ppm neomycin and oxytetracycline), 3) NCALA (NC diet + 0.1% δ-aminolevulinic acid) and 4) PCALA (PC diet + 0.1% δ-aminolevulinic acid). The δ-aminolevulinic acid increased (P<0.05) average daily gain, average daily feed intake and gain/feed were not significantly different among the treatments. For d 14 to 28, pigs fed antibiotic diets (PC and PCALA) had higher average daily gain than pigs fed diets without antibiotic (NC and NCALA) with significant difference (P<0.03). For overall period, pigs fed antibiotic diets (PC and PCALA) grew faster than pigs fed diets without antibiotic (NC and NCALA) (P<0.05). However, pigs fed δ-aminolevulinic acid diets (NCALA and PCALA) had greater average daily gain compared to pigs fed without δ-aminolevulinic acid diets (NC and PC). The a-values(redness) of the skin color was increased by dietary δ-aminolevulinic acid (P<0.01). In conclusion, the results obtained from this feeding trial suggest that the dietary δ-aminolevulinic acid was an effective means of improving a-values of the skin color in weaned pigs.

Key Words: δ-Aminolevulinic acid, Performance, Pigs

**T80** Selenium and measures of oxidative stress in the developing porcine fetus, C. E. Hostetler* and R. L. Kincaid, *Washington State University.*

To investigate the role of selenium (Se) in the developing porcine fetus, pre-pubertal gilts (n = 42) were randomly assigned to either Se adequate (0.39 ppm Se) or Se deficient (0.05 ppm Se) gestation diets 6 wk prior to breeding. Gilts were humanely killed at d 10, 20, 30, 45, 70 and 90 of pregnancy, and at term (d 114), for collection of maternal and fetal liver. Concentrations of Se in maternal blood and liver decreased ($P<.05$) during gestation in sows fed the low Se diet. Activity of cellular glutathione peroxidase (GPx) was decreased ($P<.05$) at d 30 and 45 in sows fed the low Se diet. Concentrations of total lipid peroxides (LPO) and hydrogen peroxide ($H_2O_2$), measures of cellular damage, were greater ($P<.05$) in liver homogenates from sows fed the low Se diet. The concentration of Se in the whole fetus was not affected by maternal diet, but fetal liver Se decreased ($P<.05$) if sows were fed the low Se diet. GPx’s activity in fetal liver was not affected by maternal diet; however, concentrations of LPO and $H_2O_2$ in fetal liver were greater ($P<.05$) in fetuses from sows fed low Se diet. Liver of sows fed the adequate Se gestation diet had greater ($P<.01$) concentrations of Se throughout gestation compared to fetal liver. These results indicate that maternal dietary Se intake affects fetal liver Se concentration and feeding low Se gestation diet increases oxidative damage to the fetus as measured by fetal liver hydrogen peroxide and total lipid peroxides.

Key Words: Trace element, Antioxidant, Pig.

**T81** WITHDRAWN...
1. The relative availability of calcium of different sources for broiler chickens. E. Muniz, A. Arruda, E. Pereira, C. Leseux, and N. Tsuzuki, Universidade Estadual do Oeste do Parana, Brasil.

An experiment was conducted to determine the relative bioavailability of calcium in carbochelate and two calcitic limestone A and B by utilizing analytical grade calcium carbonate as the standard source. The experiment was conducted in hot batteries for a duration of 2 weeks. 12 treatments and 2 replicates for each sex with 12 chicks of the Cobb line per experimental unit. The completely randomized design with a 4 and 3 and 2 factorial arrangement was utilized. A total of 12 corn and soybean meal based rations at levels of 0.60, 0.75 and 0.90 percent of Ca were utilized. Evaluations of pH, granulometry and solubility of the sources under study were done. To evaluate performance the ration intake, weight gain and feed conversion were determined. On the 29 day of age, two birds from each plot were slaughtered for tibia removal. The relative bioavailability of Ca of the sources were determined by using as a response criteria, the percentage of tibia ashes making use of the abscissa method. Ca from carbochelate influenced negatively the broiler performance, impairing ration intake and hence weight gain, calcitic limestone were greatly similar to analytical degree CaCO3 in the evaluation of performance. There were no significant differences for sex in the performance for any source under study. For the evaluation of length and diameter of tibia, it was found that this variable was a reflex of the broiler growth regardless of the factors. As the criterion percentage of ashes, it was observed that calcium carbochelate provide the broiler with a mineral deposition as efficient as those of limestones A and B. In relation to sex, male and female differed only in the criteria of percentage of bone ashes, females presenting higher mean. The relative bioavailability of Ca for the 3 source under study were 115, 106 and 94 percentage, respectively for Ca carbochelate, calcitic limestone A and calcitic limestone B. According to results it was concluded that although bioavailability among the sources range from 94 to 115 percentage, only carbochelate affect negatively the broiler performance indices, the other sources being similar in this variable.

Key Words: Calcium, Broiler, Nutrition

T85 The digestibility of phosphorus (P) in diclum phosphate in pigs. T.S. Stahly and T.R. Lutz, Iowa State University, Ames.

The digestibility of diclumphosphate P in pigs was determined and the effects of the dietary Ca/P regimen and stage of pig growth (10 or 30 kg BW) on its digestibility were evaluated. Pigs were self-fed diets containing 2.3, 4.5, 6.6 or 7.9% bioavailable P (aP, based on analyzed P x % availability [NRC, 1998] of P in each ingredient) from 7 to 32 kg BW. Fifteen sets of six littermate barrows were allotted within litter to one of six P regimens consisting of a basal, corn-soy-whey diet (56% analyzed P) supplemented with incremental additions of diclum phosphate (17.94% analyzed P) at the expense of starch-limestone. Dietary calcium was either fixed in each of the 6 diets at 1.15% (1.1 to 1 Ca/total P ratio in highest P diet) or adjusted in each diet to achieve a 2.5 to 1 Ca/aP ratio. Dietary P digestibility and absorption-excretion were determined in each pig for 4 days at BW (±1.3 kg) of 10 and 30 kg. Digestibility of P in diclum was estimated by subtracting basal diet contributions to P intakes and P absorption-excretions of each pig during each stage of growth and then regressing the daily intake of added diclum P against dicalcium P absorbed from the GI tract. The digestibility of dicalcium P (slopes of absorbed dicalcium P/ intake of dicalcium P; r²=0.89) was estimated as 68.1 ± 1.9% (inclusive of both Ca/P regimens and stages of growth). Digestibility of dicalcium P in diets containing a fixed dietary Ca concentration (1.15%, dietary Ca/aP ratios of 5.8, 3.8, 2.9, 2.3, 1.9, and 1.6, respectively) was estimated to be 73.3 ± 5.8% (r²=0.77) and 70.5 ± 3.5% (r²=0.90) for pigs at BW of 10 and 30 kg, respectively. Similarly, digestibility of dicalcium P in diets containing a constant 2.5 to 1 dietary Ca/aP ratio was estimated to be 72.1 ± 3.6% (r²=0.92) and 70.8 ± 4.9% (r²=0.84) for pigs at BW of 10 and 30 kg, respectively. These data highlight the opportunity/incentive for technologies aimed at improving P digestibility in P sources with relatively high (i.e. inorganic P sources) as well as low (i.e. plant P sources) phosphorus bioavailabilitys.

Key Words: Phytase, Monocalcium phosphate, Pigs

T86 Efficacy of microbial phytase in swine diets. R. N. Dilger, S. A. Adedokun, J. A. Jendza, J. S. Sands, P. H. Simmins, and O. Adeola, Purdue University, West Lafayette, IN, Danisco Animal Nutrition, Marlborough, UK.

Three experiments were designed to assess both nutrient metabolism and growth performance of young swine fed microbial phytase-supplemented diets. Dietary treatments were similar between experiments and consisted of a positive control, basal, and basal plus either 500 or 1000 g/kg microbial phytase. In the first study, twenty four 15-kg crossbred barrows were assigned to crates according to a RCBD resulting in 6 pigs per pen to characterize the effect of phytase on apparent fecal digestibilities of DM and P. Diets were formulated at 165 g/kg CP with the positive control and basal diets containing 5.5 and 3.3 g/kg total P, respectively. A positive phytase effect was observed for apparent fecal digestibilities of DM (quadratic, P < 0.05) and P (linear, P < 0.05) fecal digestibility. The second study utilized 48 pigs in a 21-d growth performance trial arranged as a RCBD with 12 pigs (6 barrows, 6 gilts) assigned to the 4 dietary treatments. The positive control and basal diets (209 g/kg CP) contained 5.7 and 4.0 g/kg total P, respectively. A linear phytase effect (P < 0.05) was observed for average daily gain and feed efficiency at week 1 and overall. Final plasma P concentrations were also shown to be positively affected by phytase addition (linear, P < 0.05). In the third study, 128 crossbred were assigned to the 4 dietary treatments with 4 pens of gilts and 4 pens of barrows per diet according to a RCBD. The positive control and basal diets were formulated at 170 g/kg CP and contained 5.3 and 3.6 g/kg total P, respectively. ADG, ADFI, and G:F exhibited a linear phytase response (P < 0.01) at weeks 4 and 6 as well as overall. In conclusion, pigs fed phytase-supplemented diets gave results comparable to those fed phosphorus-adequate diets in both nutrient utilization and growth performance.

Key Words: Microbial phytase, Growth performance, Pigs


Two experiments were conducted to determine performance and phosphorus output of growing pigs fed diets supplemented with different amounts of phytase (as FTU) and monocalcium phosphate. Pigs of both genders were individually housed with ad libitum access to water and feed. Body weight and daily feed consumption were registered over the 5 week length of trial. On a single day of the fourth week, feces were quantitatively collected, in order to measure fecal phosphorus output. In experiment 1, 21 pigs (initial BW of 65 kg) were allotted (n = 7) in a complete randomized design, to one of three dietary treatments: 1) basal diet, sorghum-soybean meal (S-SBM) without addition of monocalcium phosphate (0.32% P), 2) basal diet + 750 FTU phytase/kg, and 3) basal diet with addition of 9.40 kg monocalcium phosphate/ton (0.52% P), but without phytase. Additions of phytase (T2) and monocalcium phosphate (T3) increased (P < 0.05) ADG and 8.4% and 12.1%, respectively compared with the basal diet (ADG = 874 g). Daily feed intake and feed conversion were not affected by treatments (P > 0.05), but fecal phosphorus output was 34% higher (P < 0.05) for the diet added with monocalcium phosphate (T3), compared with diets T1 and T2. In experiment 2, 24 pigs (initial BW of 53.4 kg) were allotted (n = 6) in a complete randomized design, to diets added with 0, 3.5, 7.0, and 10.5 kg of monocalcium phosphate/ton, in order to achieve 0.35, 0.42, 0.49 and 0.56% of P, respectively. First three diets were supplemented with 750 FTU phytase/kg, but not the fourth diet. There were not treatment effects on ADG and feed conversion. Fecal phosphorus output increased (P = 0.18) 25%, 36% and 61% on diets T2, T3 and T4 respectively, related to diet T1. Results indicated that addition of either 0 or 3.5 kg monocalcium phosphate/ton plus 750 FTU phytase/kg may be enough to reduce phosphorus fecal output, without affecting the growth parameters of growing-finishing pigs.

Key Words: Phytase, Monocalcium phosphate, Pigs
A digestion trial was conducted to evaluate the effect of adding a phytase and/or pancreatin to grain sorghum-soybean meal diets on the apparent ileal digestibility (AID) of amino acids (AA) in pigs. Eight growing pigs (86.1 kg body weight) fitted with cannulas in terminal ileum were used in four experimental periods according to a replicated 4 x 4 Latin Square design. Treatments (T) were as follows: T1) basal, grain sorghum-soybean meal diet plus vitamins and minerals, T2) + 1 050 phytase units (FU), T3) + 591 mg pancreatin/kg feed, and T4) + 1 050 FU + 591 mg pancreatin/kg feed. The basal diet contained 18.2% crude protein. Yellow endosperm grain sorghum and hulless soybean were used in this trial. The enzymatic activity of the phytase used in this experiment was equivalent to 10 000 FU/g. Pancreatin digests not less than 100 times its weight of casein in 60 min at pH 7.5. The AID (%) of the essential amino acids for treatments T1 to T4 were: Arginine, 81.0, 82.6, 83.0, 82.2; Histidine, 75.6, 75.7, 75.1, 73.9; Isoleucine, 75.5, 73.0, 72.8, 72.2; Leucine, 73.2, 73.3, 72.3, 71.5; Lysine, 77.8, 77.7, 77.0, 76.3; Methionine, 67.5, 66.3, 62.9, 66.0; Phenylalanine, 74.6, 74.5, 74.0, 73.3; Threonine, 64.0, 63.6, 62.2, 61.8; Valine, 70.9, 70.0, 69.5, 68.4, respectively. Except for methionine, there was no effect of phytase or pancreatin supplementation on the AID of the essential AA. The AID of methionine tended to decrease with the addition of pancreatin to the basal diet. Arginine was the AA with the highest AID value, whereas threonine had the lowest AID value. In conclusion, the supplementation of phytase containing 0.5% total P and 0.10, 0.20, 0.22, and 0.48% phytate P, respectively. But, the supplementation of phytase, alone or in combination with pancreatin, to grain sorghum-soybean meal diets does not affect the AID of the essential amino acids in growing pigs.

Key Words: Pigs, Phytase-pancreatin, Ileal amino acid digestibility

The objectives of this experiment were to determine the effects of diet on metabolic characteristics and gene expression profile in old and young dogs. Old (ave. age = 11.1 0.6 yr; 6 M, 6 F) and weanling (age = 8 wk old; 6 M, 6 F) Beagles were used. Three of each gender and age were randomly assigned to one of two dietary treatments. Diet A was primarily composed of high quality, animal-derived ingredients and was formulated to contain 30% crude protein and 20% fat. Diet B was primarily composed of plant-derived ingredients and was formulated to contain 22% crude protein and 8% fat. Old dogs were fed to maintain bodyweight while weanling puppies were fed ad libitum. Blood samples were collected via jugular puncture at baseline and after 3, 6, and 9 months for analysis of complete blood count (CBC) and serum chemistry profile. A 4-day total fecal collection was performed to determine total tract macronutrient digestibilities after 3 months on the experiment. Data were analyzed using the GLM procedure of SAS. As expected, dry matter (DM) and organic matter (OM) digestibilities were greater ($P < 0.05$) for dogs fed Diet A. Dry matter (P = 0.06) and OM (P < 0.05) digestibilities also were greater in old dogs. Dogs fed Diet B had lower (P < 0.05) fecal DM% and greater (P = 0.05) fecal output (when expressed either on as-is or DM basis) and fecal output (as-is): food intake (DM) ratio. Age had a major impact on CBC and serum chemistry profile. At baseline, young dogs had greater (P < 0.05) total white blood cell, neutrophil, lymphocyte, and blood glucose concentrations. Old dogs had greater (P < 0.05) red blood cell, hemoglobin, hematocrit, albumin, creatinine, blood urea nitrogen and total protein concentrations at baseline. In conclusion, diet and age had dramatic effects on nutrient digestibility, fecal characteristics, CBC, and serum chemistry profile.

Key Words: Canine, Nutritional genomics, Nutrient digestibility


Detecting dietary effects on gene expression profile in geriatric and weanling dogs was the objective of this experiment. Blood samples were collected via jugular puncture at baseline and after 3, 6, and 9 months for RNA isolation. Liver biopsies also were collected after 6 and 9 months for RNA isolation. Isolated RNA samples can be hybridized with an oligonucleotide microarray to generate a gene expression profile. Oligonucleotide microarrays monitor the expression of hundreds or thousands of genes simultaneously, making them a powerful alternative to conventional techniques that limit experiments to measuring only a few genes at a time. We designed an oligonucleotide microarray containing 384 genes with major emphasis placed on metabolic pathways and immune function. With the use of Vector NTI (Informax Inc., Frederick, MD), a bioinformatics tool used for sequence analysis and molecular biology data management, canine expressed sequence tags (ESTs) and gene sequences were identified from the public domain. Genes of interest were analyzed to determine unique oligonucleotide sequences (70-mers) that could be used as a probe on the microarray. Selected sequences were then synthesized and printed on microarray slides. As with humans, diabetes is highly prevalent in dogs and is positively correlated with age. Identification of biomarkers predictive of disease is needed and is a goal of this experiment. Therefore, genes associated with glucose metabolism and homologous to human genes demonstrated to contribute to the development of diabetes were included on the microarray. To conclude, a 384-gene oligonucleotide microarray has been developed to study metabolic pathways and immune function in dogs with a strong emphasis on glucose metabolism and diabetes. This microarray will be used to generate gene expression profiles of dogs in the current experiment and those in future experiments.

Key Words: Canine, Nutritional genomics, Oligonucleotide microarray

T94  Case study of preparing a submission for regulatory clearance of a new ingredient. L. B. Deffenbaugh*, Kemin Nutrisurance, Inc.

New ingredients for companion animal diets become available only occasionally because of the rigorous approval process. Regulatory options for clearance of a new ingredient for petfoods include: Food Additive Petition (US), Letter of Non-Objection (US), GRAS declaration (US) or an Assessment of Additives in Animal Nutrition (EU). The key objectives of the regulatory clearance processes are purpose (utility) and safety. Rosemary extract is a natural botanical for which antioxidant properties have been widely reported for decades. The US Food and Drug Administration allows for the use of rosemary extract as a flavor or spice, but not as an antioxidant, in animal feeds under 21 CFR 582.20, Substances Generally Recognized as Safe (GRAS). Kemin Nutrisurance, Inc. has prepared a Letter of Non-Objection submission to extend clearance of rosemary extract to include use as an antioxidant in animal feeds. While the data gathered for the submission appears replete and voluminous, the process to collect the information was quite straightforward once a clear outline was prepared. The data for the rosemary extract submission will be described such a way to provide a template for readers who are considering preparation of an LNO submission for a new ingredient. The process was found to be valuable as the requirements for the submission fulfill many of the steps required to develop and launch a new ingredient.

Key Words: Regulatory clearance, Letter of non-objection, Rosemary extract


Effects of spray-dried animal plasma (SDAP) on intake, fecal output, fecal scores and apparent total tract digestibility were determined using 14 adult Beagle dogs (BW = 13.3 kg). The SDAP (Endure, APC, Inc.) was coated on the exterior of extruded dry dog food kibbles at 2% of weight. Coated kibbles (27% CP and 13 to 16% ether extract) were fed to dogs in two experiments (n = 6 and 8 in experiments 1 and 2, respectively) in a switchback design using two 15-d periods. The final 5 d of each period were used for feed and fecal collections. In experiment 1, kibbles were coated with 5%, 2% or 0% SDAP and 0 or 2% SDAP. In experiment 2, commercially available dry dog food, previously coated with fat and flavor were coated with 0 or 2% SDAP by mixing in a cement mixer. Intake, fecal consistency and apparent digestibility of nutrients were determined. Addition of SDAP did not affect chemical composition of diets or intake of most nutrients. Fecal scores were unaffected but total feces excreted was reduced by 13.1 and 0.3% for experiments 1 and 2, respectively. Addition of SDAP improved digestibility of DM, ash, crude fiber, and fat in experiment 1 and DM, organic matter, ash, and crude fiber in experiment 2. Digestion of crude fiber was improved from 1.8 to 20.3% in Experiment 1 and 5.4 to 29.1% in Experiment 2 with addition of SDAP. Digestion of ash was improved from 32.5 to 42.8% in Experiment 1 and 37.4 to 44.7% in Experiment 2. Changes in digestion that occurred with addition of SDAP suggested improved digestive capacity in dogs.

<table>
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<th>Item</th>
<th>CON</th>
<th>SDAP</th>
<th>SEM*</th>
<th>CON</th>
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<th>SEM*</th>
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<td>0.04</td>
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注射量为0.1 g/kg; NS = P > 0.10

Fecal score on scale of 1 = watery diarrhea to 5 = hard, dry, crumbly.

Key Words: Canine, Digestibility, Spray-dried animal plasma
Four purpose-bred ileally cannulated adult female dogs with housed bloodlines were used to evaluate the effects of supplemental spray dried plasma (SDP) on food intake, nutrient digestibility, and gastrointestinal microflora in healthy adult dogs. J. M. Dust*1, G. C. Liu*, C. M. Grieshop1, N. R. Merchenschneider, J. D. Quigley, III, and G. C. Fahey, Jr.1, 1University of Illinois, Urbana, IL, 2APC, Inc., Ames, IA.

Eight mature dogs (19.3 ± 0.1 kg) were used in a replicated 4×4 Latin square design experiment to determine the consequences of feeding low-oligosaccharide, low-phytate soy on nutrient availability in complete foods fed to dogs. All foods were isonitrogenous (20% CP) and contained low-oligosaccharide soybean meal (LLM), conventional soybean meal (SBM), low-oligosaccharide, low-phytate whole soybeans (LLB), or conventional whole soybeans (WSB) as the protein source. Daily DM averaged 287 ± 4 g/d. The LLB and WSB foods had the highest fecal outputs averaging 48.2 g DM/d. Small intestinal DM digestibility was highest for LLM (80.9%) and lowest for LLB (74.0%). Large intestinal DM digestibility was not affected by oligosaccharides (P > 0.65). Total tract DM digestibility was highest for LLM (87.0%) and lowest for WSB and LLB (averaging 83.3%). Fecal N excretion was lowest for LLM and SBM (1.5 and 1.6 g N/d, respectively) and highest for LLB and WSB (2.3 and 2.0 g N/d, respectively). No differences in N balance, small intestinal N digestibility or large intestinal N digestibility were observed due to the presence of oligosaccharides (P > 0.67, P > 0.21 and P > 0.12, respectively). Tryptophan digestibility was higher for SBM when compared to LLM (P < 0.04) and higher for WSB than LLB (P < 0.001). Histidine digestibility was higher in WSB when compared to LLB (P < 0.05). No differences in nonessential AA digestibility were observed when comparing soy-based foods. The results of this study demonstrate that LLM, SBM, LLM and WSB can be good sources of protein for canine foods and have a high digestibility. Statistical differences in small intestinal digestibility were not observed (with the exception of tryptophan and histidine) when comparing SBM to LLM and WSB to LLB indicating that oligosaccharides and phytate content did not affect digestibility in the present study.

Key Words: Dogs, Soybeans, Digestibility


The modified Atwater's equation [metabolizable energy (ME) kcal/kg = 3.5×crude protein (CP) + 8.5×ether extract (EE) + 3.5×nitrogen free extract] is currently used to predict the metabolizable energy (ME) content of dog foods. However, we found that the equation consistently under predicted ME compared to the observed ME in 55 balance trials. It was our objective to use these balance trials to develop an equation based on chemical composition of the diet to predict ME content of the diets. Eight diets that varied in ME content (3,463 to 4,233 kcal/kg) and were fed at maintenance and used in the analysis. The diets varied in protein source, with the major protein sources being low-oligosaccharide whole soybeans, low-oligosaccharide low-phytate whole soybeans (2 sources), conventional soybean meal (2 sources), low-ash poultry meal, low-oligosaccharide low-phytate soybean meal or conventional whole soybeans. A multivariate regression analysis was used to predict ME content based on chemical composition. Two initial models were fit to the data. Model 1 included CP, EE and crude fiber (CF). Model 2 replaced the CF term with acid detergent fiber (ADF) and neutral detergent fiber (NDF), which resulted in a model that contained CP, EE, NDF, and ADF. Because the diets varied in protein sources the ratio of alpha-amino N (AAN) to non-alpha-amino N (NAAN) ranged from 3.5 to 14.4, therefore we hypothesized that accounting for the proportion of AAN in CP would improve the fit of the models. Model 1 had an r² of 0.46 and when AAN and NAAN were substituted for CP, the model had an r² of 0.79. Similarly, Model 2 had an r² of 0.43 and when AAN and NAAN were substituted for CP the model had an r² of 0.82. Residual analysis suggests that by replacing the CP term in Model 1 with ADF and NDF in Model 2 there was an improvement in prediction of ME content. By splitting CP into an AAN and NAAN fractions we have further defined the chemical composition of the diet. These data suggest that defining protein quality improves the ability to predict ME content of dog foods.

Key Words: Dog, Digestibility

**T100** Estimation of the proportion of bacterial nitrogen in canine feces using diaminopimelic acid as an internal bacterial marker. L. K. Karr-Lilienthal¹, C. M. Grieshop¹, J. K. Spears¹, A. Patel², M. Larson², and G. C. Fahey, Jr.¹
¹University of Illinois at Urbana-Champaign, IL USA, ²Nestle Purina Research, St. Joseph, MO USA.

Approximately 50% of the mass of dog feces may be of bacterial origin, but this number is based on human data. A bacterial marker can be used to determine the portion of fecal N that is of bacterial origin as well as the effect of dietary ingredients on the bacterial N content found in feces of the dog. Two experiments were conducted to determine the efficacy of diaminopimelic acid (DAPA) and purines as bacterial markers in dogs. In experiment 1, five adult, female dogs were fed the same commercial diet. In experiment 2, fifty dogs were fed one of four test diets: a prebiotic-free control, or a diet containing either 1% choline, 1% manganoligosaccharide (MOS), or 1% choline plus 1% MOS. Fresh feces were collected in both experiments and used to isolate a bacterial rich sample (BRS) by differential centrifugation. In experiment 1, the BRS had a 0.66 N:purine ratio and an 18.9 N:DAPA ratio. The coefficient of variation for the N:purine ratio was much higher than that for the N:DAPA ratio, indicating that DAPA would provide a less variable estimate of fecal bacterial N. Using either marker, approximately 50% of the fecal N was estimated to be of bacterial origin. In experiment 2, the N:DAPA ratio of the BRS was not different (P > 0.05) among treatments. Dogs fed prebiotic-containing diets had N:DAPA ratios ranging from 17.3 to 18.2, while dogs fed the control were lower at 15.9. For dogs fed prebiotic-containing diets, approximately 48% of the fecal N was of bacterial origin as compared with 45% for dogs fed the control. When calculating fecal bacterial concentration using the average N:DAPA ratio for all dogs, little difference existed in the estimation compared to using the individual values. However, for dogs fed the control, the value using the average ratio was approximately 18% higher than when using the individual ratios. This is due to the lower N:DAPA ratio for dogs fed the control compared with dogs fed the other treatments. Based on the consistency of the N:DAPA ratio of the BRS, DAPA appears to be a valuable tool for estimation of bacterial N in feces.

**Key Words:** Diaminopimelic acid, Dog, Marker

**T101** The effect of preservation time length and thawing on Lactobacillus population from fecal material. C. J. Fu and M. S. Kerley, University of Missouri-Columbia.

A study was conducted to determine the effect of preservation time length on Lactobacillus population in dog feces. Lactobacillus is typically used as an indicator of dietary-induced bacteria population change, because its presence is important to normal bowel function. Also, reviewers have questioned the validity of using preserved digesta/fecal material for enumeration of bacterial populations. The objective of this research was to determine fecal storage effects on Lactobacillus population number. The treatment conditions were: 1) Maintained in buffered T100 aerobic dilution solution for 2, 4, 7, or 14 days at 4 °C; 2) Thawing on nitrogen in canine feces using diaminopimelic acid as an internal bacterial marker. L. K. Karr-Lilienthal¹, C. M. Grieshop¹, J. K. Spears¹, A. Patel², M. Larson², and G. C. Fahey, Jr.¹
¹University of Illinois at Urbana-Champaign, IL USA, ²Nestle Purina Research, St. Joseph, MO USA.

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**Key Words:** Diaminopimelic acid, Dog, Marker


Forty dogs and forty cats were used to evaluate the effect of increasing dietary antioxidants on delayed type hypersensitivity and circulating antibody response to vaccination. The experimental protocol was reviewed and approved by the Institutional Animal Care and Use Committee. Subjects were assigned to dietary treatment groups and fed the treatment foods for 84 days. Dietary treatments consisted of a control food meeting all requirements for adult maintenance and three treatment groups with incrementally increased antioxidant supplementation. The foods with increased antioxidant supplementation all received similar amounts of vitamin C and β-carotene with varying levels of increased vitamin E. Dietary vitamin E was increased by 500, 1000, and 1500 IU/kg in the supplemented foods. Circulating vitamin E increased in a linear (P<0.01) and quadratic (P<0.05) fashion with antioxidant supplementation in dogs and cats. The standard intradermal skin test (delayed type hypersensitivity) increased in response to increasing dietary antioxidants in dogs (P<0.05) and numerically increased in cats. A standard vaccine for four strains of Leptospira was used in the dog with the stimulated antibody response measured by specific serovar titer. The sum of the titers from each strain, when compared between the control and the dietary treatment groups had a quadratic trend (P<0.1) with the maximum response occurring at 1000 IU Vitamin E/kg. Rabies serology was used to determine an antibody response in cats. A quadratic response (P<0.05) was demonstrated in cats with the treatment groups of the first two levels of antioxidant increase having increased titers and the highest antioxidant level supplementation group having a decreased titer when compared to the control.

In conclusion, immune function benefits of increased response to a vaccine and increased immune response in an intradermal skin test, were demonstrated in both dogs and cats when antioxidants were added to the food. Both dogs and cats had a maximal benefit by the 1000 IU/kg addition of vitamin E to foods.

**Key Words:** Antioxidants, Canine, Feline

**T103** Evaluation of delta-6 desaturase kinetics in canine liver microsomes for alpha-linolenic acid in the presence of competitive amounts of linoleic acid. J. E. Bauer* and B. L. Dunbar, Texas A&M University.

The rate-limiting step in the conversion of essential fatty acids to long chain derivatives is controlled by delta-6 (d-6) desaturase. This enzyme competitively utilizes both linoleic (LA) and alpha-linolenic acids (ALA) as substrates. Efforts to characterize the kinetics of unpuified enzyme for ALA are confounded by the presence of endogenous LA present in the source material. A technique to correct this problem was developed and used to more accurately estimate the Km and Vmax of d-6 desaturase for ALA in the presence of these inhibitory amounts of LA. Microsomes were prepared from fresh canine liver tissue from normally fed adult, mixed breed dogs, and incubated with 14C labeled LA or ALA substrates under standardized conditions. Lipids were extracted, saponified, and the resultant fatty acids phenacylated. Fatty acid phenacyl esters were separated by HPLC and counted by liquid scintillation counting. LA and ALA contents of the microsomes were determined using internal standardization and gas chromatography. This data was then used to construct a graphical correction for the presence of varying and competitive amounts of LA in canine hepatic microsomal enzyme preparations. A similar correction for LA activity was unnecessary due to insignificant amounts of ALA in the microsome preparations. Delta-6 desaturase activities (Vmax) of 62.4 and 5.4 pmol/min mg protein with ALA and LA respectively were thus found with apparent Km values of 12.4 and 41.8 mM, respectively. These data show that dog liver microsomes have EFA desaturation capabilities and that ALA is preferred due to its higher Vmax and lower Km compared to LA. In spite of this preference it was found that liver concentration of ALA averaged only 2.4 mM. Thus, tissue ALA concentrations his may never exceed the Km for desaturation unless high dietary ALA is provided. Hence control of ALA may be unnecessary. By contrast, LA was competed because its microsomal content (64.4 mM) exceeds its Km. These characteristics may explain low in vivo ALA conversion rates in dogs and
other species. The data further suggest that high levels of dietary ALA may be needed to exceed the Km for d-6 desaturase.

**Key Words:** Delta 6 desaturase, Kinetics, Alpha linolenic acid

**T104** The effect of dietary fat on the fatty acid composition of olfactory mucosal tissues in young adult dogs. C. T. Middendorf, K. A. Cummins, E. A. Altom, and M. Craig-Schmidt, Auburn University, AL.

Previous studies have indicated that dogs fed a diet high in saturated fat had a decrease in olfactory acuity. A study was designed to determine the influence of dietary fat source on the phospholipid fatty acid composition of olfactory and respiratory mucosa in young-adult dogs. Fifteen young-adult female beagles (average age = 2 yr, body weight average = 9.69 kg) were randomly assigned to receive one of three diets varying in the amount and source of fat. These were Diet A, with 12% crude fat; Diet B, containing 16% crude fat formulated by the addition of 4% corn oil to the maintenance diet; and Diet C, containing 16% crude fat formulated by the addition of 4% coconut oil. Dogs were fed the diets for a period of sixty days, euthanized, and then samples were collected from the olfactory turbinates and nasal passage. Fatty acid compositions of phosphatidylcholine (PC) and phosphatidyl ethanolamine (PE) were analyzed by capillary gas chromatography. The amount of 16:0 in respiratory PC was greatest from dogs fed Diet B (P < 0.10), while the amount of 20:4n-6 incorporated into respiratory PC was less (P < 0.10). No differences were reported for the 20:4n-6 content in PC of olfactory mucosa (P > 0.10). The amount of 18:2n-6 in PC from both mucosal tissues was greater in dogs fed Diet B than in dogs fed Diets A or C (P < 0.10). Despite increased amounts of 18:2n-6 in Diet B, there were no differences among treatments in the amount of 18:2n-6 or 20:4n-6 incorporated into PE (P > 0.10) of either tissue. No differences were observed in the ratio of unsaturated to saturated fatty acid incorporation into phospholipids (P > 0.10), or in the mean chain lengths (P > 0.10). No differences were observed in the unsaturation index for the PE fractions and the olfactory PC (P > 0.10). However, the unsaturation index was lower in dogs fed Diet B in respiratory mucosal PC (P < 0.10). Results from this study do not fully explain the differences observed in olfactory acuity.

**Key Words:** Canine, Nutrition, Lipids


Hypoadrenocorticism (Addison’s) is a recognized late onset disorder in the dog. Symptoms are diffuse and a result of deterioration of the adrenal cortex with its subsequent reduction in the capacity to synthesize and secrete glucocorticoids and mineralocorticoids. Diagnosis of Addison’s is by ACTH stimulation challenge. Some breeds have a higher than expected incidence of Addison’s suggesting a genetic component to the disorder. We have recently reported that Addison’s has a genetic basis in the Bearded Collie and Standard Poodle although the mode of inheritance differed. Here we compare the heritabilities and mode of inheritance for the disorder in two additional but related breeds, the Leonberger and the Portuguese Water Dog (PWD). Owners were requested to submit data on the Addisonian status for the above-mentioned breeds along with pedigree, gender, and DNA. The binary nature of the data required a threshold model; a mixed Bayesian analysis model was used to arrive at heritability estimates. Complex segregation analyses were employed to characterize mode of inheritance. The heritability estimates for Addison’s disease in the Leonberger (n=294 dogs) and PWD (n=504) were 0.62 and 0.57, respectively. In contrast to the findings in Standard Poodles, the Leonberger and PWD data do not support a single locus of large effect fed Diet B than in dogs fed Diets A or C.

**Key Words:** Hypoadrenocorticism, Dog, Heritability

**Horse**

**T106** Use of ass’s milk for novel probiotic beverages. E. Salimei1, E. Sorrentino2, M. Succi2, F. Fantuz2, G. Varisco3, and R. Coppolla1, 1Dept. SAVA, Univ. of Molise, CB Italy, 2Dept. STAAM, Univ. of Molise, CB Italy, 3Dept. Sci. Vet., Univ. of Camerino, MC Italy, 4Ist. Sperim. Zootropifilattico, Brescia Italy.

Nutritional and therapeutic properties of ass’s milk are known since antiquity, and recent clinical studies confirm its efficacy in the treatment of most complicated cases of infants’ multiple food intolerance. In order to deepen the knowledge on ass’s milk and its feasible production, 6 asses were studied over two consecutive lactations (150 days/lactation). During the experimental period asses, machine milked, produced in average 740 mL milk/milking; milk yield was higher in the second lactation. Results on ass’s milk chemical composition confirm the relative dilution of this product characterized by low fat (averaging 0.38%) and protein (1.72%, in average) contents but with a high lactose content (mean value 6.88%). Protein fraction of ass’s milk showed a low protein allergenic content along with a higher content of lysozyme (1.5 g/L). Moreover, due to its high lactose content, ass’s milk could be placed amongst the new generation of milk beverages making it possible to effectively combine the advantageous properties of the raw ingredient with lactic acid bacteria. The high levels of lysozyme detected in raw and heat-treated ass’s milk could explain the observed low bacterial concentration (4x10⁶ CFU/mL) of raw milk. Besides this, pH values of control milk (heat-treated and un inoculated) were stable throughout the experiment (15d), confirming the possible role of lysozyme. Ass’s milk revealed to be a good growth medium for potentially probiotic lactobacilli strains since pH ranged between 3.67 and 3.85 for all the tested strains after a 48 hour period of incubation. Values were stable up to the end of the experiment. Results evidenced that ass’s milk can be adopted as a substrate of probiotic and therapeutic beverages.

**Key Words:** Ass’s milk, Probiotic beverages, Hypoallergenic food

**T107** The influence of training on flat walking temporal variables of Tennessee Walking Horse yearlings. K. M. Holt* and M. C. Nicodemus, Mississippi State University, Mississippi State, MS.

Tennessee Walking Horse (TWH) gaits are often described as learned, placing great importance on the training of young horses. To determine the impact of training on yearling TWH gaits, temporal variables were measured before and after a 60-day training period. 60 Hz frame-by-frame analysis was done before and after training to measure temporal variables and kinematic analysis determined velocity and wither height. Five strides of a consistent flat walk with a velocity of 1.7 (0.2) m/s were measured for 4 yearlings. Means (SD) were determined with t-tests (P=0.05). No differences were observed before and after training (Table 1). The flat walk was determined to be a symmetrical, 4-beat gait with an irregular rhythm and lateral couplets. The stride period (Table 1). The flat walk was determined to be a symmetrical, 4-beat gait with an irregular rhythm and lateral couplets. The stride period alternated between periods of bipedal and tripedal support in which the lateral bipedal support was longer than the diagonal. The majority of the stride was spent in a stance phase with a similar percent of stance for both the fore and hind limbs. These characteristics did not significantly change after the training period. Flat walking yearlings were found to have similar characteristics as the yearlings, except for some of the yearlings demonstrated regularity of rhythm with an equal percentage of lateral and diagonal bipedal support. This may indicate more of a relationship between growth and temporal variables, rather than training. Understanding the influence of such variables as growth and training on TWH gaits will assist in both clinical and performance applications.

**Key Words:** Ass’s milk, Probiotic beverages, Hypoallergenic food


### T08, T108, T110

**Effects of post-partum ivermectin administration to broodmares on the incidence of foal-diarrhea**

S. E. Harris, M. C. Nicodemus*, and K. M. Holt,
Mississippi State University, Mississippi State, MS.

Shoeing is a major component of showing for the Tennessee Walking Horse (TWH). The most popular TWH show classes are the padded classes in which multiple wedges are added to the front hooves to enhance the horse’s performance. To better understand the influence of this shoeing on the gait, the flat and running walks temporal variables of the padded TWH were measured and compared to earlier studies done on the flat shod TWH. 4 padded, show horses were ridden at the flat and running walks while being filmed. Shoeing weight, height, and angles met TWH show standards for open padded classes. 60 Hz frame-by-frame analysis of the video determined stride duration and percent of stride duration for fore and hind stance; lateral and diagonal bipedal, unipedal, and tripod support; and lateral and diagonal advanced placement and lift-off. Means (SD) are given in the table with similar superscripts between variables within a gait representing significant differences according to paired t-tests (P < 0.05).

Both gait conditions had hind stance and diagonal advanced lift-off. The flat walk had a regular rhythm with longer lateral bipedal support. The running walk had an irregular rhythm with diagonal couplets and even periods of bipedal support. In comparison to earlier flat shod TWH studies, the flat shod flat walk had shorter periods of forelimb-swing and single hind limb support while demonstrating a period of tripod support with two forelimbs. The flat shod running walk compared to the padded demonstrated lateral couplets while having a shorter period of single hind limb support and uneven periods of bipedal support. The flat shod and padded TWH gaits may be different due to shoeing. Further shoeing research can assist in both the clinical and performance evaluations of the TWH.

#### Temporal Variables

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<th>Stride Duration(ms)</th>
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<th>Running Walk</th>
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<tr>
<td>794(27)</td>
<td>783(21)</td>
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</tr>
<tr>
<td>Fore Stance(%)</td>
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<tr>
<td>Hint Stance(%)</td>
<td>54(2)a</td>
<td>54(2)a</td>
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<td>21(8)</td>
<td>14(9)b</td>
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<td>Diagonal Adv. Lift-Off(%)</td>
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<td>36(4)c</td>
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<tr>
<td>Diagonal Lift-Off(%)</td>
<td>13(8)a</td>
<td>14(4)c</td>
</tr>
<tr>
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<td>Bipedal Support(%)</td>
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<td>28(7)</td>
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<td>Tripedal Support(%)</td>
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</table>

**Key Words:** Tennessee Walking Horses, Temporal variables, Shoeing

### T109

**Effects of post-partum ivermectin administration to broodmares on the incidence of foal-diarrhea**

S. E. Harris1, M. M. Vogelsang2, E. E. Bass2, and G. D. Potter1,
1Texas A&M University, College Station, TX USA, 2University of Georgia, Athens, GA USA.

Foal-diarrhea (FHD) is the most common self-limiting diarrhea in foals less than two weeks of age with an incidence as high as 70-80 percent. Although FHD does not seem detrimental to long-term health, it does present a management problem and can predispose foals to more severe diarrhea. It has been proposed that the parasite, *Strongyloides westeri*, could be the causative agent for FHD since infestations in foals develop about 10 to 14 days of age. The objective of this on-farm study was to determine the efficacy of post-partum anthelmintic treatment of mares for reducing the incidence and/or severity of FHD in foals. Although a number of anthelmintics are effective against *S. westeri*, ivermectin was utilized because of availability and efficacy against milk borne strongyloides infestations. Twenty-four mares and their foals were alternately assigned to a treated or non-treated group according to expected foaling date. Treatment consisted of oral administration of *Zimectran* to the dam within 12 h post-foaling. From d1 through d25, foals were weighed and vital signs, incidence or absence and severity of diarrhea recorded. Incidence scores (severity of diarrhea) were assigned on a 0-3 scale with 0 being absence of symptoms and 3 being extremely profuse diarrhea. Only 1 foal (from the treated group) did not demonstrate symptoms of diarrhea during the 25-day data collection period. Foals from treated mares had symptoms of diarrhea from d2 through d21 and those from non-treated mares from d2 through d25. The greatest number of foals from treated mares showed symptoms from d8 through d13 while those from non-treated mares showed symptoms from d9 through d18. There was no difference in incidence scores due to treatment; however there was a trend for foals from treated mares to experience a more severe diarrhea over a shorter duration. There was no difference in weight change related to treatment or non-treatment of mares. Post-partum administration of ivermectin to mares did not decrease the incidence or severity of diarrhea in foals or affect growth rate of foals.

**Key Words:** Foal heat diarrhea, *Strongyloides westeri*, Ivermectin

### T111

**Effects of feeding a blend of grains naturally-contaminated with *Fusarium* mycotoxins on feed intake and indicators of athletic performance of horses**

S. L. Raymond*, T. A. Conner, K. Shortt, and T. Smith,
Texas A&M University, College Station, TX USA, USA.

An experiment was conducted to determine the effect of feeding blends of grains naturally-contaminated with *Fusarium* mycotoxins to mature horses and to test the efficacy of a polymeric glucomannan mycotoxin adsorbent (GM polymer, MTB-100, Alltech Inc.) in preventing *Fusarium* mycotoxins. Six mature, light, mixed breed mares were assigned to one of three dietary treatments for 21 days following a duplicated 3 x 3 Latin square design. Feed consumed each day was a combination of up to 3.5 kg of concentrates and 5.0 kg of mixed timothy/alfalfa hay. The concentrates fed included: (1) control (2) blend of 36% contaminated wheat and 53% contaminated corn and (3) contaminated grains + 0.2% GM polymer. Diets containing contaminated grains averaged 11.0 ppm deoxynivalenol, 0.7 ppm 15-acetyldeneoxynivalenol and 0.8 ppm 11.0 ppm deoxynivalenol, 0.7 ppm 15-acetyldeneoxynivalenol and 0.8 ppm 15-acetyldeneoxynivalenol and 0.8 ppm 15-acetyldeneoxynivalenol and 0.8 ppm 15-acetyldeneoxynivalenol and 0.8 ppm.
zeaalenone. Feed intake and body weight were monitored over a 21-day period. Horses were maintained on a fixed exercise schedule during the supplementation phase. At the end of the supplementation phase each horse completed a time to fatigue treadmill step test. Parameters measured during pre-test, each step of the test and 5 and 10 minutes post-test were: (1) time to fatigue (2) heart rate (3) hematocrit (4) serum lactate levels. Feed intake of horses fed contaminated grains was significantly reduced compared to controls throughout the experiment. Consumption of forage remained unaffected regardless of diet fed. Significant weight loss over 0 to 21 days was observed in horses fed contaminated grains as compared to control. Horses fed contaminated grains had significantly higher serum lactate levels at time of fatigue, while levels were significantly reduced 10 minutes post-test. It was concluded that horses are susceptible to *Fusarium* mycotoxozes as indicated by appetite suppression and weight loss.

**Key Words:** Deoxynivalenol, Equine, Exercise

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**Rabbit**


Two trials were conducted to study the influence of separating the litter from the doe for 53 h on fertility and reproductive parameters of multiparous Californian x New Zealand White crossbred female rabbits. There were two treatments: a control group in which litters had free access to nursing and a biostimulated group in which litters were separated from their does from Day 9 (9:00 a.m) to Day 11 (14:00 p.m) postpartum. All the does were artificially inseminated (AI) between 10:00 and 11:00 a.m. of Day 11 postpartum. In trial 1, a total of 419 Al (experimental unit), carried out in 32 multiparous does, was analyzed to determine fertility rate (number of farrowing/number of AI x 100). Separation of the litter from the doe increased fertility with respect to the control group (68% vs. 53%, P < 0.001). In fact, fertility rate was 38%, 30%, and 31% higher for 2nd, 3rd, and 4th parturition (P < 0.05) for the biostimulated does. In trial 2, a total of 16 does, between 3rd and 6th farrowings and having more than seven suckling rabbits at parturition were used to estimate milk production from 1 to 21 d postpartum. The experimental treatments were the same than in trial 1 and there were eight replicates (one doe) per treatment. Milk production was higher in the control than in the biostimulated does (5,090 ± 161 g vs. 4,593 ± 150 g, P < 0.05). In fact, on Day 12, 13, 14, and 15 of the lactation period, milk production was 40% (P < 0.0001), 18% (P > 0.05), 15% (P < 0.05), and 15% (P < 0.05) higher for the control than for the biostimulated group, respectively. Also, restricting suckling for 53 h from Day 9 to Day 11 of lactation increased oestradiol 17β during 48 h after the separation and reduced prolactin serum concentrations 24 h after the separation. We concluded that biostimulation increased fertility rate, specially from the 2nd to the 4th farrowing, but reduced milk production during the first 21 d postpartum.

**Key Words:** Doe-litter separation, Rabbit fertility, Milk production.

T113 Milk production evaluation in rabbits milking one or two times a day. R. Salcedo-Baca1,2, J. L. Echegaray-Torres2, and A. Robinson3. 1University of Guelph, Guelph, ON, Canada. 2Universidad Autonoma Chapino, Texcoco, Mexico. 3University of Guelph, Guelph, ON, Canada.

Milk production (MP) is an important trait for profitability of rabbit production, since it affects the litter weaning weight. Currently, under a typical management system, the doe is allowed to milk her litter only once a day for 5 to 10 minutes. Some reports in the literature have indicated that around 20 to 30 % of the does would get into the nest to milk 2 times a day if they were allowed. The objective of this study was to evaluate the effect of the number of times milked in a day (one or two) on the total milk production of the doe. In the Universidad Autonoma Chapino, Mexico, sixteen multi-parous New Zealand does with their litters (85 young) were evaluated for a lactation period of 35 days (during January and February, 2003). Every day the litter was weighed before and after milking in order to measure the MP of the doe. Does were separated into morning only milking (T1, n=7) and morning and night milking (T2, n=9). SAS PROC GLM was used to analyze the records, fitting a model including milking pattern, and litter size at birth, day 3, 15 and 30 as covariates. The model explained 75% of the variation. Highly significant differences were found between treatments: 3232g and 4070g for T1 and T2 respectively, the litter size was a significant variable as well. To investigate the effect on fertility, the does were not allowed to milk on day 10 and artificially inseminated (AI) on day 11 after parturition. Pregnancy diagnosis through abdominal palpation was conducted 11 days after breeding. T1 and T2 had 72% and 89% of pregnancies respectively. There were no significant differences in the doe weight change during the last 2 weeks of the experiment. For the entire period mortality of the young was 8.6% and 6.0% for T1 and T2 respectively. The average individual weight of the young at the end of the test was 511g and 657g for T1 and T2, with litter size of 4.6 and 5.2 respectively. Two times a day milking, when labor cost is not expensive, is thus recommended.

**Key Words:** Rabbit, Milk, Production

T114 Parturition synchronization in rabbits using prostaglandins: Optimal time for hormone application. J. L. Echegaray-Torres1, R. Salcedo-Baca1,2, and C. Flores-Martinez3. 1Universidad Autonoma Chapino, Chapino, Edo. de Mexico, 2University of Guelph, Guelph, ON, Canada. 3Instituto Tecnologico Agropecuario de Oaxaca, Oaxaca, Mexico.

Currently, industrial rabbit systems typically manage does in sets (bands). Each set of does is artificially inseminated together, but parturition can occur over a 4 d period. This spread in parturition time increases labor demands to attend to does, or alternatively, increases the risk of mortality in the progeny. In addition, fostering young from bigger to smaller litters increases in difficulty as age gaps widen. The objectives of this study were to use pregnant N.Z. White does to 1) evaluate the effectiveness of prostaglandins (PG) in synchronizing parturition and 2) discern optimal PG application times. In Exp. 1, 39 (Jan. 2001) and 31 (Nov. 2002) does were injected with PG 29 d post-insemination (100 mg PG/doe; T1). Respective control groups (T2) contained 38 and 27 does. Time of parturition was measured in hours considering zero the moment of hormone application. Time of parturition was higher (P=0.05) in between treatments 53:55 and 66:22 for T1 and T2 respectively. Also, more (97% vs. 60%) deliveries occurred within 48 h from start of first delivery in T1 than in T2. Litter size at birth (live progeny) was similar in T1 (7.8) and T2 (8). In Exp. 2 (Jan. 2003), different PG application days and times post-insemination (same dose as Exp.1), were tested against a control group (T4), d 29 am (Ts), d 29 pm (Tb), and d 30 am (Tc), each group with 20 does. There were significant differences between treatments in time of parturition (50:42a, 54:07b, 43:25a, and 55:10b for Ta, Tb, Tc and Td respectively). Parturitions recorded in the 24 h after the first delivery was 69, 89, 43, and 70% for Ta, Tb, Tc, and Td respectively. In conclusion, injection of 100 mg/doe PG on day 29 (pm) of pregnancy is recommended for rabbit production systems where does are managed in sets.

**Key Words:** Rabbits, Parturition, Synchronization

T115 The shape of the lactation curve in rabbits milking once or twice a day, and the function to estimate the total milk production. R. Salcedo-Baca1,2, J. L. Echegaray-Torres*, and A. Robinson3. 1University of Guelph, Guelph, ON, Canada. 2Universidad Autonoma Chapino, Texcoco, Edo. de Mexico, Mexico.

A typical doe production milk (MP) curve starts with around 50g/day increasing to reach a peak, between 200 and 250g, around day 21 and then declines to day 30 when it varies around 150g. The total MP is affected by the litter size. The persistency is known to be influenced by the breed-back schedule; shorter days open results in the MP declining sooner. To predict the total MP the following regression equation is recommended (RER) in the literature to model a rabbit lactation curve (LC): MP = 1.77 + 1.39 LW21, where LW21 is the litter weight at day 21. The shape of the lactation curve in rabbits can be estimated using Eq. (1) and (2). To predict the total MP, the function to estimate the total milk production of the doe (T1) was to evaluate the number of times milked in a day (one or two) on the total milk production of the doe. In the Universidad Autonoma Chapino, Mexico, sixteen multi-parous New Zealand does with their litters (85 young) were evaluated for a lactation period of 35 days (during January and February, 2003). Every day the litter was weighed before and after milking in order to measure the MP of the doe. Does were separated into morning only milking (T1, n=7) and morning and night milking (T2, n=9). SAS PROC GLM was used to analyze the records, fitting a model including milking pattern, and litter size at birth, day 3, 15 and 30 as covariates. The model explained 75% of the variation. Highly significant differences were found between treatments: 3232g and 4070g for T1 and T2 respectively, the litter size was a significant variable as well. To investigate the effect on fertility, the does were not allowed to milk on day 10 and artificially inseminated (AI) on day 11 after parturition. Pregnancy diagnosis through abdominal palpation was conducted 11 days after breeding. T1 and T2 had 72% and 89% of pregnancies respectively. There were no significant differences in the doe weight change during the last 2 weeks of the experiment. For the entire period mortality of the young was 8.6% and 6.0% for T1 and T2 respectively. The average individual weight of the young at the end of the test was 511g and 657g for T1 and T2, with litter size of 4.6 and 5.2 respectively. Two times a day milking, when labor cost is not expensive, is thus recommended.

**Key Words:** Rabbit, Milk, Production.
fit of the LC function estimating MP under one (T1) or two (T2) times a day milking. The material and methods have been described in another report on these proceedings*. The statistical analysis was done with SAS, PROC REG and PROC CORR, to derive a new lactation curve prediction equation (NLC). Total MP was higher for T2 compared to T1 (4070 vs. 3232 g). The peak was reached between 17-18 and 19-20 for T2 and T1 respectively. Persistency, however, was better for T1, which had a higher production after day 29 than T2. The NLC derived in this study added two components; MP on day 4 and day 30, as follows: MP = 804 +9.4 MP4 + 1.4 LW2 1 + 5.5 MP31. The correlations were 0.92 and 0.96 between the true MP and LC, and true MP and NLC. In addition MP was underestimated on average in 40% of doses with LC while NLC overestimated MP in just 4% of doses. If MP is a trait to be improved genetically based on a prediction of lactation milk yield, we recommend fitting a regression incorporating multiple measures of daily milk yield like NLC.

Key Words: Lactation, Curve, Rabbits

Ruminant Nutrition: Dairy and Beef


The effects of degradable protein (RDP) and fiber quality on extracellular proteolytic activity (PA) were examined using a 4 x 4 Latin square with a 2 x 2 factorial arrangement of treatments in dual-flow continuous culture. Factors were level of RDP and quality of fiber, and the treatments were: 1) high RDP (12.4% of dietary DM), high quality alfalfa (156 RFV) (HPHF); 2) high RDP (12.4% of dietary DM), low quality alfalfa (105 RFV) (LPHF); 3) low RDP (10.4% of dietary DM), high quality alfalfa (156 RFV) (LPHF); and 4) low RDP (10.4% of dietary DM), low quality alfalfa (105 RFV) (LPLF). Periods were 10 d and samples were collected daily at 0800 h from fermenter contents and from 3-h effluent composites. Samples were centrifuged (20,000 x g, 20 min, 4°C), and supernatant was analyzed for protein content and PA. Using an azocasein assay, PA was defined as units of activity/mg protein, where a unit equaled the change in absorbance at 450 nm/min based on the purified activity of Subtilisin (EC 3.4.21.62). Data were analyzed using SAS MIXED procedures with the model including period, fermenter, RDP, fiber quality, RDP x fiber quality interaction, type of sample (composite vs single time point), and day included as a covariate. Composite samples had greater (P=0.01) protein concentrations and less (P=0.05) PA than single time point samples. Sample protein concentration (mg/mL) was 0.27, 0.40, 0.34, and 0.36, and PA (units/mg protein) was 0.18, 0.16, 0.16, and 0.14 for HPHF, LPHF, LP HF and LPLF, respectively. Dietary RDP concentration had no effect (P>0.05) on sample protein concentration or PA. There was a RDP x fiber quality interaction for HPHF protein concentration to be less (P<0.01) than all other treatments. Decreasing fiber quality increased (P<0.01) protein concentration, and in turn, decreased (P=0.05) PA. These results suggest dietary fiber quality may have a greater influence on ruminal extracellular proteolytic activity than dietary RDP.

Key Words: RDP, Fiber quality, Proteolytic activity

T117 Relative transite time of chyme between duodenal and jejunal segments of the small intestine of cattle. V. M. Gonzalez1, E. G. Arelano1, G. Mendoza1, F. G. Monge1, A. Plascencia*, E. Silva-Pena1, C. Vasquez1, and R. A. Zinn1, 1Universidad Autonoma de Baja California, Mexico, 2University of California, Davis.

Two steers (228 ± 4.5 kg) were equipped with cannulas (25 mm ID) in the small intestine to measure transit time of chyme within the duodenum, and jejunum. Sites for cannula placement were 1) proximal duodenum (6 cm from the pyloric sphincter); 2) duodenal-jejunal junction (10 cm from the duodenocolic fold) and 3) distal ileum (22 cm from ileocecal valve). Steers were fed 5.75 kg of alfalfa hay (ground to pass through a 7.6 cm screen). Transit time was measured during three consecutive days using aniline dye, pulse-dosed via the duodenal and jejunal cannula. Subsequently, steers were euthanized. Site of cannula placement were confirmed using anatomical reference and tissue analysis. The small intestine was then dissected and measured. Transit time (time required between infusion of aniline dye into the proximal duodenal cannula and its appearance at the duodenal-jejunal and distal ileal cannula was 2.56 ± 0.06 and 176 ± 4.21 min, respectively. Length of duodenal, jejunal, and ileal segments of the small intestine were 135 ± 4, 2730 ± 27 and 110 ± 1 cm, respectively. Transit time of chyme within the duodenum and jejunum averaged 46 and 14 cm/min, respectively. Considering that the duodenum represents less of 5% of total length of small intestine, that duodenal transit time is threefold faster than that of the rest of the small intestine, and that pancreatic and bile secretions into the duodenum occur midway along its length, we conclude that the duodenum plays a minor role in net nutrient absorption from the small intestine.

Key Words: Small intestine, Transite time, Cattle

T118 Effects of feeding a slow-release urea on ruminal nitrogen dynamics in steers. C. H. Hanson*, E. Silva-Pena, C. Vasquez1, G. Mendoza1, F. G. Monge1, 1University of Kentucky, Lexington, 2IMC, Lake Forest, IL.

Twelve ruminally-cannulated steers (529 ± 11 kg BW) were used to determine the effect of feeding a slow-release urea on ruminal N dynamics. Steers were equally divided into two groups: control (feed grade urea; FGU) or slow-release urea (SRU). Steers were fed corn silage plus 10% supplement at 1.29% BW for 35 d. Diets were formulated to be isonitrogenous and contain 12.5% crude protein. All supplemental N was from FGU or SRU (42% of N intake). Blood was collected via jugular venapuncture on d 33 and plasma was harvested for analysis of urea, glucose, glutamate, and glutamine. On d 34, ruminal fluid was collected every two h for ten h post-feeding and analyzed for NH4, VFA, and pH. Samples taken 4 h post-feeding were analyzed for urease activity. On d 35, in situ study determined the release of SRU from nylon bags suspended in the rumen. Nylon bags containing SRU were SRU were suspended for 0, 2, 4, 6, 8, 12 and 24 h. Upon removal, bags were rinsed and dried at 55°C before analysis for N content. Body weights and DM intakes were similar. Rumen pH (6.5) was not affected by treatment but ruminal ammonia was less (8.9 vs. 14.1 mM; P<0.02) and ruminal urease activity was greater (149 vs. 89 mmol/(min·mL rumen fluid); P<0.06) in steers consuming SRU. In situ rates of SRU degradation were not affected by treatment (0.28%/h), indicating that the ruminal microbes did not adapt during 35 d of feeding SRU. Plasma glucose concentrations were less (50 vs. 60 mg/dL; P<0.02) in steers fed SRU. Plasma urea (5.1 mM), glutamine (255 µM), and glutamate (174 µM) concentrations were not affected. Ruminal VFA molar proportions or concentrations were not affected by treatment. These results demonstrate that SRU possesses the ability to slowly release N in the ruminant.

Key Words: Ruminant, Urea, Nitrogen

T119 Effect of a novel hexadecatrienoic acid from marine algae (Chaetoceros) and olive oil on methane production by ruminal fluid in vitro. E. M. Ungerfeld1, S. R. Rust1, M. T. Yokoyama1, R. Burnett2, and J. K. Wang*, 1Michigan State University, East Lansing, MI, USA, 2University of Hawaii at Manoa, Honolulu, HI, USA.

Since methane emissions by ruminants are a major loss of feed energy and also contribute to global warming, there is considerable interest in decreasing ruminal methanogenesis. Fats and oils usually decrease methane production both in vitro and in vivo, although they also inhibit fermentation. We studied the effects of a novel hexadecatrienoic acid (C16:6,9,12) and of olive oil on ruminal fluid 24 h-batch in vitro fermentation. The hexadecatrienoic acid was purified from a marine algae (Chaetoceros) at the Univ. of Hawai'i-Manoa. Initial concentrations of both additives were 0.5, 1, and 2 mg/L (n = 4). The hexadecatrienoic acid linearly decreased (P < 0.01) methane production by 90%, while olive oil did not affect it. The hexadecatrienoic acid also caused (P = 0.02) a 6-fold hydrogen accumulation. Production of carbon dioxide was linearly decreased (P < 0.01) by the hexadecatrienoic acid by 46%, while olive oil increased carbon dioxide production linearly (P = 0.03) by 17%. Neither additive had an effect on final pH. Apparently fermentation OM, as estimated from the VFA stoichiometry, was linearly decreased (P < 0.01) by the hexadecatrienoic acid by 46%, while olive oil increased it linearly (P = 0.03) by 5%. The hexadecatrienoic acid linearly decreased (P < 0.01) acetate molar percentage from 69 to 55%.
tended to decrease ($P < 0.10$) butyrate molar percentage, and increased ($P < 0.01$) propionate molar percentage from 21 to 36%. Olive oil linearly decreased ($P < 0.01$) acetate molar percentage from 70 to 66%, and increased ($P = 0.02$) propionate from 22 to 23% and butyrate from 6.1 to 9.5%. The hexadecatrienoic acid linearly decreased ($P = 0.04$) ammonia concentration by 21%, while olive oil did not affect it. The hexadecatrienoic acid was a strong inhibitor of ruminal methanogenesis, but it decreased fermentation, and caused some hydrogen accumulation. Olive oil could be used to increase dietary energy without negatively affecting fermentation.

**Key Words:** Methane, Rumen, Oil

**T120** Short-term energy and protein supplementation affects ammonia, urea and glucose flux across portal-drained viscera (PDV) and liver in Holstein steers. J. H. Eisemann*,1 J. E. Ramirez1, K. E. Govoni2, A. S. Zinn2, and G. B. Huntington1,1 North Carolina State University, 1University of Connecticut.

The objective was to determine the effect of dietary supplements on plasma concentration of IGF-I, IGF binding proteins (BP) and on net splanchic flux of glucose, urea, and ammonia (NH3). Eight Holstein steers (212 ± 5 kg) with catheters in the hepatic portal vein and a branch of the hepatic vein were fed a basal, low ME, and low CP diet for 3 wk (4 kg/d, 8.84 Mcal ME, 424 g CP) before receiving one of two supplements similar in ME but different in protein content. The high protein supplement (HIPRO, 4 steers, 400 g/d soybean meal:corn gluten meal 1:1; w:w), 1.37 Mcal ME, 210 g CP) or low protein supplement (LOPRO, 4 steers, 385 g/d corn grain, 29 g CP) was fed for 7 d. Steers were fed equal-size meals every 12 h. Plasma concentrations of NH3, urea N, and glucose, plasma flow (indicator dilution) and net flux (mmol/h, vena-arterial differences x plasma flow) through PDV and liver were measured hourly for 12 h during the basal period and after 7 d of supplementation. Plasma IGF-I, BP2 and BP3 concentrations were measured in arterial samples taken 4 h post-feeding. Means ± SEM for the basal period were 7.6 ± 0.014, 13.2 ± 0.18 mM and 4.34 ± 0.09 mM for arterial NH3, urea N and glucose, 386 ± 23 L/h and 470 ± 24 L/h for PDV and liver plasma flow, 46 ± 3.4 and 48 ± 3.7 for net PDV release and net liver uptake of NH3, 38 ± 5.7 and 85 ± 8.5 for net PDV uptake and net liver release of urea N, 30 ± 3.3 and 121 ± 13.7 for net PDV uptake and net liver release of glucose, 108 ± 13 ng/mL, 22 ± 3 arbitrary units (AU), and 24 ± 2 AU for arterial IGF-I, BP2 and BP3. Supplement minus basal differences in concentration or net flux within steer were used to assess response ($P < 0.05$). Supplement NH3 responses were due to increased PDV release and liver uptake with HIPRO. Supplement urea responses were due to increased PDV uptake and liver release with HIPRO. Supplement glucose responses were due to a combination of decreased PDV uptake and liver release with LOPRO and increased PDV uptake and liver release with HIPRO ($P < 0.13$ for liver). Supplement did not affect plasma concentration of IGF-I, BP2 or BP3. Ruminal degradation of supplemental protein and gluconeogenesis from absorbed amino acids likely explain observed responses.

**Key Words:** Protein, Ammonia

**T122** Ammonia production rate from five protein sources. E. B. Venable* and M. S. Kerley, University of Missouri-Columbia.

The purpose of this study was to measure the rate of ammonia production by ruminal fermentation of five common protein sources. It is possible to minimize nitrogen waste in the rumen if excessive ammonia production from dietary protein is prevented. Ammonia production rates from the degradable protein sources, which was the objective of our research. An in vitro batch culture was used to ferment five sources of rumen degradable protein (RDP) to ammonia. Those sources were commercial rumen (SRBM), soy hulls (SH), corn gluten meal (CGM), corn gluten feed (CGF), and dried distiller’s grains with solubles (DDGS). Ruminal fluid and McDougall’s buffer was mixed to 1 L volume at a ratio of 1:4 with 2.5 g of RDP source added. Samples were taken at 1, 2, 4, 8, 10, 12, 16, 24, and 30 hours and analyzed for ammonia concentration. The rate of ammonia N released per hour per gram of protein was 0.3, 0.5, 0.4, 0.3, and 0.9 for DDGS, CGF, CGM, SH and SBM, respectively. The ammonia N production rate was expressed as a percentage of the fermented protein fraction, ammonia N production rate was 3.2, 3.0, 3.2, 2.6, and 3.5% for DDGS, CGF, CGM, SH, and SBM, respectively. Concluded from this research was that proteolytic activity against degradable protein followed substrate limiting kinetics with ammonia N production rates similar across sources of protein studied. Therefore, ammonia production could be calculated by an empirical equation based upon the degradable protein mass consumed.

**Key Words:** Protein, Ammonia

**T123** Influence of abomasal carbohydrates on small intestinal sodium-dependent glucose co-transporter activity and abundance in steers. S. M. Rodriguez1, K. C. Guimaraes1, J. C. Matthews1, K. M. McLeod1, R. L. Baldwin2, and D. L. Harmon1.1 University of Kentucky, Lexington, 2USDA, ARS, Beltsville, MD.

There is conflicting data concerning the extent of up-regulation of SGLT1 in response to carbohydrate in the small intestinal lumen. An experiment was conducted to determine the effect of glucose and starch hydrolysate on activity and abundance of sodium-dependent glucose co-transporter 1 (SGLT1) in the small intestine of steers. In a randomized complete block design, forty crossbred beef steers (243 ± 2 kg BW) were fed 0.163 Mcal ME/(kg BW0.75 - d) (1M) or they were fed 0.163 Mcal ME/(kg BW0.75 - d) (2M) or they were fed 0.163 Mcal ME/(kg BW0.75 - d) and infused for 35 d into the rumen (R) or abomasum (A) with starch hydrolysate (S) or into the abomasum with glucose (G). Steers were slaughtered, and brush-border membrane vesicles were prepared from the small intestinal samples obtained from five equidistant sites along the intestine. The maltase activity, Na+ dependent glucose transport capacity and SGLT1 protein abundance of the vesicles were determined. Maltase specific activity in vesicles and homogenates differed with intestinal sampling site (quadratic; $P < 0.001$). The AG treatment yielded a higher intestinal maltase specific activity (38 nmol glucose/(mg protein×min)) compared to the AS, RS, 1M or 2M treatment 34, 26, 23, and 21 nmol glucose/(mg protein×min), respectively (SEM = 0.02). Sodium dependent glucose uptake was not affected by treatment, but decreased distally along the intestine ($P < 0.001$). There was no effect
of treatment on SGLT1 protein abundance, but SGLT1 protein abundance increased from the duodenum to the ileum (linear; $P = 0.05$). The inverse relationship between glucose uptake and SGLT1 abundance suggests that regulation of glucose transport capacity is complex, involving factors other than SGLT1 abundance.

Key Words: Glucose, Ruminant, Transport

T124 Effects of combinations of ethyl 2-butynoate and crotonic acid or 3-butenolic acid on ruminal degradability and microbial efficiency in vitro. E. M. Ungerfeld*, S. R. Rust, and R. Burnett, Michigan State University, East Lansing, MI, USA.

It is desirable to decrease methane formation in the rumen because it represents an energy loss and contributes to global warming. Ethyl 2-butynoate has been shown to inhibit ruminal methanogenesis in vitro, but also had adverse consequences on fermentation. As crotonic acid and 3-butenolic acid seemed to stimulate fermentation, it was hypothesized that they could relieve the fermentation constraints caused by ethyl 2-butynoate. In 1000 mL-Erlenmeyer flasks, 750 mL of a 4:1 mixture of buffer and ruminal fluid was delivered under O$_2$-free CO$_2$, and 6 g of grass hay used as substrate. Ethyl 2-butynoate at 0, 4, and 8 mM initial concentration was combined with crotonic acid (Exp. 1) or 3-butenolic acid (Exp. 2) at 0 or 4 mM, ruminal fluids from steers at 39°C for 72 h. $^{13}$N was used as a microbial marker. In Exp. 1, ethyl 2-butynoate decreased N ($P = 0.04$; quadratic response) and OM ($P = 0.04$; quadratic response) degradability from 48 to 19%, and from 36 to 31%, respectively. Ethyl 2-butynoate increased the efficiency of microbial CP ($P < 0.01$) and OM ($P = 0.02$) synthesis by 58 and 47%, respectively. Crotonic acid had no effects on OM or N degradability, or on microbial efficiency of OM or CP synthesis. In Exp. 2, ethyl 2-butynoate decreased ($P < 0.01$) N degradability from 71 to 57%, and did not affect OM degradability. Ethyl 2-butynoate tended to increase the efficiency of microbial CP ($P = 0.06$) and OM ($P = 0.08$) synthesis by 28 and 18%, respectively. 3-Butenolic acid had no effects on OM or N degradability, but tended to improve the microbial efficiency of CP ($P = 0.12$) and OM ($P = 0.08$) synthesis by 12 and 13%, respectively. Both 3-butenolic and crotonic acid were ineffective in improving fermentation. It remains to be elucidated if the improvement in the microbial efficiency of OM and CP synthesis caused by ethyl 2-butynoate was a consequence of the change in H dynamics caused by the inhibition of methanogenesis, or a particular effect of ethyl 2-butynoate on some microorganisms.

Key Words: Methane, Rumen, Degradability

T125 Amino acid profiles of tropical forages and of residues after incubation in the rumen and phosphate borate buffer rate buffered corrected by the ADIP amino acid profile. L. Miranda$^1$, N. Rodriguez$^2$, R. Sainz$^3$, E. Perera$^3$, M. Gontijo Neto$^3$, C. Veloso$^3$, and P. Fernandes$^3$. 1 FEAD-Minas, Brazil, 2 Universidad Federal Minas Gerais, Brazil, 3 University of California- Davis, USA, 4 Universidad Estadual Oeste Parana, Brazil, 5 EMBRAPA Gado de Corte, Brazil.

Amino acid (AA) profiles of several feed protein fractions were determined for foliage from leucaena (Leucaena leucocephala), perennial soy (Neomotonia wightii), cassava (Manihot esculenta), rami (Boehmeria nivea) and pigeon pea (Cajanus cajan) using in situ and in vitro procedures. Fractions included total feed protein; phosphate-borate buffer (PBB) insoluble residue; and (rumen) undegradable intake protein (UIP), the residue after 18h rumen incubation in nylon bags, corrected by the ADIP amino acid profile. These were analyzed by HPLC after acid hydrolysis or peroxidation followed by acid hydrolysis. Amino acid concentrations were determined for three replicates of each forage and their corresponding residues, in a totally randomized design. Data were analyzed by analysis of variance (PROC GLM), and means were compared using Tukey's test with a 5% significance level. Protein fractions RDS and B2 at 40% and RDS of B3, respectively. Fractions were expressed as a % of crude protein of the corresponding residue. There were differences in the amino acid profiles of the original forage and PBB residues, as well as after 18h of rumen incubation for all forages except pigeon pea. In rami only the content of Lys was higher ($P < 0.05$) in PBB than in the original forage. For leucaena, several AA (EAA, Phe, His, Ile, Lys, and Val) the contents differed between the original forage and the UIP residue. The same was true for perennial soybean (EAA, Leu, Lys, Met, and Val) and cassava (Arg, Iso, Phe and Lys). If the insoluble fraction has higher chances of bypassing rumen fermentation, the amino acid profiles of the insoluble fraction and of non-degradable amino acids would be similar. However, the present study identifies differences between the amino acid profiles of the PBB insoluble residue and of residues after 18h of rumen incubation.

Key Words: Amino acid, Tropical forage, ADIP amino acid profile

T126 Contribution of degraded starch to the prediction of fermentable organic matter for ruminants. A. Offner* and D. Sauvant, INRA P-G INRA, Paris, France.

In ruminants, the amount of organic matter truly fermented in the rumen (RFOM, % of DM) has many consequences, especially on microbial growth. The objective of this study was to examine the influence of starch degraded in the rumen on prediction of RFOM. A database on starch digestion in ruminants was built from 87 references and included 316 treatments. Data were analyzed by GLM including the study effect. First, RFOM measured in vivo was compared to RFOM predicted by the CNCPS and INRA models. The CNCPS tended to overestimate RFOM (+15.8 % of DM). Variations in RFOM within study were predicted by the CNCPS with a residual standard deviation ($r_{sd}$) of 3.51 % of DM. The RFOM was estimated by INRA from digestible organic matter (DOM), ruminally undegraded protein (RUP) and ether extract (EE): RFOM = DOM - RUP - EE. In this case, variations in RFOM within study were predicted with a $r_{sd}$ of 3.15 % of DM. These results confirmed the need for a more accurate prediction of RFOM in feeding systems. This could be achieved by including ruminally degraded starch (RDS, % of DM) in RFOM predictions: RFOM = 42.2 + 0.59 × RDS ($r_{sd}$ = 0.85, $R^2$ = 0.94, $r_{sd}$ = 3.4 % of DM, $sd_{RDS}$ = 4.48 % of DM). Despite the correlation between DOM and RDS ($r = 0.65$), the INRA equation did not accurately account for RDS effects. This equation can be adjusted: RFOM = 10.6 + 0.69 × RFOM$_{INRA}$ + 0.29 × RDS; variations in RFOM within study were then predicted with a $r_{sd}$ of 2.99 % of DM. These results emphasized the significant and large influence of RDS on RFOM. Such equations could be of a practical interest for feeding systems, allowing better estimation of RFOM for various feeds.

Key Words: Rumen, Fermentable organic matter, Starch

T127 Using Synchrotron infrared microspectroscopy to probe molecule chemical difference between two types of barley with distinguished biodegradation behaviors. P. Yu$^1$, J. J Mckinnon$^2$, C. Christensen$^3$, M. D. Drew$^2$, B. G. Rossnagel$^3$, and D. A. Christensen$^1$. 1 Department of Animal and Poultry Science, University of Saskatchewan, 2 BioMedical Imaging Group, 3 Department of Plant Sciences, University of Saskatchewan.

Feed-type barley (cv. Valier) and malting-type barley (cv. Harrington) markedly differ in degradation behavior in ruminants. Harrington barley is higher than Valier barley in the rate and extent of rumen degradation. A high degradation of barley may result in digestive disorders in ruminants when feeding barley-based concentrate diets. Traditional “wet” chemical analysis methods cannot detect such distinguished biological differences mainly because the chemical structures and molecular characteristics of intrinsic structures of plant are destructed during the processing for analysis. Synchrotron Fourier transform infrared microspectroscopy (S-FTIR) is an advanced and newly emerging bioanalytical microprobe capable of exploring the molecular chemistry within microstructures. The objective was to use the non-invasive S-FTIR to explore and identify molecular chemically difference on ultra-structural microstructures. The objective was to use the non-invasive S-FTIR to explore and identify molecular chemically difference on ultra-structural microstructures. Results show that infrared absorbance intensity of starch to protein ratio was different (4.12 vs. 2.78 for Harrington and Valier barley, respectively, $P < 0.05$), indicating the chemical matrix of micro-endosperm tissue are different. Harrington barley had a wider range of starch to protein ratio (1.41 to 10.12 vs. 1.42 to 4.27, $P < 0.05$), suggesting that Harrington barley is more heterogeneous than Varlier barley in chemical makeup of endosperm. In conclusion, different chemical makeup in micro-endosperm matrix may explain the biological difference. Lower starch to protein ratio in micro-endosperm tissue of Valier barley implicates that starch granules in Valier barley have more proteins associated with. This may prevent Valier barley degrade fast and highly in the rumen. More research is needed on plant chemical makeup of intrinsic micro-structure for a better understanding of
plant inherent micro-structure in relation to biodegradation behaviors in animals

**Key Words:** Synchrotron infrared microspectroscopy, Chemical microarray, barley endosperm tissue, Ultra-structure

**T128** Improved method for measuring processing degree and gelatinized starch in steam-flaked grain. Marcus Meilahn1 and Davy Brown2, 1Weld Laboratories, 2Agricultural Research, Inc.

The nutritive value of flaked grain can be quantified by measuring starch availability, degree of processing, and the percentage of gelatinized starch in relation to the total amount and availability of starch in whole (unprocessed) grain. A new, commercially available, enzymatic method is described for measuring the degree of processing and starch gelatinization in grain. The method utilizes the differences in reaction rates between corn starch and gelatinized corn starch. This method was used to determine the relationship between glucose yield and gelatinized starch percent of known reference standards, whole grain, and flaked grain samples. The sensitivity for measuring degree of processing and gelatinized starch percent in flake grain was significantly improved (P<0.001) over that by other methods currently used in the feeding industry. These data have been used to provide valuable information for grain processors to adjust milling practices resulting in improved flaked grain quality.

**Key Words:** Steam-flake, starch gelatinization, degree of processing

**T129** Comparative effect of pork meat meal and chicken meat meal on apparent digestibility of diets for sheep. A. Estrada1, 2, R. Barajas1 and J. F. Obregon1, 1FMVZ-Universidad Autónoma de Sinaloa (Mexico).

To determine the comparative effect of pork meat meal and chicken meat meal on apparent digestibility of diets for sheep, a digestibility experiment by total fecal collection was conducted. Four Pelibuey sheep, males (BW=18.75 kg) were used in a cross over design experiment. The animals were placed individually in metabolics crates (0.6 x 1.2 m), and randomly assigned to consume one of two diets in that consists the treatments: 1) Diet 15.8% CP and 3.16 Mcal of DE/kg, containing (DM basis), pork meat meal 5.84%, ground corn 50.73%, sesame meal 10.22%, sudan grass hay 19.45%, sugarcane molasses 11.1%, urea 0.72%, limestone 1.1%, and mineral premix 0.89% (PMM); and 2) diet similar to treatment 1, but containing 5.84% of chicken meat meal (CHM) substituting all the pork meat meal. Diets were offered twice a day (800 and 1600 h), after six day of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. Samples were dried, weighed. DM and CP analyses were performed, and apparent digestibility was calculate. DM fecal excretion was not affected (P=0.23) by treatments (177 vs. 165 g/day). DM digestibility was similar (P=0.26) across treatments (73.5 vs. 75.2%). The fecal excretion of crude protein was similar (P=0.41) between treatments (34.0 vs. 35.6 g/day). The apparent digestibility of crude protein was not affected (P=0.62) by the kind of meat meal included, with values of 68.4% and 69.2% for pork and chicken meat meal, respectively. Calculate digestible energy of diets was equal (P=0.26) in both treatments (3.137 vs. 3.213 Mcal/kg). It is concluded that both pork meat meal and chicken meat meal could be indistinct used as rumen undegradable crude protein source, in growing sheep diets without affecting its digestion characteristics.

**Key Words:** Pork meat meal, Chicken meat meal, Digestibility

**T130** Effects of intranasal administration of a lysozyme/zinc/carbopol solution on health and performance of newly received beef cattle. J. D. Rivera1, J. T. Richeson1, J. F. Gleghorn1, N. A. Elam1, M. L. Galyean1, M. E. Hubbert1, and S. E. Bachman2, 1Texas Tech University, Lubbock, TX, 2Carnegie Science, Amarillo, TX.

Ninety-one crossbred (British x Continental) steer and bull (17.5%) calves (average BW = 231 ± 17.5 kg) were used in a randomized complete block design to examine the effects of intranasal administration of a lysozyme/zinc/carbopol preparation on health and performance of lightweight newly received cattle. Calves were assigned randomly to pens, and each pair of pens (block) was assigned randomly to one of two treatments at receiving: intranasal (1 mL/nostril) of 1) lysozyme/zinc/carbopol solution (LYS); or 2) intranasal glycerol and water solution (CON). The lysozyme/zinc/carbopol solution was composed of 2.5 g of lysozyme, 2 g of zinc acetate, 1.25 g of carbopol 940, and 75 mL of glycerin brought to 100 mL volume with deionized water. Cattle were allowed ad libitum consumption of a 65% concentrate receiving diet along with long-stem alfalfa hay. Hay was fed for the first 5 d, after which only the 65% concentrate diet was offered. Cattle were monitored daily for signs of bovine respiratory disease (BRD) and treated with antibiotics as needed based on rectal temperature (≥39.7°C). Body weight was measured on d 14 and 28 to determine ADG, and DMI was measured for the same time intervals as ADG. Intranasal administration of LYS did not affect (P > 0.10) ADG for d 0 to 14, 14 to 28, or 0 to 28. In addition, LYS administration did not affect feed:gain at any period of the study; however, administration of LYS tended to decrease (P < 0.08) DMI from d 0 to 14 and from d 0 to 28 (P < 0.11). Moreover, a trend (P < 0.12) for increased morbidity from BRD was observed for cattle receiving intranasal LYS. When analyzed by day after arrival, LYS increased morbidity (P < 0.03) on d 5 following receiving compared with CON. Results suggest that administration of LYS intranasally at receiving tended to increase morbidity later in the receiving period and decrease DMI, possibly because intranasal lysozyme might have increased the potential for later re-inoculation of the nasopharynx by respiratory pathogens.

**Key Words:** Lysozyme, Beef cattle, Health

**T131** Effect of N-source on in vitro microbial crude protein and glycogen yields and NDF digestion from NDF and sucrose fermentations. L. Holtshausen1 and M. B. Hall, Department of Animal Sciences, University of Florida, Gainesville, FL USA.

The effect of N-source on microbial crude protein yield (MCP), microbial glycogen yield (GLY), and NDF digestion was examined in two 16 h batch culture fermentations of isolated Bermuda grass NDF (NDFP) or 50% sucrose+50% INDF (SuNDf) (240 mg substrate/tube) with mixed ruminal microbes in 50 ml tubes fitted with gas release valves. The isonitrogenous media used were Goering and Van Soest medium (GVM), [non-protein nitrogen (NPN)+true protein; B], and GVM modified to contain only NPN (U) by substituting urea for casein acid hydrolysate, and to contain only true protein (C) by substituting casein acid hydrolysate+sodium bicarbonate for ammonium bicarbonate. Fermentation tubes for each substrate and medium were destructively sampled every 4 hours and analyzed for MCP, GLY and residual NDF. MCP was estimated as CP precipitated with 20% trichloroacetic acid, and GLY as alpha-glucan corrected for free glucose. MCP and GLY at each hour were corrected for 0 h and sampling hour fermentation blanks. All values presented are least squares means data at 16 h unless indicated. Orthogonal contrasts U vs B+C and B vs C were used for media comparisons (see table). By 8 h, no free sucrose, glucose or fructose remained. Maximum GLY was achieved at 4 h and MCP at 16 h. Media pH did not decline below 6.45. For all media, MCP was lower for NDF than for SuNDF (P<0.01). For SuNDF MCP differed among media (P<0.01). At 4 h GLY did not differ across media for SuNDF (P=0.64). Medium affected NDF digestion for SuNDF (P<0.01) but not for INDF (P<0.18). Gross efficiency of MCP per unit sucrose differed by medium (P<0.01). Adding true protein increased MCP from NDF, as well as increased fiber digestion, MCP, and efficiency of MCP when sucrose was present.

<table>
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<th>B-</th>
<th>C-</th>
<th>U-</th>
<th>B-</th>
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<td>16.6</td>
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<td>14.4</td>
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<td>4 h GLY, mg</td>
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<td>7.17</td>
<td>6.84</td>
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Contrast superscripts: SuNDF: x = U vs B+C, y = B vs C, differ P<0.05; INDF: a = U vs B+C, b = B vs C, differ P<0.05

**Key Words:** Sucrose, Nitrogen source, Fermentation
T132  Biohydrogenation of unsaturated fatty acids and duodenal flow of CLA and trans-fatty acids in dairy cows fed a high-concentrate diet supplemented with linseed, sunflower, or fish oil. J. J. Loor1,2, M. Doré1, and Y. Chilliard1, and M. Doré1,1 INRA, 63122 St.-Genes Champanelle, France, Department of Animal Sciences, University of Illinois.

Ruminal hydrogenation and duodenal flow of hydrogenation intermediates were evaluated in three lactating Holstein cows fed a diet with a high concentrate:forage ratio (65:35) plus 5% (DM basis) sunflower oil (SO), 5% linseed oil (LO), or 2.5% fish oil (FO). A 3 x 3 Latin square with 4-week periods was used. Grass hay was the forage. Hydrogenation of cis9-18:1 (76%) did not differ (P > 0.05) due to oils. Dietary SO increased (P < 0.05) hydrogenation of 18:2n-6 (91%) compared with FO or LO (79%). Cows fed LO had greater (P < 0.05) 18:3n-3 hydrogenation (94%) compared with FO or SO (84%). Hydrogenation of eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid due to feeding FO averaged 94% and 92%. Total CLA flow was greater (P < 0.05) in cows fed SO (8.0 g/d) compared with FO (4.0 g/d). Feeding LO resulted in 1.6 g 9-11CLA/d.

Key Words: Biohydrogenation, Trans fatty acids, Oil

T133  Conjugated linoleic acids (CLA) and trans-fatty acid profiles of blood plasma and milk fat in dairy cows fed a high-concentrate diet supplemented with linseed, sunflower, or fish oil. J. J. Loor1,2, A. Ferlay1,2, A. Ollier1,2, K. Ueda1, M. Doré1,3, and Y. Chilliard1,1 INRA, 63122 St.-Genes Champanelle, France, Department of Animal Sciences, University of Illinois.

Profiles of hydrogenation intermediates in plasma and milk lipids due to dietary 18:2n-6, 18:3n-3, or 20:5n-3 were evaluated using three lactating Holstein cows fed a high-concentrate diet (65:35 concentrate:forage ratio with 5% (DM basis) sunflower oil (SO), 5% linseed oil (LO), or 2.5% fish oil (FO). A 3 x 3 Latin square with 4-week periods was used with grass hay as the forage. Milk yield (26 kg/d), DM (18 kg/d), and percentages of milk fat (2.64) and protein (3.22) did not differ (P > 0.05). Total plasma fatty acids averaged (P > 0.05) 2.8 mg/ml across diets.

Percentage of cis9,cis11-18:2 (9-11CLA), cis10,cis12- (10,12CLA), cis9,cis11- (9-11CLA), and trans11,trans13-18:2 (11,13CLA) in milk plasma also was similar (P > 0.05) (0.32, 0.09, 0.01, and 0.12%, respectively). Trans,trans-18:2 (tCLA), however, was greater (P < 0.05) due to feeding FO (0.48%) compared with LO or SO (0.24%). Percentage of trans11,cis15-18:2 (11,15LA), an intermediate of 18:3n-3 hydrogenation, was greater (P < 0.05) when LO (0.87%) was fed, intermediate with FO (0.47%), and lower (P < 0.05) with SO (0.15%). Plasma trans10-18:1 was not altered (P > 0.05) by diets (0.09%). Plasma trans11-18:1 (TVAg) was greater (P < 0.05) when FO (4.1%) was fed compared with LO or SO (2.3%). Percentage of 9/11CLA (2.2%), 10,12CLA (0.07%), cis9c11CLA (0.07%), 11,13CLA (0.10%), and tCLA (0.11%) in milk fat did not differ (P > 0.05). Milk 11,15LA ranked by treatment was (P < 0.05) LO (2.9%) > FO (1.8%) > SO (0.5%). Milk trans10-18:1 (4.8%) and TVA (5.4%) percentage was not altered (P > 0.05) by diets. Stearic acid in plasma or milk fat due to FO (8.4%, 3.5%) was reduced (P < 0.05) compared with LO or SO (13%, 1.1%). Except for TVA and tCLA, results show that responses in the profile of other CLA, 11,15LA, and trans10-18:1 in blood plasma and milk fat followed the same trend due to feeding each oil.

Key Words: Oil, CLA, Trans fatty acids

T134  Effect of chromium methionine supplementation in diet on milk production of holstein pure breed and 3/4 holstein cows receiving recombinant bovine somatotropin hormone injection. R. Barajas1,2,3, R. Zambada1, J. J. Portillo1, L. M. Rubio1, C. Lizarraga2, Z. Verdugo1, and N. Gonzalez1, 1FMVZ-Universidad Autonoma de Sinaloa (Mexico), 2Establo Lechero.

With the objective of determine the effect of chromium methionine supplementation in diet on milk production of holstein pure breed and 3/4 holstein cows receiving recombinant bovine somatotropin hormone injection, a milk production experiment was conducted. Eighteen dairy cows (8 holstein pure breed cows, and 10 holstein 3/4 brahman 1/4 blood cows), pregnant, body size condition upper than 3.5, and produc- upper than 17 kg of milk/day, were used in a complete randomized block design experiment. The cows were placed in a ground flour pen, providing an area of 48 m2/cow, shade area of 7.5 m2/cow, 3.1 m of feed bunker/cow and 0.5 m of drinker/cow. the animals were fed with a ration consistent in sudan grass silage 40 kg, alfalfa hay 2 kg, and 11 kg of pellet concentrate (18%CP, 75%CF, 3%fat, and 0.7% Ca) and has free access to a mineral premix. After a 14 days adjustment pe- riod, daily milk production (DMP) by cow was recorded during seven days, and was considered as previous milk production. Next days all the cows receiving an intradermal injection of bovine somatotropin hormone (STB), and agreement with its blood, and previous DMP were grouped and assigned to treatments: 1) Regular management as was described above (control); and 2) similar to control but receiving a supplementation of 12 mg of Cr/cow/day from chromium methionine during 14 days. Milk production was measured during 14 days. Data was analyzed as a factorial arrangement (Cr x day) of treatments and previous daily milk production has not effect (P=0.29) as covariate variable. STB increased (P<0.01) in 22.6% milk production (19.74 vs. 24.2 kg). In holstein pure breed cows STB improved (P<0.01) DMP (22.10 vs. 26.76 kg) in the same proportion (21%) than in 3/4 holstein cow (17.85 vs. 21.63 kg). Chromium methionine supplementation increased (P=0.02) DMP in 2.5% with relationship of cows that not received it (23.9 vs. 24.5 kg). It is concluded, that chromium methionine could help to improve milk production in dairy cows receiving bovine somatotropin hormone.

Key Words: Chromium, Somatotropin, Dairy cows

T135  Comparison of inorganic and complexed trace element supplements on performance of dairy cows. R. L. Kincaid1, J. D. Cronath1, and M. T. Socha2, 1Washington State University, 2Zinpro Corporation.

To determine the effect of chemical form of trace element supplements on performance of dairy cows, Holstein cows (n = 36) were assigned to dietary treatments of inorganic trace elements and a combination (1:1) of inorganic and complexed trace elements. Starting 21 days prepartum, dietary treatments of inorganic trace elements and a combination (1:1) of inorganic and complexed trace elements. Estimated concentrations of trace elements in the dry cows diets were 12 ppm Cu, 52 ppm Mn, 68 ppm Zn, and 1.8 ppm Co. From parturition until 150 DIM, cows were fed their respective TMR that contained 11 ppm Cu, 41 ppm Mn, 59 ppm Zn, and 2.5 ppm Co, by analysis. Cows fed the complexed trace elements lost less (P < 0.05) weight prepartum (23 vs 55 kg); however, there was no difference (P > 0.05) between treatments in postpartum weight change or BCS. Cows fed complexed trace elements prepartum had colostrum with higher (P < 0.05) IgG (5.1 vs 7.6 g/dl) and lower Zn (125 vs 91 ppm). There was no difference (P > 0.05) in concentrations of IgM, Co, Mn or Cu in colostrum. Dry matter intakes of lactating cows were similar between treatments (26.0 vs 26.4 kg/d). Although there were period effects on serum concentrations of IgG, IgM, NEFA, Zn, and Ca, there were no treatment effects on milk yield (P > 0.05) and milk fat (P > 0.05). 3.5 FCM (42.3 vs 42.3 kg/d), and measures of production efficiency also were similar between treatments. These results indicate similar perform- ance of cows fed inorganic and a mixture of inorganic and complexed trace elements.

Key Words: Cows, Inorganic trace elements, Complexed trace elements

T136 Effects of Lactonin on milk production of dairy cow during weeks 20 through 42 of lactation. Z. M. Shen*, R. F. Zhang, F. Chen, and T. S. Lu*, Nanjing Agricultural University, Nanjing, China, Shanghai Bright Group, China, Shanghai Walcom Bio-Chem Co., Ltd., China.

Lactonin is a compound containing 30% of cysteamine (CS). CS is a special component of coenzyme A and therefore an endogenous substance. One of the physiological functions of CS is to decline somatostatin but increase the blood glucose level. The purpose of this study was, therefore, to investigate the effects of Lactonin on milk production during weeks 20 through 42 of lactation. 100 black and white dairy cows were assigned to 4 groups (G1, n=21; G2 and G3, n=24 and G4, n=31) on the basis of their daily milk yield prior to the experiment and their calving date. The recorded daily milk yield (M) prior to the experiment is: G1=29 kg; G2,30-34 kg; G3,35-39 kg and G4>40 kg, respectively. In each group the cows were divided randomly into Lactonin treatment (LT) and Control. In all LT the Lactonin was administered progressively within 10 weeks period at the CS doses of 10-30 mg/d and then degressively to 15 mg/d through the experiment. In G1 cows received LT produced 17.8 % more milk (P<0.05) than did Control cows during the entire 23 weeks of treatment. But it was not in the cows received LT in the other groups, suggesting that the effect of LT on milk production was influenced by the starting basic milk yield of the cow in the pretreatment period. Milk fat percentage was greater for cows given LT both in G2 (5.8 %, P<0.05) and G4 (10.8 %, P<0.05) than that of Control cows. In G2 and G4 a trend of increase (P=0.10) of milk protein percentage was observed in the cows treated with LT. In CLA The milk protein synthesis was 11.0 % higher (P<0.05) with cows given LT, resulting from the greater milk protein percentage induced by Lactonin. This study indicates that Lactonin can improve the milk yield and milk composition. The effects of Lactonin on milk production are related to the production level of cows prior to the treatment.

Key Words: Cysteamine, Cow, Milk production

T137 Serum β carotene concentrations and variability factors in US dairy herds. T. H. Herdt1 and W. M. Seymour2, 2 Michigan State University, 2Roche Vitamins Inc.

To determine descriptive statistics and selected variability factors for serum β carotene concentrations in US dairy cows, selected samples from the 1996 NAHMS Dairy study (Reference of 1996 Dairy Management Practices, USDA) were analyzed for β carotene, retinol, and cholesterol concentrations. A total of 358 serum samples distributed among 35 herds were tested by HPLC with UV detection. Samples were analyzed in 2001 and had been held at –80 °C for approximately 80% of the storage time, and at –20 °C for the remainder. Samples were selected to create a balanced data set with respect to herd size class and US region, and use of pasture as a major forage (+/-). The overall mean of serum β-carotene was 2.02 μg/ml with SD 1.94 μg/ml. The distribution of values was markedly skewed to the right, but approximated normal after log transformation. Serum β carotene was correlated positively (P<0.05) with serum cholesterol, and did not differ among treatments. The 7.5 kb IGF-I transcript was regulated steady-state levels of IGF-II and IGFBP-2 genes in the liver. The objective of this experiment was to determine if P homeostasis could be maintained at sub-optimal levels of P intake. This was established through P balance at two dietary levels of P, one at the recommended NRC level of 0.36% (n=7) and one at 0.24% (n=7), which has been previously shown to deplete cows of P. P balance was measured one week before the dry period, at 1 month prepartum and at 2 weeks postpartum to establish P balance on a corn silage, haylage based TMR. Once on the experimental diet (3 weeks to 13 weeks postpartum), P balance was measured at 6 weeks and 13 weeks postpartum. The experiment did consist of corn silage, urea, soybean meal, soybean hulls, beet pulp, bloodmeal, limestone, dicalcium phosphorus, salt, magnesium oxide, tallow and a mineral mix balanced to 0.36% P or 0.24% P. Results to date show there was no significant difference (P>0.05) in blood yield (31.3 ± 4.8 kg/day - 0.36% P; 31.6 ± 4.8 kg/day - 0.24% P) or dry matter intake (15.5 ± 0.9 kg/day - 0.36% P; 15.3 ± 0.9 kg/day - 0.24% P). Furthermore, there was no significant difference (P>0.05) in blood plasma calcium (2.48 ± 0.03 mM - 0.36% P; 2.53 ± 0.03 mM - 0.24% P), magnesium (1.02 ± 0.02 mM - 0.36% P; 1.04 ± 0.02 mM - 0.24% P) or P (1.84 ± 0.07 mM - 0.36% P; 1.76 ± 0.07 mM - 0.24% P), and all parameters remained within normal physiological range.

Key Words: Phosphorus, Dairy cattle, Balance


Thirty-eight multiparous Holstein cows were utilized in a completely randomized design to examine the effect of feeding ruminally-protected conjugated linoleic acid (CLA) and trans-octadecenoic fatty acids (tFA) on the insulin-like growth factor (IGF) system during the transition to lactation. Dietary treatments were initiated approximately 28 d prior to expected calving dates and continued through d 49 postpartum. Preparatory treatments consisted of 1) a basal TMR diet (control), 2) basal TMR + 231 g/d CLA mix (CLA), and 3) basal TMR + 214 g/d tFA mix. Average intakes of CLA and tFA mixes were 258 and 261 g/d, respectively, during the 49 d postpartum treatment period. On d 2, 14, and 28 ± 2 postpartum, liver samples were collected by biopsy and stored at –80°C until analyzed for mRNA abundance. Plasma IGF-I concentration decreased (P<0.01) from 120.3 ± 5.5 ng/ml at 2 wk before parturition to 91.4 ± 3.4 ng/ml at calving, and remained low through 7 wk of lactation. In spite of small tendencies, IGF-I concentration in blood did not differ among dietary treatments. Plasma IGF-binding protein (IGFBP) profiles (MW = 44-48, 35, 31, 30, and 28 kDa) were unaffected by dietary treatment and sampling day. Liver IGF-I mRNA transcripts were low during the first few weeks of lactation and did not differ among treatments. The 7.5 kb IGF-I transcript was not detected until d 28 postpartum. Dietary supplementation of tFA up-regulated steady-state levels of IGF-II and IGFBP-2 genes in the liver. The abundance of IGFBP-3 mRNA in the liver did not vary among dietary treatments. Results provide the first direct evidence that dietary tFAs induce hepatic IGF-II and IGFBP-2 genes in cattles. Additional studies are warranted to elucidate the interactions between supplemental fats, energy homeostasis and the IGF system in Holstein cows during the early lactation period.

Key Words: Fatty acids, IGF system, Cattle
Effects of feeding calcium salts of fatty acids with methionine hydroxy analog and bacterial fermentation residue vs. tallow-vegetable blend and plant proteins on lactational performance and in-vitro fermentation. K. A. Koudele1, W. K. Sanchez2, L. H. Adams1, D. E. Weber2, D. R. Metzger3, N. R. St-Pierre4, and E. Block5. 1Andrews University, Berrien Springs, MI, 2Arm & Hammer Nutrition Group, Church & Dwight Co, Inc., Princeton, NJ, 3Metzger Consulting Services, Goshen, IN, 4Ohio State University, Columbus, OH.

One hundred fifty-five free-stall housed multiparous Holstein cows from a high producing herd (RHA = 12,190 kg) were randomized by DIM (14-165 d) and milk production into two equally managed groups. Each group was fed either a control (CON) ration containing tallow-vegetable blend and plant proteins or a treatment (TMT) ration containing calcium salts of fatty acids complexed with methionine hydroxy analog (MEGALAC Plus®), and bacterial fermentation residue (FERMENTEN®) in a switch back design with five-28 d periods. Cows were fed ad lib daily with refused feed weighed daily. Data from the last week of each period were used in the analysis. Diets were formulated to be similar in NDF, NFC and fat. Groups were the experimental units in the statistical analyses. Milk yield (43.5 vs. 43.2 kg), protein (2.79 vs. 2.76 %), lactose (4.79 vs. 4.79 %), SCC (313,000 vs. 310,000), and DMI (25.8 vs. 25.5) did not differ (P>0.05) between CON and TMT, respectively. However, milk fat % was higher (P=0.03) in the TMT group (3.99 vs. 3.75%). The TMR of CON and TMT rations were evaluated in triplicate 9-day continuous culture fermenters which resulted in no differences (P>0.05) between CON and treatment in VFA production, acetate:propionate ratio, and pH. Crude protein efficiency (dry feed N as microbial N) was greater (P=0.002) in the TMT group (84.73 vs. 88.19) due in part to the greater (P=0.03) ammonia-N production for CON (8.83 vs. 6.41 mg/dl). These differences were likely due to how the fat and proteins affected rumen fermentation and biohydrogenation. The higher milk fat % from cows on the TMT diet indicated that the combination of MEGALAC Plus® and FERMENTEN® were utilized more efficiently in the rumen than the tallow-vegetable blended fat and plant proteins.

Key Words: Dairy nutrition, Calcium salts of fatty acids, Bacterial fermentation residue


Lactating Holstein cows (n=47) were randomly assigned to one of four treatments to evaluate the effect of supplemental fat (tallow or yellow grease) from sources varying in proportion of unsaturated and saturated fatty acids on production. All diets (45% choppeed alfalfa hay and 55% concentrates) contained 12% whole cottonseed (as-fed) and were fed as a TMR. Treatments were no supplemental fat (Control, 3% total fatty acids, DM basis) or the addition of 2% supplemental fat from Tallow, Yellow Grease, or Blend (60% tallow; 40% yellow grease). Unsaturated to saturated fatty acid ratios were 1:1 for tallow, 2.5:1 for yellow grease, and 1.5:1 for the blended fat. All cows were fed the control diet during week 3 of lactation. Cows were then assigned to their treatment diets beginning week 4 and ending week 18 of lactation. Cows were milked twice daily and yields recorded. Cows were fed their assigned TMR twice daily. Milk samples were collected once weekly and analyzed for fat, protein, solids-not-fat, and nitrogen fractions. Body condition scores (BCS) and body weights (BW) were assessed once weekly. Repeated measures were analyzed by the PROC MIXED procedure of SAS using week 3 as a covariate. There were no significant differences for intake of DM (25.6, 25.9, 25.6, and 26.4 kg/d) and yield of milk (41.8, 42.3, 42.3, and 43.6 kg/d) for the Control, Blend, Tallow, and Yellow Grease, respectively. Digestible energy intake (DM basis) tended to increase when yellow grease was supplemented as compared to tallow. BCS and BW were similar across all treatments. Concentrations and yields of milk components were unaffected by fat supplementation or saturation level. Supplementing the diet of lactating cows with fat during early lactation did not affect production performance, and there were no effects due to the differences in the unsaturated to saturated fatty acid composition of the supplemental fat source.

Key Words: Dairy cows, Fat saturation, Fatty acids

Techniques to measure the bioavailability of rumen-protected methionine supplements. C. E. Moore1, B. Sloan2, D. A. Henderson1, and L. H. Baumgard1. 1University of Arizona, Tucson, AZ, 2Adisseo, Alpharetta, GA.

Methionine bioavailability was assessed in two ways: 1) blood plasma methionine concentrations and 2) impact on milk composition. Two different rumen-protected methionine supplements were evaluated using 72 Holsteins (H) and 48 Brown Swiss (BS) 40 to 200 DIM at trial initiation. All animals were pre-blocked based on breed and parity (primiparous vs. multiparous). Cows were then randomly assigned to a control diet (C: 48% alfalfa hay and 14.9% steam flaked corn; Alime® was included [21.8 g/hd/d] to maximize microbial protein synthesis) formulated to be adequate in metabolizable lysine (6.83% of MP - CPM Version 1), or C supplemented with either Smartamine® M (S: 16 g/hd/d), or Mepron® MS8 (M: 14.1 g/hd/d), both supplements provided 12 g methionine/hd/d. Milk yield recorded daily and milk samples were obtained on 2 consecutive milkings from each cow on d -1, 14, 28, 42 and 56 relative to treatment initiation for compositional analysis. Blood plasma samples were obtained on d 56 from 10 cows/trt and analyzed for amino acid content. There was no effect of treatment (P=0.07) on milk yield (35.3 kg/d). Milk fat percentage was affected by treatment 3.80%, 3.85% and 3.98% for C, M and S, respectively. Milk protein % was increased by methionine treatments 3.11%, 3.16% and 3.20% for C, M and S, respectively. Both methionine supplements increased milk protein content and yield were reduced (2 and 4%) by both methionine supplements. Plasma concentrations (mg/ml) of methionine (P<0.01) and methionine as a percentage of total amino acids (P<0.01) were both significantly higher for S (3.43, 4.11, 5.20 and 1.13, 1.27, 1.62% for C, M and S, respectively). Both methionine supplements increased milk protein content and S increased milk fat compared to C and this illustrates the benefits of providing supplementary bio-available methionine to a ration adequate in metabolizable lysine. Furthermore, blood plasma methionine proved to be the more precise technique to discriminate between the relative methionine bioavailability of different ruminant protected technologies.

Key Words: Methionine, Milk protein, Lactation

Comparison of abomasal infusion of free fatty acid and methyl ester forms of conjugated linoleic acids on milk fat depression in dairy cows. M. J. de Veth1, J. M. Grinnari2, A. M. Pfeiffer3, and D. E. Bauman1. 1Cornell University, Ithaca, NY, 2Clanet Ltd, Espoo, Finland, 3BASF-AG, Offenbach, Germany.

Conjugated linoleic acids (CLA), specifically the trans-10, cis-12 isomer, have been shown to be potent inhibitors of milk fat synthesis. The majority of studies investigating CLA-induced milk fat depression have used mixtures of CLA in free fatty acid form. However, in the commercial synthesis of CLA, methyl esters of CLA are initially formed. The objective of this study was to compare effects of the free fatty acid CLA (FFA-CLA) and methyl esters of CLA (ME-CLA) on the inhibition of milk fat synthesis. Three mid-lactation Holstein cows fitted with a rumen fistula were used in a 3 x 3 Latin square design. Treatments were 1) control, 2) FFA-CLA, and 3) ME-CLA. Treatments 2 & 3 involved a 60% CLA formulation that was composed equally of trans-10, cis-12 and cis-9, trans-11 isomers; the CLA formulation was solubilized in ethanol and a daily dose of 4.2 g of trans-10, cis-12 CLA was infused abomasally as equal aliquots at 6 h intervals. Each treatment period was 5 d with a 7 d interval between periods. CLA treatments reduced milk fat yield (P<0.02) compared to control (0.77 kg/d), but there were no differences (P>0.92) between FFA-CLA and ME-CLA (39% and 38% reduction, respectively). Milk yield, yield and content of milk protein, and DMI were unaltered (P>0.14) by CLA treatment. Both de novo synthesis and the uptake of preformed fatty acids were affected as yields of all fatty acids (P<0.08) were reduced by CLA treatment. However, there were no differences in the yield or proportions of individual fatty acids between the FFA-CLA and ME-CLA. Milk fatty acid content of trans-10, cis-12 CLA increased (P=0.01) from 0.01% in control to 0.18% and 0.17% for FFA-CLA and ME-CLA, respectively. The transfer efficiency of the abomasally infused trans-10, cis-12 CLA into milk fat averaged 18.8% for FFA-CLA and 17.8% for ME-CLA. Overall, results demonstrate that the ME-CLA are equally potent at reducing milk fat synthesis as the FFA-CLA, and that the presence of the methyl ester had no apparent effect on intestinal absorption of CLA or its incorporation into milk fat. Therefore, rumin-protected forms that utilize either free
fatty acids or methyl esters of trans-10, cis-12 CLA would be effective dietary supplements of CLA to induce milk fat depression.

**Key Words:** Conjugated linoleic acid, Milk fat depression, Milk fat

**T144 Trans-fatty acids (tFA), CLA isomers, and milk fat deposition (MFD) in dairy cows receiving incremental doses of fish oil.** J. J. Loor*, 1, 2, J. M. Chardigny, 2, J. Chabrot, 1, M. Doreau, 2, A. Ollier, 2, J. L. Sebedio, 2, and Y. Chilliard, 1, 1INRA, 63122 St.-Genès Champanelle, France, 2INRA, 21065 Dijon, France, 3Department of Animal Sciences, University of Illinois.

Correlations (CORR) between percentage of tFA in milk and milk fat percentage (MF%) due to fish oil (FO) were evaluated using data from two independent exp. (n = 45). Exp. were conducted as replicated 3 × 3 Latin squares with 4-wk periods using corn silage, and doses of 0, 200, 300, or 400 mL FO/d into the rumen. MF% was 3.52, 2.40, 2.51, or 2.17 due to incremental FO. Highest positive CORR were between 18:0 (0.68) or oleic acid (0.63), both of which were markedly reduced by FO, and MF%. All t-18:1 isomers, except t-16:18-1, were negatively correlated with MF%. T9-18:1 (-0.69) and t12-18:1 (-0.68) had the most negative CORR. CORR for t10-18:1 and t11-18:1 (TVA) were -0.58 or -0.47. All CLA isomers, except t10-c12-CLA which was not detectable, were negatively correlated with MF%. T11, t13-18:2, derived from 18:3n-3 hydroxylation, had a CORR of -0.62 with MF%. Among individual isomers, t10- to t13-14+18-1 were all negatively correlated with 6:0, 8:0, or 10:0 concentration. T10-18:1, however, had the highest negative CORR with 8:0, 10:0, 12:0, and 14:0 (0.33-0.55). Although CORR between t-18:1 isomers and 16:0 was not significant (-0.16), that between t9-16:0 and CLA was 0.56. t-9 and t-11-CLA also were negatively correlated (-0.55) with 16:0, but not with MF% (-0.16). T14- to t9-18:1 and t12- to t13-14+18-1 had CORR of 0.67 or 0.80 with TVA, and -0.14 to 0.59 with t10-18:1. TVA had CORR of 0.15 with t10-18:1. CORR between TVA and c9,c11-CLA was 0.94. Data suggest other t-18:1 are more closely associated with MFD than t10-18:1 or t10-c12-CLA in cows fed FO. Certain rumen-derived t-18:1 and CLA isomers may interact to reduce t-18:1 and FA synthesis. Lower endogenous synthesis of c9-18:1, due to reduced 18:0 availability, may be an additional factor leading to decreased MF% and fat yield in cows fed FO.

**Key Words:** Fish oil, CLA, Trans fatty acids

**T145 Trans fatty acids (tFA) and CLA in liquid-associated (LAB) and solid-adsorbed (SAB) ruminal bacterial communities from dairy cows fed diets varying in forage:concentrate ratio (F:C) and level of linseed, sunflower, or fish oil.** J. J. Loor*, 1, 2, K. Ueda, 1, A. Ferlay, 1, Y. Chilliard, 3, and M. Doreau, 2, 1INRA, 63122 St.-Genès Champanelle, France, 2Department of Animal Sciences, University of Illinois.

CLA and tFA percentage in LAB and SAB due to F:C and unsaturated oils was evaluated. Exp. periods lasted 4-wk with grass hay as the forage. In exp. 1, four Holstein cows were fed a diet with low (35:65) or high (65:35) F:C without (LC, HC) or with linseed oil at 3% of DM (LCL3, HCL3) in a 4 × 4 Latin square. In exp. 2, three Holstein cows were fed HC with 5% linseed (HCL5), 5% sunflower (HCS5), or 2.5% fish oil (HCF2.5) in a 3 × 3 Latin square. In exp. 3, 22:5n-3 in cows fed HCF2.5 averaged 39, 52, and 22% of total n-3 FA in milk and milk fat, and increased (P < 0.01) the proportion of acetate and increased (P < 0.01) the proportion of butyrate without affecting the proportions of any other VFA (P > 0.2) or total VFA concentrations (P > 0.6). These data indicate that free methionine and lysine alter ruminal fermentation but this change may not be large enough to elicit a production response in late lactation cows.

**Key Words:** Methionine, Lysine, Milk production

**T147 Transfer of dietary fatty acids and hydrogenation intermediates from duodenum to milk in cows fed diets varying in forage:concentrate ratio and level of linseed, sunflower, or fish oil.** J. J. Loor*, 1, 2, K. Ueda, 1, A. Ferlay, 1, M. Doreau, 1, and Y. Chilliard, 1, 1INRA, 63122 St.-Genès Champanelle, France, 2Department of Animal Sciences, University of Illinois.

Relationships between duodenal flow and milk secretion of fatty acids due to dietary forage:concentrate ratio (F:C) and unsaturated oil were evaluated using data from two exp. Exp. periods were of 4-wk with grass hay as the forage. In exp. 1, four Holstein cows were fed a diet with low (35:65) or high (65:35) F:C without (LC, HC) or with linseed oil at 3% of DM (LCL3, HCL3) in a 4 × 4 Latin square. In exp. 2, three Holstein cows were fed HC with 5% linseed (HCL5), 5% sunflower (HCS5), or 2.5% fish oil (HCF2.5) in a 3 × 3 Latin square. Mean transfer of 18:2n-6 from duodenum to milk was 48% in cows fed LC compared with 41% for HC. Feeding LCL3 increased 18:2n-6 transfer (59%) compared with HCL3 (28%). In exp. 2, no differences due to diet were observed (37%). Dietary 18:3n-3 transfer averaged 60% or 53% in cows fed LC or HC. Feeding LCL3 compared with HCL3 increased 18:3n-3 transfer. Transfer of 18:3n-3 in exp. 2 was greater in cows fed HCF2.5 (42%) compared with HCL5 (29%). In exp. 2, transfer of 20:5n-3, 22:5n-3, and 22:6n-3 in cows fed HCF2.5 averaged 39, 52, and 22%, respectively. Trans10-18:1 transfer was greater in cows fed LC than HC (72% vs. 51%), but decreased in response to LCL3 or HCL3. In exp. 2, trans10-18:1 transfer was 43%. Transfer of (c9t11-18:1 + c9t11-18:1) (TVA + c9t11-CLA) was 50% or 50% due to LC or HC, and feeding LCL3 increased it compared with HCL3 (63% vs. 26%). In exp. 2, HCF2.5 increased TVA + c9t11-CLA transfer markedly compared with HCL5 or HCS5 (66% vs. 40%). There was a positive correlation (r = 0.66) between duodenal flow of TVA + c9t11-CLA and their yield in milk, and between duodenal TVA flow and milk CLA yield (r = 0.74). Results indicate transfer rate for dietary fatty acids and biohydrogenation intermediates from duodenum to milk differs with forage:concentrate ratio and oil type.

**Key Words:** Forage:concentrate ratio, Oil, Milk fat

Sixteen Holstein cows in late lactation (mean DIM = 267) were paired by current milk production and DM and randomly assigned to one of two diets. Diets were based on corn silage with alfalfa hay. Concentrates for diets included ground corn and a commercial protein mixture. Diets differed by addition of 0.29% methionine and 2.9% lysine (DM basis). Methionine was provided as dl-methionine and lysine was provided as lysine-HCl. Cows were fed individually and intake measured daily for 28 d. Milk was measured and sampled at each milking. Samples of rumen fluid were collected via stomach tube at the beginning, midpoint, and end of the trial. Adding amino acids did not alter mean DMI, OM intake (P > 0.15), milk yield (P > 0.7), or milk production efficiency (kg milk / kg DMI; P > 0.6). Supplemental amino acids also had no effect on milk component percentages or production (P > 0.5). There was a statistical interaction of treatment and day on study for DMI, OM intake (P < 0.01), and milk production efficiency (P < 0.05) but the biological implications of these interactions are nonsignificant. As expected, supplemental amino acids increased ruminal NH3 concentrations (P < 0.01). Supplemental amino acids decreased (P < 0.01) the proportion of acetate and increased (P < 0.01) the proportion of butyrate without affecting the proportions of any other VFA (P > 0.2) or total VFA concentrations (P > 0.6). These data indicate that free methionine and lysine alter ruminal fermentation but this change may not be large enough to elicit a production response in late lactation cows.

Optimizing dietary CP is important for improving N efficiency in dairy production. Forty lactating Holstein cows (10 ruminally fistulated) were used in an incomplete 5 x 5 Latin Square design with 4-wk periods to assess the effects of different dietary CP levels on milk yield and ruminal metabolism. Diets contained (% of DM) 25% alfalfa silage, 25% corn silage, and 50% concentrate. High moisture corn was replaced with sol-vent soybean meal to increase CP from 14.6% (diet A), to 15.6% (diet B), 16.6% (diet C), 17.1% (diet D), and 18.4% (diet E). DMI and milk and lactose yield followed the same pattern, with response on diet C being greater than that on diets A and D. Yield of FCM and protein had a similar pattern except that diet C was only greater than diet A. Milk/DMI, fat yield, and ruminal propionate and total VFA did not differ. As expected, MUN and ruminal ammonia increased linearly with dietary CP content. Digestibility of DM and NDF was higher on diets B and C than on diets A, D, and E and significant quadratic effects were noted for both traits. Overall, poorer N utilization was associated with diets higher in CP. A diet containing 16.6% CP was adequate to sustain production under the conditions of this study.

Key Words: Dietary protein, Milk yield, N-efficiency

T149 Feeding calcium salts of linoleic and linolenic essential fatty acids to pre and post-partum Holstein cows improves reproduction, health and profit. W. K. Sanchez*, E. Block, and K. R. Cummings, ARM & HAMMER Animal Nutrition Group, Church & Dwight Co., Inc., Princeton, N.J.

Field trials involving over 5,000 high producing Holstein cows (averaging > 12,000 kg ME milk) with over 14,000 eligible breedings were conducted to evaluate the effects of feeding calcium salts of essential fatty acids (linoleic and linolenic acids as MEGALAC-R®; MEG-R) on reproduction, health, and lactational performance. Cows were fed either a control close-up, fresh cow, and high group ration; CON) or a similar set of treatment rations plus MEG-R (115 g for 21-d before calving, 227 g for 10-21 d postpartum, and 454 g through 110 d postpartum) in place of tallow or MEGALAC®. In two trials MEGALAC was the control and in two trials tallow was the control. The percentages of pregnancies and health events were compared using a standard chi-square analysis. Overall cumulative pregnancy rates were 6.5% greater (P < 0.05) for animals fed MEG-R. Primiparous cows responded better (>10% response) to MEG-R than multiparous cows, but the multiparous cows fed the larger dose (454 g) of MEG-R had the greatest response (19% increase overall). Health events such as retained placenta, displaced abomasums, cases of mastitis, and abortions were all lower (P < 0.10) for cows fed MEG-R. Milk production and milk composition was similar (P > 0.05) between groups, likely due to the fact that the control and treatment diets were similar in calories. Effects of reproduction and health changes on milk yield, culling patterns and herd composi- tion (i.e. the number of calves, heifers, and cows) were used to estimate the economic impact. With $10/cwt milk, $500 culls, $250 calves, and $1500 replacements the net return from feeding MEG-R was $19 per cow overall (a 90% return on investment). The herd fed 454 g MEG-R netted $45 per cow (a 250% return on investment). This research indi-cates that feeding calcium salts of linoleic and linolenic essential fatty acids can improve reproduction, health and profitability on commercial dairy farms.

Key Words: Dairy nutrition, Reproduction, Health


The CLA content of milk from cows in usually low. However, this proportion can be enhanced by dietary addition of soybean oil (SO), which is rich in linoleic acid. Our objective was to evaluate the effect of dietary SO on milk production, milk composition and CLA concentrations in milk from cows under commercial conditions. In this multi-site trial, 254 cows were fed 12 different diets for 8 weeks. For the first 7 farms, the herd was divided into two groups. The first group remained on the normal herd diet and the second group received SO at the rate of 1 l/d. For the other 5 farms, the herd was divided into two groups according to lactation stage (early vs. late). Within each of these groups half of the cows remained on the herd diet. The second half received SO at the rate of 1 l/d for cows in early lactation, and 0.5 l/d for cows in late lactation. Soybean oil was added to the diets at the expense of grain concentrates on an energy basis. Metabolizable protein supply was maintained by adjusting the concentration of rumen-undegradable protein. Vitamin E was added in SO at the rate of 1000 IU/l. Experimental period was 8-wk in length. Milk production was recorded and milk was sampled every week for chemical analysis. Milk yield and milk protein yield were not improved by treatments. Protein content decreased (P<0.06) for cows receiving 1 l/d of SO (-3.0%). Milk fat content decreased (-6.3% and -18.7%; P<0.05) for cows fed 0.5 and 1 l/d of SO, respectively. Milk fat yield decreased (-22.2%; P<0.05) only for cows receiving 1 l/d of SO. Dietary addition of SO increased (P<0.05) milk fat content of CLA from 5.2 to 20.0 and 18.8 mg/g of fatty acids for cows fed 0.5 and 1 l/d of SO, respectively. Soybean oil can be used on commercial dairies to produce high CLA milk fat.

Key Words: soybean oil, conjugated linoleic acid, milk fat

T151 Effects of essential oils and monensin on ruminal pH, ammonia concentration and in situ degradability of dry matter and nitrogen in the rumen of lactating dairy cows. C. Benchar*1,2, T. D. Whyte3, H. V. Petit1, R. Berthiaume1, D. R. Ouellet1, and P. Y. Chouinard3, 1Agriculture and Agri-Food Canada, Lennonsville, Quebec, Canada, 2 Nova Scotia Agricultural Col-lege, Truro, Nova Scotia, Canada, 3Universite Laval, Ste-Foy, QC, Canada.

ABSTRACT Four ruminally cannulated lactating cows were used in a 4x4 Latin square design to examine the effects of dietary addition of essential oils (Crinia®) and monensin (Rumensin®) on in situ ruminal degradability of soybean meal, ruminal pH and ammonia concentration in the rumen fluid. Cows were fed for ad libitum intake a TMR unsup-plemented (control, CO), or supplemented with essential oils (2 g/d, EO), monensin (350 mg/d, MO) or a combination of both additives (EO+MO). Each experimental period consisted of two weeks of adjust-ment to the diet, three days for in situ incubation, and two days for rumen fluid sampling. No interaction was observed (P>0.05) between EO and MO. The rapidly (a), and the slowly degradable fractions (b) of DM were most affected (P<0.05) by additive treatment with 36.9 and 62.8%, respectively. However, DM degradation rate tended to be higher (7.1 vs 6.4%/h; P=0.08) and effective degradability (ED) was increased (67.5 vs 65.9%; P<0.05) for cows fed MO. Fractions (a) and (b), and degradation rate of OM were not changed (P>0.05) by treatments. ED of OM was slightly higher (66.7 vs 64.9%; P<0.05) for cows fed MO. Degradation kinetics of CP showed that the fraction (a) was lower (P<0.05) with MO. Inversely, this fraction was increased (P=0.05) when cows were fed EO. Fraction (b) was not changed by dietary treatments (83.9%; P>0.05).

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CP degradation rate was slightly higher (6.9 vs 5.5%/h; \( P < 0.05 \)) with MO and tended to increase (5.9 vs 5.6%/h; \( P = 0.07 \)) for cows fed EO. Effective CP degradability increased (55.6 vs 53.0%; \( P < 0.05 \)) with MO. Ruminal pH was increased (+ 0.11 points; \( P = 0.04 \)) or tended to increase (+ 0.09 points; \( P = 0.08 \)) with the addition of EO and MO, respectively. Ammonia concentration in the rumen fluid was reduced (11.7 vs 14.3 mg/100 ml; \( P < 0.05 \)) for cows fed MO. This study showed that the addition of EO and MO in dairy cow diets has minor effects on protein degradation and ammonia concentration in the rumen. More investigation is needed to assess the effectiveness of essential oils to impact protein digestion and rumen fermentation.

**Key Words:** Essential oils, Monensin, Protein degradation

### Table T152

#### Effect of vitamin E supplementation in late lactation on milk production and milk fatty acid profile.

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**Key Words:** Fat supplementation, Parity, Grazing

### Table T154

#### Biotin supplementation for periparturient dairy cows. O. Rosendo1, C. R. Staples2, L. R. McDowell1, R. J. McMahon1, and W. M. Seymour2.

Multiparous Holstein cows were fed an average of 0 or 20 mg/d of biotin from an average of 17 d prepartum to calving and 0 or 30 mg/d of biotin from calving to 70 d postpartum. Diets fed during the nonlactating period were 1.63 Mcal NEL/kg and 13.4% CP whereas diets fed during the lactating period were 1.69 Mcal NEL/kg and 17.3% CP (DM basis). Mean concentration of biotin in plasma sampled weekly was greater in cows fed biotin (9.4 vs 4.3 nM/liter; \( S.E. = 0.5 \)). Mean intake of DM was 8.6 and 10.3 kg/d (\( S.E. = 0.8 \)) during the nonlactating period and 22.1 and 23.8 kg/d (\( S.E. = 0.7 \)) postpartum for cows fed control (\( C; n = 18 \)) and biotin (\( B; n = 20 \)) diets, respectively. Intakes were not different. Production of milk (35.8 vs 34.8 kg/d; \( S.E. = 1.3 \)), milk fat concentration (3.59 vs 3.69%; \( S.E. = 0.08 \)), and milk protein concentration (2.73 vs 2.83%; \( S.E. = 0.05 \)) were similar between treatment groups.

**Key Words:** Biotin, Lactation, Liver

### Table T155

#### Effects of dietary addition of essential oils and monensin on nutrient digestibility, nitrogen retention, milk production and milk composition of Holstein cows. C. Benchaa1,2, T. D. Whyte2, R. Berthiaume1, H. V. Petit1, D. R. Ouellet1, and P. Y. Chouinard3.

Fifteen lactating dairy cows were used in a 4 x 4 Latin square design to study the effects of dietary addition of essential oils (C18:1) and monensin (Rumensin®) on nutrient digestibility, nitrogen retention, milk production and milk composition. Cows were fed a diet without (control, C) or supplemented with essential oils (2 g/d), EO, monensin (350 mg/d, MO) or a combination of both additives (EO+MO). Each experimental period consisted of 21 days of adjustment.
to the diet and 7 days for data recording and sample collection. No interaction (P>0.05) was observed between EO and MO. Dry matter intake was not affected by dietary additives (22.7 kg/d, P>0.05). Apparent DM (66.6%), OM (68.3%), and NDF (47.9%) digestibilities were similar (P>0.05) among treatments. However, apparent ADF digestibility was higher (49.8 vs. 46.0%, P<0.05) for cows fed EO. Apparent CP digestibility was increased (65.0 vs. 63.6%; P=0.05) when cows were fed MO. Nitrogen retention was not changed (27.1 g/d; P>0.05) by treatments. Production of milk and 4% FCM remained unchanged (P>0.05) among treatments (33.6 and 33.4 kg/d, respectively). Milk protein and lactose concentrations were not different (P>0.05) between treatments (3.5 and 4.6%, respectively). Milk fat and total solids contents were lower (3.8 vs. 4.1% and 12.6 vs. 13.6%; P<0.05) for cows fed MO. Milk urea-nitrogen concentration tended to increase (12.6 vs. 12.0 mg/dl; P=0.06) for cows fed MO. Somatic cell count was not affected by additive treatments (55x10^6/ml; P>0.05). Initial and final body weights were unaffected (P>0.05) by treatments. However, body weight change was higher (0.4 vs. 0.2 kg/d; P=0.05) for cows fed EO. This study showed that the addition of essential oils and monensin does not have major impacts on nutrient digestibility and milk production and composition in dairy cows. Further investigations are needed to evaluate the potential of adding essential oils in dairy cow diets to manipulate rumen fermentation and to improve feed efficiency.

Key Words: Essential oils, Monensin, Cows

T156 Relation of arterial concentration of lysine and methionine milk and milk protein production: a twenty-year literature review. R. A. Patton1, M. J. Stevenson2, and A. J. Duffield3, 1Nittany Dairy Nutrition, Mifflinburg, PA, 2Degusso Corporation, Kennesaw, GA.

This study investigated relationships of blood methionine and lysine concentration from literature studies to milk yield, protein yield and milk protein %. Data consisted of all studies published in the Journal of Dairy Science between 1982 and 2002 with sufficient information on dietary composition, dry matter intake, milk yield, milk protein percent and jugular concentrations of MET and LYS. Sixty-six studies met the established criteria, representing 281 diets at 21 institutions. Diets were entered into the Meson Dairy Ration Evaluation (AMRE) to predict duodenal amino acid flow, MET and LYS as a percent of metabolizable protein and ratio of LYS:MET. Main effects of AA measurement (serum or plasma), cow breed and study type (protein fed or infused beyond the rumen) entered into the Mepron Dairy Ration Evaluator (AMRE) to predict dietary measures were assessed with PROC MIXED of SAS. Linear relationships between blood MET and LYS concentrations and dietary measures were assessed with PROC REG, while non-linear relationships were studied with PROC NLIN.

In these studies there was no significant difference in MET or LYS concentration whether measured in serum or plasma, so studies were pooled. Breed had a significant effect on milk protein %, but not on blood AA concentration. Linear regression was significant only for duodenal flow of MET and milk yield and milk protein yield (P<0.05) overall. There was no significant relation to blood AA. Non-linearly, duodenal MET and LYS were significantly associated with milk yield, milk protein yield (P<0.01). Duodenal MET, MET as % of MP and LYS:MET were not significantly related to blood MET, Duodenal LYS and LYS:MET, but not LYS as % MP, were related to blood LYS. Blood MET but not LYS was related to protein%. This study suggests that duodenal MET and LYS as well as MET and LYS as a percent of MP are associated with milk yield, protein % and protein yield in a non-linear manner. Blood AA is not consistently correlated, and its use as a measure of AA adequacy is questionable.

Key Words: Methionine, Lysine, Dairy cattle

T157 Response of pre-partum and early lactation dairy dairy cows to dietary inclusion of rumen-inert conjugated linoleic acid. T. R. Dhiman1, M. S. Zaman1, and N. D. Luchini2, 1Utah State University, Logan, UT, 2Bioproducts, Incorporated, Fairlawn, OH.

A study was conducted to determine the feed intake and milk production response of pre-partum and early lactation dairy cows to inclusion of partially rumen protected calcium salts of conjugated linoleic acid (CLA). Thirty-four multiparous cows during dry period were blocked according to calving date and milk yield from previous lactation. Within blocks cows were randomly assigned to control (CT) or CLA (CL) treatments. Cows in both treatments were fed a dry cow diet containing 84% forage 3 wk prior to due calving date, a fresh cow diet containing forage to grain in 51:49 ratio for 2 wk post-calving and a milking diet containing forage to grain in 47:53 ratio during weeks 3 to 10 of lactation. In addition to the basal diet, cows in CT and CL received 0 and 150 g of CLA supplement before calving and 225 g of hydrolyzed animal fat or 225 g of CLA supplement after calving, respectively. The fat supplements were top dressed on the total mixed ration. Daily feed intake and milk yield were recorded. Weekly milk samples from 6 consecutive milkings were analyzed for fat, protein and lactose content. Weekly composite milk samples collected from 6 consecutive milkings during 1, 2, 3, 4, 5 and 10 wk were analyzed for fatty acid profile. Cows in CT and CL treatments had similar DMI before calving. During 1-10 wk of lactation the average DMI was 23.0 and 20.8 kg/d (P<0.07), milk yield 46.0 and 45.0 kg/d, energy corrected milk 32.8 and 29.6 kg/d (P<0.03), fat content 3.90 and 3.45% (P<0.01), protein content 2.89 and 2.82%, fat yield 1.76 and 1.47 kg/d (P<0.01), protein yield 1.31 and 1.24 kg/d, lactose 4.86 and 4.81%, and ECM/MILY 1.48 and 1.52 in CT and CL treatments, respectively. The average CLA content of milk was 3.8 and 3.5 mg/kg in CT and CL treatments, respectively. Results suggest that feeding partially rumen protected CLA supplement 3 wk prior to calving had no influence on feed intake. Feeding CLA supplement during early lactation reduced fat content, fat yield and energy corrected milk yield and had no influence on CLA content of milk fat. The CLA supplement can be used as a tool to reduce fat content of milk.

Key Words: Cow, Milk, Conjugated linoleic acid

T158 Comparison of commercially available rumen-stable choline products. L. Kung, Jr1, D. E. Putnam2, and J. Garrett2, 1University of Delaware, Newark, DE, 2Balchem Encapsulates, New Hampton, NY.

The objectives were to determine the rumen DM and choline stability of five commercially available rumen-stable choline products and to determine qualitative differences of rumen-stable nutrients by measuring rumen DM and nutrient stability. Products evaluated were ReaSure® (25% choline; Balchem Encapsulates, New Hampton, NY), product A (13% choline) product B (40% choline; Italian manufactured, North American distributed), product C (40% choline, Italian manufactured, Asian distributed), product D (25% choline; Canadian manufactured, North American distributed). Products were obtained through commercial distributors, and stored at ambient temperature. Dry matter and choline stability were determined at 0.5, 6, 12 and 24 hours of incubation using an Ankom Dairy II Incubator. Triplicate samples were used for each time point; corn silage was used as an internal standard. Each sample bag was dried for 24 hr at 65°C, with residues weighed and analyzed for choline content using a choline oxidase based detection system. Rumen-stability was calculated by subtracting the recovered DM or choline from the amount of DM or choline added to the bag originally. Results are detailed in the table below. All products had reasonable DM stability (63 to 98% at the 12 hr time point). However, choline stability varied considerably, with only one product (ReaSure) having choline stability after 12 hr of incubation. In conclusion, considerable differences exist between commercially available rumen-stable choline products. Measuring DM stability is not an acceptable method for accessing the quality of rumen-stable nutrients.

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>Rumen DM stability, %</th>
<th>Rumen choline stability, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>99.8 ± 1.1</td>
<td>87.5 ± 1.1</td>
</tr>
<tr>
<td>6</td>
<td>98.9 ± 1.2</td>
<td>86.6 ± 1.0</td>
</tr>
<tr>
<td>12</td>
<td>98.4 ± 0.9</td>
<td>88.6 ± 0.2</td>
</tr>
<tr>
<td>24</td>
<td>97.4 ± 0.8</td>
<td>85.7 ± 3.3</td>
</tr>
</tbody>
</table>

Key Words: Choline, Rumen, Stable

The objective of this study was to compare the accuracy and precision of predicting protein requirements for lactating dairy cows using the 1989 and 2001 NRC models. The study was based on two previously published research datasets. Both of the datasets were conducted with specifically formulated low crude protein (CP) diets with varied rumen degraded (RDP) and rumen undegraded protein (RUP) and a high CP diet as control. The first dataset varied RUP percentage at a constant CP content in early, mid and late lactation. Low RUP diets resulted in reduced milk production especially in early lactation (32 kg/d vs. 37 kg/d). The 1989 model predicted reduced milk production with the low RUP diet especially in early lactation (30.1 kg/d vs. 34.6 kg/d), as observed. The 2001 model overestimated RUP supply, predicting adequate RUP even when production losses were observed from RUP deficiency. The 1989 model predicted sufficient N for bacterial synthesis for cows at all lactation stages fed both control and high RDP diets. The 2001 model predicted deficient rumen N for all diets and all stages. The second dataset included diets with different RDP concentrations but the same CP and RUP. The RDP concentration varied from 10% to 25% of the diet DM. A comparison of the 1989 and 2001 National Research Council models on predicting protein requirements for lactating dairy cows using the 1989 and 2001 NRC models showed that the 2001 model was more accurate in predicting protein requirements for lactating dairy cows. The 1989 model overestimated RUP supply, predicting adequate RUP even when production losses were observed from RUP deficiency. The 1989 model predicted sufficient N for bacterial synthesis for cows at all lactation stages fed both control and high RDP diets. The 2001 model predicted deficient rumen N for all diets and all stages.

Key Words: Protein requirement, RDP, Model evaluation


HMBi is a novel source of methionine for ruminants: 50% is absorbed by the rumen wall to provide metabolisable methionine and the remaining 50% hydrolysed in the rumen to form methylthiobutanoic acid. Methylthiobutanoic acid was incubated with 6 or 9 mg of HMBi. The effects of HMBi on corn digestion were studied by two datasets. The first dataset consisted of 13,14-dihydro-15-keto-PGF2α used in blood between 0 and 120 min following the oxytocin injection were lower (P = 0.07) for cows fed Megalac (51.5 pg/ml) and flasked (55.5 pg/ml) than for those fed whole sunflower seed (102.7 pg/ml); cows fed control had intermediate values (71.4 pg/ml). Mean plasma progesterone concentration was lower (P < 0.05) for cows fed flasked (6.430 pg/ml) compared to those fed control (10.108 pg/ml) or sunflower (9.061 pg/ml); cows fed Megalac had intermediate values (6.610 pg/ml). Feed intake averaged 21.7 kg/d and was similar (P > 0.05) among treatments. Milk yield was greater (P < 0.05) for cows fed Megalac (31.5 kg/d) and flasked (31.2 kg/d) compared to those fed sunflower seed (25.9 kg/d) and control (24.8 kg/d). Digestibilities of DM, CP, ADF, NDF, and energy were similar among treatments. Milk fat percentage was similar (P > 0.05) among treatment but protein concentration tended (P = 0.11) to be greater for cows fed flasked (3.87%) and control (3.92%) compared to those fed Megalac (3.68%). Cows fed sunflower seed had intermediate values (3.74%). Feeding flasked decreased (P < 0.05) the omega 6 to omega 3 fatty acids ratio in milk (2.8) compared to feeding control (6.5), Megalac (6.8) and sunflower (9.9). In conclusion, feeding a source of omega 3 fatty acids such as sunflower seed, which could contribute to improving gestation rate as observed in other studies.

Key Words: Dairy cattle, Fatty acids, Reproduction

T161  Milk production and composition and prostaglandin secretion in dairy cows fed different fat sources. H. V. Petit1, C. Gerniquet2, and D. Lebel1. 1Agriculture and Agri-Food Canada, Dairy Nutrition Development Centre, Département de Biologie, Université de Sherbrooke.

Four non-lactating Holstein cows were used in a 4 × 4 Latin square design experiment to study the effects of feeding different fat sources on milk production and composition and prostaglandin secretion in dairy cows. Cows were fed total mixed diet containing around 50% silage and 50% concentrate. All diets were equal in protein and energy contents. Four different concentrations were tested: Megalac, whole linseed, whole sunflower seed, and absence of fat in the concentrate. Estrous cycles were synchronized for each period and animals were challenged with oxytocin (100 IU) to stimulate uterine PGF2α production. Mean concentrations of 13,14-dihydro-15-keto-PGF2α were in blood between 0 and 120 min following the oxytocin injection were lower (P = 0.07) for cows fed Megalac (51.5 pg/ml) and flasked (55.5 pg/ml) than for those fed whole sunflower seed (102.7 pg/ml); cows fed control had intermediate values (71.4 pg/ml). Mean plasma progesterone concentration was lower (P < 0.05) for cows fed flasked (6.430 pg/ml) compared to those fed control (10.108 pg/ml) or sunflower (9.061 pg/ml); cows fed Megalac had intermediate values (6.610 pg/ml). Feed intake averaged 21.7 kg/d and was similar (P > 0.05) among treatments. Milk yield was greater (P < 0.05) for cows fed Megalac (31.5 kg/d) and flasked (31.2 kg/d) compared to those fed sunflower seed (25.9 kg/d) and control (24.8 kg/d). Digestibilities of DM, CP, ADF, NDF, and energy were similar among treatments. Milk fat percentage was similar (P > 0.05) among treatment but protein concentration tended (P = 0.11) to be greater for cows fed flasked (3.87%) and control (3.92%) compared to those fed Megalac (3.68%). Cows fed sunflower seed had intermediate values (3.74%). Feeding flasked decreased (P < 0.05) the omega 6 to omega 3 fatty acids ratio in milk (2.8) compared to feeding control (6.5), Megalac (6.8) and sunflower (9.9). In conclusion, feeding a source of omega 3 fatty acids such as sunflower seed, which could contribute to improving gestation rate as observed in other studies.

Key Words: Hydroxy-methylthiobutanoic acid, Amino acid, Degradation

T162  Effects of monensin and (or) high levels of zinc on ruminal degradability of free lysine and liquid hydroxy-methylthiobutanoic acid (HMB). H. G. Bateman, II*, H. C. Williams1, D. T. Gantt1, Y. H. Chung1, A. E. Beem1, C. C. Stanley1, G. E. Goodier1, P. G. Hoyt2, and L. D. Bunting3, 1LSU AgCenter, Baton Rouge, LA, 2LSU School of Vet Medicine, Baton Rouge, LA, 3Archers Daniels Midland Company, Quincy, IL.

Four non-lactating Holstein cows were used in a Latin square designed experiment to investigate the effects of monensin (M) and high levels of Zn on ruminal degradability of lysine and hydroxy-methylthiobutanoic acid (HMB). Treatments were arranged as a 2 x 2 factorial of added ZnSO4 (0 or 500 ppm Zn) with or without M (0 or 40 ppm). Diets were based on alfalfa hay (50% of DM) with a grain supplement and were limited-fed at 8.2 kg of DM/cow daily. Lysine-HCl (85g) and HMB (50g) were dosed through the rumen cannula on the last day of each period and ruminal concentrations of each compound were measured every 0.5 h for 8 h. Neither added Zn nor M affected the fractional disappearance rates of lysine (P > 0.2) through 8 h. Stable rumen lysine concentrations were reached by 6 h post-dosing; when data prior to 6 h were analyzed, M tended (P = 0.13) to decrease the rate of disappearance of lysine. The disappearance rate of HMB tended (P = 0.098) to be decreased by M through 8 h. High levels of Zn increased (P = 0.04) the proportion of propionate in rumen fluid but had no effect on the proportion of acetate. As expected, M decreased (P = 0.052) the proportion of acetate and increased (P = 0.02) the proportion of propionate in rumen fluid. Neither M nor Zn affected (P > 0.19) total VFA in ruminal fluid. Dietary treatments had no effect (P > 0.2) on ruminal NH3 or peptides. Unexpectedly, supplemental Zn increased (P = 0.02) the rate of disappearance of soybean meal and tended (P = 0.08) to increase the rate of disappearance of extruded soybean meal from nylon bags. These data suggest that supplemental Zn and M alter ruminal fermentation patterns and M but not Zn may decrease the rate of degradation of lysine and HMB.

Key Words: Hydroxy-methylthiobutanoic acid, Methionine, Reproduction
### T164 Milk choline concentration as an index of bioavailability of rumen-protected choline. J. R. Newbold* and J. Lavrijssen, Provinci Research and Technology Centre, Brussels, Belgium.

Milk choline has been suggested as an index of bioavailability of rumen-protected choline (RPC). Our objective was to identify the response of milk choline concentration to RPC in order to define an appropriate feeding rate at which different sources of RPC may be compared. Eight primiparous Holstein cows (days in milk = 233, SE 14.3) were used in a duplicate 4x4 Latin squares with two-week periods. Treatments were: A, Negative control; B, Low-RPC (equivalent to 25g choline chloride/d); C, High-RPC (50g choline chloride/d) and D, Unprotected choline chloride (50g/d). RPC was a fat-encapsulated product (Provinci Italia, Agrate Brianza, Italy)containing 250g/kg choline chloride. Fractionated palm oil was used to equalize fat intake across treatments. A semi-complete ration based on maize silage, grass silage and a protein concentrate was offered ad libitum, supplemented with 1kg (Square 1) or 0.5kg (Square 2) of an additional concentrate. Milk choline was determined for four replicates 4x4 Latin Squares with two-week periods. Treatments were: A, Control; B, 8g Rhodimet TM AT88™ (Adisseo); H = 9.8g RhMB; H3 = 4g Rhodimet AT88™ + 9.8g HMB. These quantities supplied respectively 7g methionine equivalent for H1 and H2 and 10.5g for H3. Estimated HMB available in the rumen was: 7g for H1 and H3 and 3.5g for H2 based on assumed availabilities in the rumen of 100% for pure HMB and 50% for pure HMBi. Ration fed was composed of (DMI per animal per day) = corn silage 4.2 kg + corn grain 1 kg + concentrate 2 kg (composition % barley, 41 ; beet pulp, 37 ; soybean meal, 15 ; molasses, 5 ; urea, 2). Ruminal juice was collected two days during the third week of each period at 8h30 and 9h30 for pH, ammonia-N and VFA determinations. Representative gas samples were collected through rumen canulae with a special device (Jouany et al., 1979) on two days during the third week of each period at 8h30 and 9h30 for CO2, CH4, H2S, CH3SH and DMS determinations. In general treatments H1 and H3 lowered concentrations of acetate (molar%) and increased concentrations of ammonia-N, butyrate (molar %), H2S and CH3SH compared to the Control and H2 treatment. It appears that the quantity of HMB ruminally available from the level of HMBi used in H2 was insufficient to modify ruminal metabolism except for propionate which was decreased with H2 but the mode of action is unclear and this result needs to be verified. For the higher levels of rumen available HMB (H1 and H3), the changes in individual VFA (molar%) : decrease in acetate, increase in butyrate -classic with HMB—could be due to changes in microbial population. Increases of ammonia-N, H2S and CH3SH can be assumed to be linked directly to diethionymethyl of HMB in the rumen and to the quantity of HMB degraded.

<table>
<thead>
<tr>
<th>Item</th>
<th>15.00</th>
<th>16.25</th>
<th>17.50</th>
<th>18.75</th>
<th>Effect</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI (kg/d)</td>
<td>28.6</td>
<td>28.4</td>
<td>30.0</td>
<td>28.9</td>
<td>L</td>
<td>0.8</td>
</tr>
<tr>
<td>Milk (kg/d)</td>
<td>34.7</td>
<td>34.9</td>
<td>35.8</td>
<td>36.5</td>
<td>NS</td>
<td>1.4</td>
</tr>
<tr>
<td>MUN (mg/dl)</td>
<td>6.2</td>
<td>6.8</td>
<td>8.5</td>
<td>9.9</td>
<td>L</td>
<td>0.5</td>
</tr>
<tr>
<td>Milk fat (%)</td>
<td>3.46</td>
<td>3.55</td>
<td>3.54</td>
<td>3.63</td>
<td>NS</td>
<td>0.17</td>
</tr>
<tr>
<td>Milk protein (%)</td>
<td>3.06</td>
<td>3.01</td>
<td>3.04</td>
<td>3.03</td>
<td>NS</td>
<td>0.08</td>
</tr>
<tr>
<td>PUN (mg/dl)</td>
<td>7.8</td>
<td>8.4</td>
<td>10.1</td>
<td>12.3</td>
<td>L</td>
<td>0.5</td>
</tr>
<tr>
<td>Fecal N (%)</td>
<td>14.9</td>
<td>16.2</td>
<td>17.0</td>
<td>17.7</td>
<td>L</td>
<td>0.2</td>
</tr>
<tr>
<td>Urine N (g/L)</td>
<td>5.1</td>
<td>5.6</td>
<td>6.6</td>
<td>7.5</td>
<td>L</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Significant at P <0.05 for C = cubic, L = linear effects, or NS = not significant effects.

**Key Words:** Amino acid, Ruminant, Nutrition


Excess N from agriculture has become a crucial experimental problem. Reducing protein allowances and altering the forage portion of the diet are tools considered to be effective in minimizing N excretion. Sixteen Holstein cows (80 ± 18 DIM) were utilized in a replicated 4 x 4 Latin square design to determine the effects of dietary protein concentration on lactation performance and N excretion. The experimental period included 2 wk for adaptation followed by 1 wk for data collection. Diets had a 50:50 forage to concentrate ratio and were formulated to contain 15.00, 16.25, 17.50, or 18.75% CP. The forage portion of the diet consisted of 75% alfalfa silage and 25% corn silage. Increasing dietary CP did not (P >0.05) have an effect on milk yield, but resulted in a linear increase in MUN, PUN, fecal N and urinary N concentrations (P <0.05). Varying the concentration of protein from 15.00 to 18.75% in diets that used a 75 : 25 alfalfa to corn silage ratio did not effect overall lactation performance. Results are consistent with previous trials that used different alfalfa to corn silage ratios.

<table>
<thead>
<tr>
<th>Dietary Protein (%)</th>
<th>Item</th>
<th>15.00</th>
<th>16.25</th>
<th>17.50</th>
<th>18.75</th>
<th>Effect</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI (kg/d)</td>
<td>28.6</td>
<td>28.4</td>
<td>30.0</td>
<td>28.9</td>
<td>L</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Milk (kg/d)</td>
<td>34.7</td>
<td>34.9</td>
<td>35.8</td>
<td>36.5</td>
<td>NS</td>
<td>1.4</td>
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</tr>
<tr>
<td>MUN (mg/dl)</td>
<td>6.2</td>
<td>6.8</td>
<td>8.5</td>
<td>9.9</td>
<td>L</td>
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<tr>
<td>Milk fat (%)</td>
<td>3.46</td>
<td>3.55</td>
<td>3.54</td>
<td>3.63</td>
<td>NS</td>
<td>0.17</td>
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<tr>
<td>Milk protein (%)</td>
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<td>3.04</td>
<td>3.03</td>
<td>NS</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>PUN (mg/dl)</td>
<td>7.8</td>
<td>8.4</td>
<td>10.1</td>
<td>12.3</td>
<td>L</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Fecal N (%)</td>
<td>14.9</td>
<td>16.2</td>
<td>17.0</td>
<td>17.7</td>
<td>L</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Urine N (g/L)</td>
<td>5.1</td>
<td>5.6</td>
<td>6.6</td>
<td>7.5</td>
<td>L</td>
<td>0.3</td>
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</tr>
</tbody>
</table>

**Key Words:** Protein, Dairy cows, Forage
MPS for cassava was higher in the residue than in the original forage, but remained the lowest for all the forages studied. After rumen incubation, predominant limiting amino acids changed in all forages, except for pigeon pea, showing that the amino acid composition of the non-degradable fraction differs from the one found in the original forage.

Key Words: Limiting amino acids, Milk protein composition

T167 Changes in volatile fatty acid and trans fatty acid concentrations in the rumen of lactating Holstein cows fed four concentrations of unsaturated free fatty acids. S. A. Mosley, E. J. Thies, E. E. Mosley, and T. C. Jenkins*, Clemson University, Clemson, SC 29634.

The accumulation of unsaturated fatty acids in ruminal contents can disrupt both carbohydrate fermentation and lipid biohydrogenation increasing the passage of fiber and trans fatty acids to the intestines. Previous results suggested that these negative effects of unsaturated fatty acids are more related to their accumulation in the rumen as the free acid rather than in esterified lipid fractions. This study was conducted to determine the pattern and extent of changes in volatile fatty acid (VFA) and trans fatty acid concentrations that accompany increasing concentrations of unsaturated free fatty acids (UFFA) in the rumen. Four diets were fed to four lactating Holstein cows (fitted with a ruminal cannula) in a 4 x 4 Latin square design with 2-week periods. Diets contained 0, 1, 2, or 3% (DM basis) added unsaturated free fatty acids (UFFA) consisting of 61% linoleic acid, 20% oleic acid, and 5% linolenic acid. Samples were taken from the rumen just prior to the morning feeding, and at 0.5, 1, 1.5, or 2 hours after feeding on the last day of each period. As UFFA increased in the diet, the concentrations of UFFA in ruminal contents increased (P < 0.01) linearly (4.2, 5.8, 7.5, and 8.5 mg/g DM), dry matter intake declined (P = 0.02) linearly (from 25.5 to 22.2 kg/d), but milk yield did not change. Total VFA concentration (P = 0.07) and the ratio of acetate to propionate (P < 0.01) both declined linearly as UFFA increased in the diet. However, as UFFA increased from 0 to 3% of the diet DM, the trans-C18:1 concentrations in ruminal contents increased quadratically averaging 4.6, 5.4, 5.3, and 9.4% of total fatty acids (P = 0.13) and 1.2, 1.7, 1.9, and 4.0 mg/g DM (P = 0.14). Linear increases in UFFA concentration in ruminal contents were accompanied by quadratic increases in trans-C18:1/C18:2 (0.46, 0.54, 0.60, and 1.31, P = 0.04) and trans-C18:1/C18:0 (0.11, 0.12, 0.12, and 0.22, P = 0.13). This study shows that increases in ruminal UFFA concentration from feeding fat supplements will disrupt fermentation in direct proportion to its concentration. However, ruminal UFFA concentrations in excess of 7.5 mg/g DM were required to appreciably disrupt biohydrogenation and increase the concentration of trans-monoenes.

Key Words: Rumen, Fatty Acids, Fermentation

T168 Milk protein response to rumen protected methionine in two commercial herds in central Mexico. H. Gutierrez*, G. Zavala2, and R. A. Patton3, 1Ganaderos Asociados de Queeretaro, Queeretaro, Mexico, 2Degussa Mexico, Mexico City, Mexico, 3Nittany Dairy Nutrition, Millinburg, PA.

We wished to test whether a small amount of rumen protected methionine (RPMet) included in a total mixed ration and fed under commercial conditions could affect milk protein production. Ratios were evaluated relative to the 2001 NRC suggested ratio of methionine and lysine as a percent of metabolizable protein, LYS:MET ratio and theoretical daily requirements for MET and LYS. Two dairy herds, feeding diets typical of the geographic area, feeding the same amount of protein supplement and having approximately the same ratio of LYS to MET in the diet were selected. RPMet (Mepron®) was fed at 11 g per day mixed into a protein supplement fed at 4.2 kg/head/day in a switchback design. Only cows finishing all six weeks of the study (n=613) were analyzed. Milk was weighed one day per week. Composite samples were submitted to a commercial laboratory for analysis of milk CP %, milk fat % and MUN (Alpura, Cuanuitlan, Mexico). Statistical analysis was by the Mixed procedure of SAS with compound symmetry covariance. Fixed terms included RPAA and parity. Random factors were farm and period with time as repeated factor and cow (herd) as subject. AA sufficiency was analyzed using the Mepron Dairy Ration Evaluator (Ver 2.6). These data indicate small additions of RPMet can significantly increase milk protein production in a commercial setting. The milk protein response may be due to the increased supply of methionine as the first limiting amino acid or may be a consequence of improved amino acid profile as represented by the LYS:MET ratio.

<table>
<thead>
<tr>
<th>Amino acid parameters:</th>
<th>Herd 1</th>
<th>Herd 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>RPMet</td>
<td>Control</td>
</tr>
<tr>
<td>MET % MP</td>
<td>2.31</td>
<td>2.56</td>
</tr>
<tr>
<td>LYS % MP</td>
<td>7.64</td>
<td>7.62</td>
</tr>
<tr>
<td>LYS:MET</td>
<td>3.31</td>
<td>2.97</td>
</tr>
<tr>
<td>Met, g above req.</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Lys, g above req.</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

RPMet effects:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>RPMet</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (kg)</td>
<td>31.3</td>
<td>31.5</td>
<td>0.85</td>
<td>.31</td>
</tr>
<tr>
<td>Milk fat (%)</td>
<td>3.54</td>
<td>3.50</td>
<td>0.17</td>
<td>.81</td>
</tr>
<tr>
<td>Milk fat (kg)</td>
<td>1.101</td>
<td>1.095</td>
<td>0.050</td>
<td>.93</td>
</tr>
<tr>
<td>MUN (mg/dl)</td>
<td>15.78</td>
<td>15.50</td>
<td>.13</td>
<td>.11</td>
</tr>
<tr>
<td>Milk crude protein (%)</td>
<td>3.00</td>
<td>3.06</td>
<td>.014</td>
<td>.01</td>
</tr>
<tr>
<td>Milk protein (kg)</td>
<td>0.937</td>
<td>0.963</td>
<td>0.026</td>
<td>.01</td>
</tr>
</tbody>
</table>

Key Words: RPMet, Milk Protein

T169 Rumen undegradable protein characterization of three protein sources. W. H. Kolath*, P. L. Bond Jr.2, and M. S. Kerley1, 1University of Missouri - Columbia, 2Mid South Milling, Memphis, TN.

Rumen undegradable protein (RUP) is commonly used in dairy lactation diets to increase milk production and protein content. The objective of this study was to determine the RUP value of two blended protein sources (Apcon 1 and Apcon 2; Mid South Milling). Fish meal (Special Select, Omega Protein Inc.) was used as the control standard. Twenty-four single-phase continuous culture fermentors with a dilution rate of 6% hr$^{-1}$ were used to determine the rumen undegradable protein value of the three protein sources. Four treatments were fed, a control diet (C) consisting of soyhulls and purified cornstarch, Apcon 1 + C, Apcon 2 + C, and fish meal + C. The C was fed at 36g day$^{-1}$ and the protein sources were added at 9g day$^{-1}$. True DM and OM digestibility was greatest (P < 0.05) for the Apcon 1 and fish meal diets. Microbial efficiency was similar among the three protein sources and lower (P < 0.05) for C. The RUP nitrogen was greatest (P < 0.05) for Apcon 2 and was similar (P < 0.05) among the other treatments. The RUP amino acid values were similar to the RUP nitrogen data. Cenecized roosters were fed 15g of effluent to determine the digestibility of the protein sources. The amino acid digestibilities of Apcon 1, 2 and fish meal were 69.90, 69.31 and 73.96 respectively. We concluded that Apcon 1 and Apcon 2 can be viable alternatives for post-ruminally delivered amino acids.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fish Meal</th>
<th>Control Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>True DM Digestibility</td>
<td>84.16</td>
<td>71.69</td>
</tr>
<tr>
<td>True OM Digestibility</td>
<td>79.95</td>
<td>72.02</td>
</tr>
<tr>
<td>Microbial Efficiency</td>
<td>12.56</td>
<td>12.50</td>
</tr>
<tr>
<td>Ammonia (mg/mL)</td>
<td>2.51</td>
<td>6.54</td>
</tr>
<tr>
<td>% RUP Nitrogen</td>
<td>52.43</td>
<td>82.30</td>
</tr>
<tr>
<td>% RUP Amino Acid</td>
<td>38.30</td>
<td>59.82</td>
</tr>
<tr>
<td>Amino Acid Digestibility (%)</td>
<td>69.90</td>
<td>69.31</td>
</tr>
</tbody>
</table>

Key Words: Rumen undegradable protein, Fish meal, Continuous culture

T170 Effects of nonfiber carbohydrate source and protein degradability on lactation performance and ruminal pH of Holstein cows. C. C. Larson* and M. B. Hall, University of Florida, Gainesville, Florida, USA.

The effect of nonfiber carbohydrate (NFC) source and protein degradability on milk yield and composition and dry matter intake (DMI) were evaluated using 38 multiparous Holstein cows in a three period (21 d) partially balanced incomplete latin square design with a 3x2 factorial arrangement of treatments. Ruminal pH was evaluated with 6 ruminally cannulated dairy cows within the group. Dietary
treatments included three NFC sources (ground corn=starch=ST; molasses+ sucrose=sugar=SU; and citrus pulp=soluble fiber=sugar=SF) and two concentrations of ruminally undegradable protein (+ or -RUP) achieved by the addition or omission of expeller soybean meal (SoyPlus). The total mixed rations were isonitrogenous and provided ad libitum. Milk yield and DMI were measured daily. Milk samples were taken on days 15, 17, and 19 of the period for composition analysis. Feed efficiency (FE) was calculated as 3.5% fat- and protein-corrected milk kg / DMI kg. Data were analyzed using PROC MIXED with orthogonal contrasts (ST vs SF+SU; SF vs SU). Data presented are least squares means. DM was affected by NFC (P=0.09), but not RUP (P=0.64). SU gave a greater DM than SF (P=0.08). NFC affected milk yield (P=0.01), but RUP did not (P=0.82). Cows fed SU had higher milk yield than SF (P<0.01). NFC*RUP was significant for milk yield for the contrast of ST vs SF+SU (P=0.05). Milk fat kg was not affected by NFC (P=0.26) or RUP (P=0.69), but ST vs SF+SU differed for NFC*RUP (P=0.07). Milk protein kg was only affected by NFC with ST greater than SU+SF (P<0.01), and SU greater than SF (P=0.06). Milk urea N was affected by NFC (P=0.05) and RUP (P=0.07) with ST yielding greater values than SF+SU (P=0.02). FE tended to differ for NFC*RUP (P=0.10), with ST differing from SF+SU (P=0.04). Rummen pH differed with NFC (P<0.01), RUP (P=0.02), and NFC*RUP (P<0.01). We conclude that manipulation of dietary NFC source and protein degradability may be used to modify lactation performance.

### Key Words:
Nonfiber carbohydrates, Protein degradability, Milk production

### Table 171 Production and reproductive performance of dairy herds fed different amounts of phosphorus.

<table>
<thead>
<tr>
<th>Item</th>
<th>ST-RUP</th>
<th>ST+RUP</th>
<th>SF-RUP</th>
<th>SF+RUP</th>
<th>SU-RUP</th>
<th>SU+RUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, kg</td>
<td>24.9</td>
<td>25.0</td>
<td>24.0</td>
<td>23.7</td>
<td>25.1</td>
<td>24.6</td>
</tr>
<tr>
<td>Milk, kg</td>
<td>41.0</td>
<td>39.1</td>
<td>38.0</td>
<td>38.6</td>
<td>40.1</td>
<td>40.9</td>
</tr>
<tr>
<td>Fat, kg</td>
<td>1.37</td>
<td>1.30</td>
<td>1.27</td>
<td>1.37</td>
<td>1.38</td>
<td>1.39</td>
</tr>
<tr>
<td>Protein, kg</td>
<td>1.13</td>
<td>1.06</td>
<td>1.01</td>
<td>0.98</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td>Feed eff</td>
<td>1.58</td>
<td>1.48</td>
<td>1.51</td>
<td>1.58</td>
<td>1.53</td>
<td>1.56</td>
</tr>
<tr>
<td>MUN, mg/dl</td>
<td>13.6</td>
<td>13.2</td>
<td>13.1</td>
<td>12.1</td>
<td>12.8</td>
<td>12.2</td>
</tr>
<tr>
<td>Rummen pH</td>
<td>5.99</td>
<td>5.98</td>
<td>6.11</td>
<td>6.03</td>
<td>5.83</td>
<td>6.07</td>
</tr>
</tbody>
</table>

DM = dry matter intake; Feed eff = 3.5% fat- & protein-corrected milk kg/DMI kg; MUN = milk urea nitrogen

### Key Words:
Nonphosphorus, Reproduction, Dairy cows

### T172 The new French available phosphorus allowances for ruminants.

Faced to new challenges as safety of animal products and environmental concerns, a re-assessment of nutritional allowances is needed. Excessive phosphorus (P) runoffs in the animal wastes contribute to the deterioration of groundwater (eutrophication); in France, two thirds approximately of the 300 000 t. of P annually rejected by the livestock productions come from the ruminants. Thus it seems necessary to revalue the level of P supply to the ruminants. A meta-analysis of literature data where faecal endogenous losses were measured by isotopic dilution of P and some recent experimental data allow a new nutritional standard based on available (absorbed) P. Major changes related to former systems concern maintenance requirement (MR) and principally the true absorption coefficient (TAC) of the components of the diet. Only the irreducible part of faecal endogenous losses corresponds to the MR and is strongly linked to salivary P production; for this reason MR (g/d) is now related to dry matter intake (DMI; kg/d) and body weight (BW; kg). MR = 0.83 DMI + 0.002 BW (n = 68, R2 = 0.89, rsd = 1.05) for cattle and MR = 0.905 DMI + 0.3 + 0.002 BW (n = 192, R2 = 0.95, rsd = 0.17) for small ruminants. We adopted the allometric equations of the AFRC (1991) for ruminants to be considerably higher than 2 ppm. It seems plausible, therefore, to consider the maximum tolerable level of selenium fed to growing wether lambs for one year. Sodium selenite was added to provide 0.2, 2, 4, 6, 8, and 10 ppm Se to a basal diet. Thirty-nine crossbred wether lambs initially weighing 22.8 ± 3.3 kg were randomly allotted to one of six treatments. Blood samples were collected and liveweight gain determined at 28 d intervals and tissue samples were collected at experimental termination. Serum and whole blood, wool, hooves, bile and five tissues were analyzed for selenium concentrations. Five tissues at experimental termination were microscopically evaluated for tissue breakdown due to selenium toxicosis. Also five enzyme concentrations and albumin were determined that are suggestive of selenium toxicosis. Lamb body weights were not influenced by dietary selenium concentrations (P < 0.01). Both serum and whole blood selenium concentrations increased at each collection period as dietary selenium level increased (P < 0.01) and the serum had a dietary selenium level x time interaction (P < 0.01). The whole blood selenium content was 2-3 times greater than serum selenium content. There was a strong positive correlation (r = 0.92) between serum and whole blood selenium level. All tissues and wool, hoof, and bile selenium concentrations increased as dietary selenium level increased (P < 0.01). Liver had the highest selenium concentration followed by the kidney in all but the lowest treatments. Both gross and microscopic evaluation of tissues revealed no significant lesions for any treatment groups. There was no apparent pathological suggestion of selenium based on tissue evaluation. Albumin and serum enzyme levels suggestive of tissue breakdown as a result of selenium did not vary (P > 0.15) among the treatment, and enzymes were within their respective normal ranges. These results suggest that ≤ 10 ppm dietary selenium is not toxic to wether lambs over the course of a year. It seems plausible, therefore, to consider the maximum tolerable level of selenium for ruminants to be considerably higher than 2 ppm.

### Key Words:
Phosphorus, Requirements, Ruminants

### T173 Tolerance of inorganic selenium in wether sheep.

This experiment evaluated the maximum tolerable level of selenium fed to growing wether lambs for one year. Sodium selenite was added to provide 0.2, 2, 4, 6, 8, and 10 ppm Se to a basal diet. Thirty-nine crossbred wether lambs initially weighing 22.8 ± 3.3 kg were randomly allotted to one of six treatments. Blood samples were collected and liveweight gain determined at 28 d intervals and tissue samples were collected at experimental termination. Serum and whole blood, wool, hooves, bile and five tissues were analyzed for selenium concentrations. Five tissues at experimental termination were microscopically evaluated for tissue breakdown due to selenium toxicosis. Also five enzyme concentrations and albumin were determined that are suggestive of selenium toxicosis. Lamb body weights were not influenced by dietary selenium concentrations (P < 0.01). Both serum and whole blood selenium concentrations increased at each collection period as dietary selenium level increased (P < 0.01) and the serum had a dietary selenium level x time interaction (P < 0.01). The whole blood selenium content was 2-3 times greater than serum selenium content. There was a strong positive correlation (r = 0.92) between serum and whole blood selenium level. All tissues and wool, hoof, and bile selenium concentrations increased as dietary selenium level increased (P < 0.01). Liver had the highest selenium concentration followed by the kidney in all but the lowest treatments. Both gross and microscopic evaluation of tissues revealed no significant lesions for any treatment groups. There was no apparent pathological suggestion of selenium based on tissue evaluation. Albumin and serum enzyme levels suggestive of tissue breakdown as a result of selenium did not vary (P > 0.15) among the treatment, and enzymes were within their respective normal ranges. These results suggest that ≤ 10 ppm dietary selenium is not toxic to wether lambs over the course of a year. It seems plausible, therefore, to consider the maximum tolerable level of selenium for ruminants to be considerably higher than 2 ppm.

### Key Words:
Selenium, Sheep, Tolerance
Eight wether sheep were utilized in an experiment to determine the effect of diet forage: concentrate ratio on biotin balance. The pelleted diet included alfalfa, corn, soybean meal and corn oil. The four diets were formulated in percentages to contain forage:concentrate ratios as follows: A, 95:5; B, 50:50; C, 30:70; D, 10:90. Sheep were placed in metabolic crates and fed their respective diet for a period of ten days. The experiment was constructed as a 4x4 Latin Square in which the four groups of two sheep were fed a different diet (A-D) in each of the respective treatments. For each diet change there was a 20 d period; 10 days of adaptation with the 50:50 forage to concentrate diet followed by 10 days of the designated treatment diet. Feedings were conducted twice daily; 8:00am and 4:00pm. Total collection of feces and urine for determination of biotin balance was done twice daily on days 8, 9, and 10 of each period. Analyzed biotin for the four diets was 0.176, 0.157, 0.122 and 0.096 µg/g, respectively. Biotin balance was negatively higher (P<0.05) for the forage:concentrate ratio of 30:70 compared to the highest forage or concentrate diets due to the high (P<0.05) fecal biotin concentrations.

Table 1. Biotin (µg) balance data (3d) 1.

<table>
<thead>
<tr>
<th>Diet</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>595±39 a</td>
<td>552±15 b</td>
<td>385±17 c</td>
<td>259±25 d</td>
</tr>
<tr>
<td>Feces</td>
<td>2588±210 b</td>
<td>3464±498 b</td>
<td>4763±1978 a</td>
<td>2588±211 b</td>
</tr>
<tr>
<td>Urine</td>
<td>402±76 b</td>
<td>278±58 c</td>
<td>371±40 c</td>
<td>378±176 c</td>
</tr>
<tr>
<td>Balance</td>
<td>-2395±229 b</td>
<td>-191±524 b</td>
<td>-4748±961 b</td>
<td>-2707±221 b</td>
</tr>
</tbody>
</table>

1 Means ± S.E. Means with different superscripts, within a row, differ (P<0.05).

Key Words: Biotin, Sheep, Balance

Production, Management, and the Environment

A total of 791 sheep in two research flocks at the University of Wisconsin-Madison were used to study the effectiveness of three types of electronic rumen boluses for individual animal identification. One flock consisted of dairy sheep and the other of meat and wool sheep. All sheep carried at least one ear tag with a unique number for identification. The three types of electronic rumen boluses consisted of ISO radio frequency transponders of different technology encased in capsules of different size and construction: B1 (full duplex; 20×74 mm, 70 g, white plastic cover), B2 (half duplex; 21×68 mm, 79 g, white ceramic cover), and B3 (half duplex; 12×42 mm, 16 g, brown ceramic cover). Boluses were given orally to all sheep (rams, adult ewes, ewe lambs) on a farm on the same day by both trained and untrained operators using appropriate balling guns. Bolus readability was checked immediately before and after administration to ensure that only functional boluses were administered and present in each sheep. Boluses in all sheep were read 1 d following administration, approximately one wk later, and at approximately 1 mo intervals thereafter through d 102 using handheld transceivers. Animals ranged in weight from 25 to 145 kg in body weight at the time of bolus administration, and there were no injuries or deaths from bolus administration. Application time averaged 71.4 s and was affected by operator (P < 0.05). Application time was greater (P < 0.05) for rams than for adult ewes or ewe lambs. Approximately 102 d after administration, bolus readability varied by sheep group (rams, 86.8%; ewes, 92.0%; ewe lambs, 86.0%; P < 0.05) and bolus type (B1, 63.2%; B2, 95.5%; and B3, 98.7%; P < 0.001). The B1 bolus was insufficiently readable for ICAR requirements of 98% readability, but the B2 and B3 boluses were very effective in electronic identification of sheep.

Key Words: Sheep, Electronic identification, Rumen bolus

The objective was to determine effects of VFA on the extent of assimilation of ammonia N into amino acids and urea by isolated ruminal epithelial (REC) and duodenal mucosal cells (DMC) in short-term incubations. Cells were isolated from growing Polypay ram lambs (n=4) fed a mixed forage-concentrate diet, and incubated for 90 min in media containing [15N]ammonia and glucose plus either acetate or propionate (5 mM each). Production of Ala, Asp, Glu, Arg + citrulline, and urea, and [15N]enrichment were determined by gas chromatography-mass spectrometry. In all tissues, the total release of Ala, Arg, Arg + citrulline, and urea was not affected by VFA treatment. However, for REC, assimilation of ammonia N into Glu (0.51 vs. 0.40 nmol; P<0.05) was greater, and that into Asp (0.19 vs. 0.15 nmol; P = 0.07) and Ala (0.64 vs. 0.40 nmol; P = 10) tended to be greater for acetate compared to propionate treatment. However, ammonia N was not incorporated into Arg + citrulline and urea by REC. For DMC, assimilation of ammonia N into Ala, Asp, and Glu was also greater for acetate (1.57, 0.69, and 2.07 nmol, respectively) compared to propionate treatment (0.86, 0.46, and 1.37 nmol, respectively; all P < 0.05). Utilization of ammonia N for Arg + citrulline synthesis tended to be greater for acetate compared to propionate treatment (0.75 vs. 0.49; P = 0.08), but ammonia N was not incorporated into urea. In summary, ruminal gut tissues are capable of assimilating ammonia N into amino acids, and VFA type affects the extent of ammonia N utilization for amino acid synthesis.

Key Words: Ruminal epithelial cells, Duodenal mucosal cells, Ammonia utilization
ammonia emission (mg per m

Wood

by week interaction (P

Ammonia emissions, Aluminum sulfate, Calf hutches

Key Words:

calves housed in hutches treated with alum. Incidences of respiratory

istted due to treatment. There was a trend (P

hutches when calves were 4 and 8 weeks of age at 1400 h when ambient

treatments and maintained in the hutches with no additional bedding

arameters evaluated. Twenty eight hutches (Calf-Tel

Growth performance and health of dairy calves bedded with different types of materials. R. Panivivat*1, J. A. Pennington2, E. B. Kegley1, D. W. Kellogg2, and S. L. Krumpellman1, 1University of Arkansas, Fayetteville, 2University of Arkansas Cooperative Extension Service, Little Rock.

Granite fines (GF), sand (S), rice hulls (RH), long wheat straw (ST) and wood shavings (WS) used as bedding for 60 heifer calves were compared at Ark-Tenn Dairy Research and Development Facility, a commercial 1100-cow dairy in central Arkansas. Growth, health, stress indices, behavior, physical characteristics and bacterial counts of bedding from d 1 to 42 were evaluated from August to October 2002. There were differences (P < 0.05) due to bedding type in dry matter intake (DMI) during wk 2. Calves housed on RH had the greatest and those housed on WS had the lowest DMI. Calves have average daily gain and DMI for the entire 42 d did not differ (P > 0.05) due to bedding type. Using a subjective cleanliness score (1= clean to 4 = dirty), calves housed on GF were the dirtiest in appearance. There was a bedding material by week interaction (P < 0.01) for the number of antibiotic treatments given for scour control. During wk 2 calves housed on GF and S were treated more often for scours than wk 1 and 2, calves housed on ST received the fewest antibiotic treatments. Serum cortisol, alpha-1 acid glycoprotein, and immunoglobulin G concentrations, and neutrophil:lymphocyte ratio were not affected (P > 0.05) by bedding type. On d 0, GF were harder than sand (P < 0.05), and all materials were harder than straw (P < 0.05). In addition, there were bedding material by week interactions (P < 0.05) for coliform counts (P < 0.05). On d 0, coliform counts were lowest in GF and greatest in RH. However, on d 14, 28 and 42, coliform counts were greatest in ST. On d 42 the concentration of ammonia, 10 cm above the bedding was lowest (P < 0.05) for ST. Growth performance of calves bedded for 42 d with five bedding materials did not differ. However, the number of antibiotic treatments given for scours and bacterial counts in the bedding did vary due to bedding type.

Key Words: Dairy calves, Bedding material, Bacterial Counts

T180 Effect of free-stall design on cow behavior and performance. R. J. Norell1, S. Mosley2, A. Ahmadzadeh2, and P. Deaton1, 1University of Idaho, Idaho Falls, 2University of Idaho, Moscow.

The objective of this study was to assess the effects of free-stall design on cow behavior and performance. Two groups of 18 lactating Holstein

cows were housed in two different free-stall pens and animals moved between pens according to a switchback statistical design. Free-stall treatments varied in dimensions, lunge space, and stall bed surfaces. Modern stalls (MOD) were wider (1.22m vs 1.14m), had taller stall divi-
ders (1.22m vs 0.91m), and had improved forward and sideways lunge space compared to the older design stalls (OLD). MOD stalls had neck rails and plastic bristle boards located 1.68m from the curb while OLD had neither component. Stall bases were deep beds of sand (OLD) or sand over commercial rubber filled mattresses (MOD). Cows were as-
signed to pairs based on parity and DIM then randomly assigned to groups for 90 d. Animals switched housing treatments on d 31 and again on d 61. Cow behavior in the free-stall area was scanned every 10 minutes throughout the trial with wireless digital cameras. Behavior comparisons utilized data from the last 4 d of each period while milk production comparisons utilized the last 7 d. Means and SE for stall occu-

pency, resting, standing in stall, daily resting periods and cow comfort index were: 73±7.2 vs 68±8±19 min/d; 67±2.22 vs 61±5±20 min/d; 61±1.10 vs 73±1±7 min/d; 6.9±0.3 vs 7.9±0.4 events/d, and 91±4±3 vs 89.1±1.0 percent for MOD and OLD, respectively. Treatment differences were as-

sessed by the Wilcoxon Two Sample Test (a non-parametric test). Cows spent more time occupying MOD stalls (p<0.001), more time resting in MOD (p<0.001), and had fewer daily resting periods (p<0.001) in MOD. Standing behavior (all four feet in stall or half-in/half-out) was significantly shorter in duration for MOD stalls (p<0.007). Cow comfort index for time divided by stall occupancy time was significantly higher (p<0.03) for MOD stalls. Milk production was not influenced by switching cows between housing treatments (p>0.5). We conclude that modern stalls significantly enhanced cow comfort by increasing daily resting time and decreasing time spent standing in the free-stall. In this study, improved cow comfort did not lead to higher milk production.

Key Words: free-stalls, behavior

T181 The effects of cooling strategy and level of milk production on milk constituents and body composition quality traits during summer heat stress in lactating Holstein dairy cattle. H. Evans1, 2, J. Murphey3, E. Cuadra4, T. Dickerson2, S. Gandy2, S. Willard2, and R. Vann*1, 1Brown Loam Branch Experiment Station, Raymond, MS, 2Mississippi State University, Mississippi State, MS, 3Coastal Plains Branch Experiment Station, Newton, MS, 4Alcorn State University, Alcorn State, MS.

The metabolic demands of milk production often draw on body energy reserves to fulfill the requirements of lactation. These demands can be further intensified by the effects of heat stress, which alone can nega-
tively impact production performance in lactating dairy cows. However, various cooling strategies can alleviate some of the detrimental effects of summer heat stress on metabolic processes and production performance. The objective of this study was to determine whether type of cooling system (Fan vs. Fan and Sprinkler) influences production performance, body composition (BC), and milk constituents (MC) in dairy cattle exposed to summer heat stress. Lactating Holstein cows (n=96) were as-
signed to groups (n=24/group) based on high (H; 28.0 ± 0.9 kg/d) and low (L; 21.8 ± 0.8 kg/d) milk production and cooling strategy as follows: H-Fan only (HF); H-Fan and Sprinklers (HFS); L-Fan only (LF); L-Fans and Sprinklers (LFS). Data was collected prior to milking every 14d over an 84-d period and included: respiration rate (RR; breaths/min), dor-
sal coat temperature using infrared thermometers (DIR; °C) and rectal temperature (RT; °C). Measurements by real-time ultrasound for BC consisted of percent intramuscular fat, gluteus medius depth and stress scores for IMF and GM muscle. Environmental temperature, relative humidity (RH), and temperature-humidity index were recorded daily throughout the trial. Milk samples were collected at 14-d intervals and analyzed for fat, protein, somatic cell count (SCC), and lactose. Cows in the HFS and LFS groups had lower (P<0.05) RT, DIR and RR than cows in the HF and LF groups. No differences (P>0.10) in MC were observed relative to level of milk production (H vs. L) for SCC and lactose, however protein and fat were lower (P<0.01) in H than L cows. Milk fat, protein, and SCC did not differ (P>0.10) between F and FS groups, however lactose was lower (P<0.05) in the F-only compared to the FS group. Body composition traits did not differ (P>0.10) between F and FS groups, however both GM stress and IMF stress were higher (P<0.05) in the H than L milk production groups. In summary, while cows in the FS groups were less affected by heat stress than cows in the
F-only groups, body composition traits and most milk constituents were not influenced by cooling strategy.

Key Words: Milk production, Holstein, Body composition

T182 Relationships between body condition score and peak milk in Holsteins. M. L. Theurer*, M. A. McGuire1, and J. J. Higgins2, 1University of Idaho, Moscow, 2Standard Nutrition, Richland, WA.

Two hundred fifty-two Holstein cows were assigned body condition scores (BCS) in the close up pen through mid lactation to evaluate changes in BCS and their relation to milk production. The cows were housed at three commercial dairies in central Washington. Two individuals assigned BCS on a 5 point scale by 0.25 points beginning about 14 d before parturition, continuing monthly until approximately 140 DIM, without knowledge of previous scores. Using the REG procedure of SAS, peak milk yield was regressed with close up BCS and change in BCS as independent variables. The mean close up BCS was 3.30 with a range from 1.88 to 4.63. Regression analysis determined that no relationship existed between peak milk and close up BCS or change in BCS. To further determine if BCS had any effect on peak milk production, cows were grouped for analysis into three groups by close up BCS > 3.5, 3.0 < close up BCS ≤ 3.5, close up BCS ≤ 3.0 (n = 65, 110, and 77, respectively) or change in BCS > 0.75, 0.5 < change in BCS ≤ 0.75, change in BCS ≤ 0.5 (n = 91, 73, and 88, respectively). Peak milk by close up BCS and change in BCS group was analyzed using the GLM procedure of SAS with LS means reported. Peak milk yield for the high, mid, and low close up BCS groups (46.6, 47.5, and 49.2 kg, respectively; SEM = 1.0) did not affect peak milk production. Similarly change in BCS did not affect peak milk production. Peak milk production in Holstein cows is driven by factors other than close up BCS or body condition loss in early lactation.

Key Words: Body condition loss, Early lactation, Milk yield

T183 BeefSys: An interactive database program for on-going experiments and archival of livestock data. F. M. Rouquette, Jr.*, K. D. Norman, G. M. Clary, and C. R. Long, Texas A&M University Agricultural Research & Extension Center, Overton, TX/USA.

Efficient, effective, and sustained use of data depends on interactive use of current information and a method of archiving previously collected data. BeefSys has been developed by the Texas Agricultural Experiment Station and the Texas Beef Initiative to provide a data storage site to accommodate all phases and relevant data on beef production including climate, soils, forage, and birth-to-harvest data. BeefSys resides on a computer which runs the Linux Operating System. The database software used to manage BeefSys is MySQL, which is the most popular open source database server and was designed for speed, power, and precision in mission-critical, heavy load use. BeefSys is not an open database, but rather offers a security code for the user who has exclusive use of specific records and can control other user access. BeefSys is accessed via the Internet using a web browser. Data can be downloaded into BeefSys from Excel, Access, etc. spreadsheet format or entered directly. All data input is backed up on external storage media on a routine basis. The user can retrieve very detailed data (i.e. all calves of a particular cow including birthing and weaning data), or summary data (i.e: average carcass traits of a breedtype for a 20-yr period that received supplement during the stocker phase). Currently, there are 70 fields in the expandable template. The initial data sets to test BeefSys consisted of more than 6,000 records for cow-calf, stockers, feeders, and carcass data collected during a 30-year period at TAMU-Overton. A secondary priority of SAS with LS means reported. Peak milk by close up BCS groups (46.6, 47.5, and 49.2 kg, respectively; SEM = 1.0) did not affect peak milk production. Similarly change in BCS did not affect peak milk production. Peak milk production in Holstein cows is driven by factors other than close up BCS or body condition loss in early lactation.

Key Words: Body condition loss, Early lactation, Milk yield

T184 Contribution of manure and legume nitrogen to crop fertilization plans of Wisconsin dairy farms. B. J. Towns* and M. A. Wattiaux, University of Wisconsin-Madison.

Producers should be encouraged to maximize the use of manure and legume nitrogen (N) to limit fertilizer purchases and risks of environmental pollution. Our objective was to determine the N-credit, that is, the contribution of manure and legume N to total crop N needs on mixed dairy/cropping operations, assuming producers fertilize crops according to current guidelines. Descriptive data were collected on nitrate testing using solid manure (SM) handling systems and nine farms using liquid manure (LM) systems for years 2000 and 2001. Cows, hectares (ha), and animal units (AU) were 91±10, 136±36, 184±27 and 611±101, 482±101, 929±144 for SM and LM farms, respectively. A "de-facto" N credit (kg/ha) was calculated as: (Total Crop N Recommended - Imported Fertilizer N)/N-Required Ha. A de-facto N credit (%) was calculated as: (Total Crop N Recommended - Imported Fertilizer N)/Total Crop N Recommended. University of Wisconsin-Extension guidelines were followed to calculate crop N recommendations. The de-facto estimates represent crop N supplied by sources other than imported fertilizer. Despite large differences in AU for SM and LM farms, AU/N-Required Ha were similar and averaged 4.8±12.2 and 4.5±0.7, respectively. De-facto N credit for all operations was 115±2 kg/ha for SM and 0.7±0.6% of total crop N recommendations. There was no difference (P>0.10) between SM and LM farms as de-facto N credits were 71±8% (117±12 kg/ N-Required Ha) and 65±12% (113±21 kg/ N-Required Ha) of the total crop N recommendations, respectively. Imported fertilizer averaged 48±38 and 57±58 kg N N-Required Ha for SM and LM farms, respectively. De-facto N credit was not correlated with cows, AU, N-Required Ha, or total hectares. This research indicates that producers rely heavily on manure and legume N in their crop fertilization plans because imported fertilizer accounted for only 32% of total crop N recommendations. Contributions of manure and legume N as crop fertilizer were similar between small producers on SM systems and large producers on LM systems.

Key Words: Manure credits, Legume credits, Dairy

T185 Impact of manure application timing in dairy pastures on the migration of nitrates to groundwater. T. Downing*, B. Lambert, and M. Gamroth, Oregon State University.

Manure application to pastures is a common management practice among dairy farmers. Manure application can increase pasture crop production and minimize manure storage and handling costs. The amount and timing of these manure applications may be important because of agronomic and environmental implications. Excess nitrogen, not absorbed by the pasture vegetation can leach past the root zone and into groundwater. High nitrate levels in groundwater can lead to health risks. A year-long study was conducted on grazing pastures at two dairy farms to monitor potential nitrate movement from the surface through the soil profile toward groundwater. Precipitation, irrigation, manure application, and grazing were compared to nitrate movement. Both sites were planted in cool season perennial pasture, comprised of rye grass and orchard grass. Both pastures were part of rotational grazing systems and receive periodic applications of manure by cattle and by typical manure application equipment. Sampling devices were located in the center of operational fields. A total of nine sampling wells (lysimeters) were installed at depths of 1.3, 1.6 and 1.5 m below the surface of each pasture. Each depth was replicated three times at each site. Water samples were taken every two weeks at each site and tested for nitrate-N. Manure application, forage harvests, and commercial fertilizer application records were recorded. Rainfall measurements were estimated using local weather data. Farm A applied a total of 600 kg N/hectare throughout the year while farm B applied approximately 300 kg. Farm A nitrate values averaged at 15.2 ± 12.2 ppm, 6.5 ± 6.9 ppm and 2.9 ± 3.6 ppm at 1, 1.3 and 1.6 m respectively. Farm B nitrate values averaged 13.8 ± 8.5 ppm, 8.5 ± 5.7 ppm, and 1.3 ± 2.9 ppm at 1, 1.3 and 1.6 m. No relationship between farming activity and nitrate movement was noted. In addition, irrigation appeared to have no influence on nitrate movement. Substantial rainfall (>15 cm per two week period) appears to be the major factor in nitrate movement.

Key Words: Nitrate, Nitrogen leaching

**T189** The effects of irrigation of soil and stage of harvest on mineral contents of grasslands located at high altitude. A. Hajiryi1,2, I. Kaya3, K. Haliloglu4, and B. Karademir4.
1 Dept. of Animal Nutrition, School of Veterinary Medicine, Atatürk University, Erzurum 25700, Turkey, 2 Dept. of Animal Nutrition, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey, 3 Dept. of Agronomy, College of Agriculture, Atatürk University, Erzurum 25100, Turkey, 4 Dept. of Internal Medicine, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey.

In this study, the effects of soil irrigation and maturity stage on mineral concentrations were evaluated on 4 irrigated and 4 non-irrigated grasslands located at altitude of 2100 m. Grasslands were irrigated for one week and composites of plant subsamples (n = 10) from each grassland were pooled by cut with 14-d interval (n = 5) between May 21-July 30, 1999. The model included main effects of soil irrigation and maturity stage and their interaction in 2-way ANOVA. Irrigation did not affect soil pH (6.92), and clay (28.84%), sand (39.1%), OM (6.69%), K (50.60 Meq/g), Ca (1.22%), Mg (3.17 g/kg), Al (0.05 ppm), Ba (1.27 ppm), Co (0.07 ppm), Cu (1.82 ppm), Fe (0.61 ppm), Mn (8.14 ppm), Zn (0.38 ppm), and Sr (2.54 ppm) levels. However, concentrations of Na (109.6 vs. 39.9 mg/kg), P (19.1 vs. 4.68 g/kg), Cd (0.02 vs. 0.001 ppm), Cr (0.09 vs. 0.001 ppm), Ni (1.62 vs. 0.97 ppm), and Pb (0.39 vs. 0.07 ppm) were greater in irrigated soils than non-irrigated soils. Concentrations (ppm) of Mn (79.62), Al (472.6), B (8.27), Ca (2.55), Mg (3.64), Mn (0.57), Zn (0.90), Cu (2.44), Fe (0.61 ppm), and V (4.20) in plants were not affected by irrigation. However, concentrations of plant K (262.6 vs. 220.8 Meq/g) (P = 3.24 vs. 2.62 g/kg), Mg (1.71 vs. 1.47 g/kg), S (555 vs. 529 g/kg), Na (0.87 vs. 0.52 g/kg), and Zn (19.09 vs. 13.52 mg/kg) were greater in Ca (4.18 vs. 5.60 g/kg) and Sr (6.71 vs. 12.11 mg/kg) levels were lower in irrigated grasslands than non-irrigated grasslands. There was no effect of stage of maturity on plant Mg, S, Mn, Na, Al, Ba, Ca, Cr, Fe, Li, Se, and V levels. There were linear decreases in concentrations of plant K from 258.8 to

**Forages & Pastures**

**T188** Forage mineral concentrations in West Virginia pastures. E. B. Rayburn, W. L. Shockey9, and R. M. Wallbrown, West Virginia University, Morgantown, WV.

Mineral nutrition of grazing livestock is directly related to pasture mineral content. Livestock mineral intake varies because pasture forage species are not constant, fertilizer application varies, and most pastures are not tested for mineral content. An evaluation of pasture mineral status was conducted over 5 years (1997 through 2001) and involved the cooperation of 17 extension agents in 18 counties. Objective was to develop a livestock mineral supplement that would insure adequate mineral intake for livestock grazing West Virginia pastures. Data represent over 105 site-years with monthly samples taken randomly from selected farms. Forage samples were analyzed by commercial laboratory for protein, fiber, and mineral content. Mineral concentration mean and 10, 50 and 90 percentile values were Ca 1.08, 0.30, 0.88, 2.08; Na 0.237, 0. 009, 0.020, 0.070; and Zn 34.7, 20.0, 21.0, 109.6, 39.9 mg/kg, P (19.1 vs. 4.68 g/kg), Cd (0.02 vs. 0.001 ppm), Cr (0.09 vs. 0.001 ppm), Ni (1.62 vs. 0.97 ppm), and Pb (0.39 vs. 0.07 ppm) were greater in irrigated soils than non-irrigated soils. Concentrations (ppm) of Mn (79.62), Al (472.6), B (8.27), Ca (2.55), Mg (3.64), Mn (0.57), Zn (0.90), Cu (2.44), Fe (0.61 ppm), and V (4.20) in plants were not affected by irrigation. However, concentrations of plant K (262.6 vs. 220.8 Meq/g) (P = 3.24 vs. 2.62 g/kg), Mg (1.71 vs. 1.47 g/kg), S (555 vs. 529 g/kg), Na (0.87 vs. 0.52 g/kg), and Zn (19.09 vs. 13.52 mg/kg) were greater in Ca (4.18 vs. 5.60 g/kg) and Sr (6.71 vs. 12.11 mg/kg) levels were lower in irrigated grasslands than non-irrigated grasslands. There was no effect of stage of maturity on plant Mg, S, Mn, Na, Al, Ba, Ca, Cr, Fe, Li, Se, and V levels. There were linear decreases in concentrations of plant K from 258.8 to
T190  Effects of soil irrigation and maturity stage on organic macronutrient composition and nutritive value of grasslands at high altitude. I. Kaya¹, A. Hayirli², K. Haliloglu³, and S. Yildiz⁴, ¹Dept. of Animal Nutrition, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey, ²Dept. of Animal Nutrition, School of Veterinary Medicine, Ataturk University, Erzurum 25700, Turkey, ³Dept. of Agronomy, College of Agriculture, Ataturk University, Erzurum 25100, Turkey, ⁴Dept. of Physiology, College of Veterinary Medicine, Kafkas University, Kars 36100, Turkey.

Effects of soil irrigation (SI) and maturity stage (MS) on nutrient composition and nutritive value of grasslands located at altitude of 2100 m were studied. Four of 8 grasslands were irrigated after each cut (n = 5, with 14-d interval between May 21-July 30, 1999). Fooled plant composites (n = 10) by grassland at each cut were analyzed for CP, OM, NDF, CF, EE, and ash. Three cuttled grasses were utilized for nutritive value. Kinetic parameters for degradability of nutrients were assessed using equation P = a + b(1-e^-c), where P = degradability (%), a = soluble and readily degradable fraction, b = insoluble and slowly degradable fraction, and c = rate constant, and t = time relative to incubation time (h). For effective degradability (Pe), passage rate was assumed to be 0.02, 0.05, and 0.08% per h. Two-way ANOVA was used in data analyses. There was no effect of SI on OM (90.8), CP (16.1), NFE (43), and ash (9.2) levels (%), but DM (25.1 vs. 32.0%) and EE (1.8 vs. 2.0%) were lower and NDF (60.1 vs. 55.7%) was greater in irrigated grasslands than non-irrigated grasslands. There was no effect of SI on OM, EE, NFE, and ash, but NDF were linear increases in DM from 28 to 33%, and 28 to 30% in OM, NDF from 59% to 65% at 2 and 5% for CF. SI affected linear decrease in CP from 20.8 to 10.4% as MS advanced. There was no effect of SI by MS interaction on nutrient density. SI did not affect parameters “c” (0.06), lag phase (2), and Pe at 2 (76.3), 5 (66.6), and 8% (61.3) for CP, but parameter “a” (43.3 vs. 39.4) was greater and parameter “b” (45.7 vs. 48.8) was lower for irrigated grasslands than for non-irrigated grasslands. Parameter “a” and Pe at 2, 5, and 8% decreased and lag phase increased linearly as MS advanced. SI affected only parameter “a” for CF (3.6 vs. 5.3 for irrigated vs. non-irrigated grasslands) and average of parameters “b” and “c”, lag phase, and Pe at 2, 5, and 8% was 75.9, 0.06, 2.4, 58.8, 42.9, and 34.5, respectively. MS linearly decreased parameters “a”, “b”, and Pe at 2, 5, and 8% for CF. Regardless of MS, SI mainly affects plant fiber level and its effects on nutritive value seem to be related to changes in nutrient compositions.

Key Words: Organic macronutrient, Irrigation of forage, Stage of Maturity

T191  Nitrate concentration of cereal forage species at three stages of maturity. L.M.M. Surber*, S. D. Cash, J.G.P. Bowman, and M. C. Meuchel, Montana State University, Bozeman, MT USA.

Cereal forages have become an increasingly economical source of winter feed for livestock producers, comprising 11% of all hay harvested in Montana. Livestock producers need to be concerned with nitrate concentrations when feeding annual cereal forages. Six cereal forage species (18 varieties) were grown in a randomized complete block design field trial (r = 4) under irrigated conditions in Bozeman, MT, and were used to test the effects of cereal forage species and stage of maturity on forage nitrate concentration. Plots were 1.5 x 6.10 m in length and spaced 0.46 m apart. Forage clip samples were collected at three stages of plant maturity: boot, anthesis and when the plots were harvested for hay (milk stage of maturity). A 0.15 m clip sample of one row was cut at stubble height and dried at 60°C for 48 h. Forage clip samples were ground to pass a 1-mm screen in a Wiley mill and evaluated for DM and nitrate-nitrogen (NO₃-N). The range in NO₃-N was from 0.01 to 0.55% (CV = 47.2%). There were significant (P < 0.05) cereal forage species responses and stage of maturity effects on NO₃-N concentration. Nitrate-nitrogen concentration at the boot stage of maturity did not differ (P > 0.05) when compared to the anthesis stage of maturity (avg. 0.244 %). However, NO₃-N concentration at harvest was 36% lower than at anthesis (0.168 vs. 0.230 %). Barley forage NO₃-N was similar (P > 0.05) when compared to emmer, triticale and wheat x spelt crosses (avg. 0.195 %) and lower (P < 0.001) when compared to oats and spelt forage (0.186 vs. 0.341 and 0.258 %, respectively). Barley forage NO₃-N concentration was highest (P < 0.05) at the boot stage, intermediate at anthesis and lowest at harvest (0.230, 0.195 and 0.131 %, respectively). Oat forage maintained high NO₃-N concentrations at all growth stages (P > 0.05; avg. 0.341%). It appears that stage of maturity and cereal forage species greatly affect NO₃-N concentration. Also, NO₃-N concentrations of various cereal forage species respond differently at boot, anthesis and harvest. This implies that different harvest management must be implemented for oats compared to other cereal forage species.

Key Words: Cereal forage, Stage of maturity, Nitrate concentration

T192  Relationship of ADICP and NDICP to crude protein and soluble protein in forages fed to dairy cattle. R. T. Ward¹, M. J. Stevenson*, and R. A. Patton¹, ¹Cumberland Valley Analytical Service, Mauquaisville, MD, ²Degussa Canada, Inc., Burlington, ON, ³Nittany Dairy Nutrition, Millington, PA.

New computer models for balancing rations as well as 2001 NRC depend on measurement of ADICP and NDICP for accurate prediction of energy content of forages. Accurate predictions of either ADICP or NDICP could reduce cost of analysis. As part of the development of a database for the Amino Cow-Mepron Ration Evaluator, we examined the relationships between ADICP and NDICP to CP and soluble protein (SP). In this study ADICP, NDICP, CP and SP were determined chemically as a percent of dry matter. Simple correlations and regression equations were developed using PROC CORR and PROC REG of SAS. Means, standard deviations and simple correlations are presented below. Overall relationships between ADICP and NDICP among DM, CP, SP, ADF and NDF were weak (i.e. no regression equations with R² greater than .55). The magnitude of ADICP and NDICP values significantly affect calculation of energy and protein flows in ration formulation. Since accurate prediction of these terms does not appear to be feasible, ADICP and NDICP should be analyzed. These data are generally consistent with the values reported in 2001 NRC.

<table>
<thead>
<tr>
<th>Feed</th>
<th>N</th>
<th>ADICP</th>
<th>SD</th>
<th>CP</th>
<th>R²</th>
<th>SP</th>
<th>R²</th>
<th>CP</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa hay</td>
<td>1017</td>
<td>1.43</td>
<td>0.43</td>
<td>.02</td>
<td>.33</td>
<td>3.14</td>
<td>1.56</td>
<td>.05</td>
<td>.45</td>
</tr>
<tr>
<td>Alfalfa silage</td>
<td>978</td>
<td>1.78</td>
<td>0.58</td>
<td>.07</td>
<td>.19</td>
<td>3.40</td>
<td>1.28</td>
<td>.03</td>
<td>.54</td>
</tr>
<tr>
<td>Corn</td>
<td>3793</td>
<td>1.05</td>
<td>0.27</td>
<td>.25</td>
<td>.00</td>
<td>1.60</td>
<td>0.50</td>
<td>.35</td>
<td>.16</td>
</tr>
<tr>
<td>Grass hay</td>
<td>236</td>
<td>1.51</td>
<td>0.67</td>
<td>.16</td>
<td>.04</td>
<td>4.10</td>
<td>1.78</td>
<td>.26</td>
<td>.03</td>
</tr>
<tr>
<td>Grass silage</td>
<td>160</td>
<td>1.68</td>
<td>0.63</td>
<td>.15</td>
<td>.18</td>
<td>3.57</td>
<td>1.33</td>
<td>.31</td>
<td>.15</td>
</tr>
<tr>
<td>Mixed legume</td>
<td>266</td>
<td>1.98</td>
<td>0.55</td>
<td>.05</td>
<td>.12</td>
<td>3.75</td>
<td>1.20</td>
<td>.33</td>
<td>.42</td>
</tr>
<tr>
<td>Sorghum hay</td>
<td>114</td>
<td>1.64</td>
<td>0.60</td>
<td>.60</td>
<td>.13</td>
<td>2.44</td>
<td>0.97</td>
<td>.51</td>
<td>.05</td>
</tr>
<tr>
<td>Wheat silage</td>
<td>119</td>
<td>1.22</td>
<td>0.33</td>
<td>.09</td>
<td>.07</td>
<td>1.98</td>
<td>0.84</td>
<td>.38</td>
<td>.05</td>
</tr>
</tbody>
</table>

Key Words: ADICP, NDICP, Forages

T193  Relationship of starch content in common forages to dry matter, crude protein, non-fiber carbohydrate and neutral detergent fiber. R. T. Ward¹, M. J. Stevenson*, and R. A. Patton¹, ¹Cumberland Valley Analytical Service, Mauquaisville, MD, ²Degussa Canada, Inc., Burlington, ON, ³Nittany Dairy Nutrition, Millington, PA 17844.

Improvement in prediction of microbial protein synthesis requires better knowledge of nutritionally relevant carbohydrate amounts in feedstuffs. Although data exists for starch in grains and byproducts, few data are available for forages. Analytical variation was minimized by using results from one laboratory using current best practice for starch analysis. Samples varied widely in quality / nutrient content. Our objective was to determine whether starch content could accurately be predicted by more traditionally measured nutrients. CP, NDF, and starch were determined chemically, while NFC was determined by difference. Investigations of relationships was by the PROC REG of SAS using the Maxim
option. Equations that improved the $R^2$ less than 5 percent were rejected. Starch contents are presented below (DM basis). Regression for starch as a percent of NFC was always less significant than as a percent of dry matter except for grass hay where $R^2 = .73$. Due to high standard deviation and low correlations, this data suggests that starch should be expressed as a percent of dry matter only. Accuracy in prediction of starch content from other constituents was only achieved for silages with high starch content.

<table>
<thead>
<tr>
<th>Feed</th>
<th>N</th>
<th>Mean ± Std Dev</th>
<th>Min</th>
<th>Max</th>
<th>Regression Equation</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa hay</td>
<td>121</td>
<td>6.00 ± 1.05</td>
<td>1.00</td>
<td>11.70</td>
<td>0.058*NFC</td>
<td>0.78</td>
</tr>
<tr>
<td>corn silage</td>
<td>89</td>
<td>2.51 ± 1.57</td>
<td>0.00</td>
<td>7.00</td>
<td>0.084<em>C+0.29</em>IP</td>
<td>0.68</td>
</tr>
<tr>
<td>Grass hay</td>
<td>12</td>
<td>5.89 ± 1.93</td>
<td>2.00</td>
<td>7.00</td>
<td>0.087*NDF</td>
<td>0.69</td>
</tr>
<tr>
<td>Mixed legume- grass silage</td>
<td>21</td>
<td>3.71 ± 3.23</td>
<td>0.50</td>
<td>13.90</td>
<td>0.058*IP</td>
<td>0.68</td>
</tr>
<tr>
<td>Sorghum silage</td>
<td>57</td>
<td>3.41 ± 2.11</td>
<td>0.60</td>
<td>2.00</td>
<td>0.096*NDF</td>
<td>0.67</td>
</tr>
<tr>
<td>Wheat silage</td>
<td>27</td>
<td>3.56 ± 2.08</td>
<td>0.90</td>
<td>8.30</td>
<td>0.096*NDF</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Key Words: Sugar, Forage


Legume-grass silage (LGS; n = 210) and corn silage (CS; n = 300) samples were collected from submissions to the Marshfield Forage Laboratory, Marshfield, WI. Samples were dried and ground for chemical or NIR determinations. Samples were scanned on a Model 6500 near infrared reflectance spectrophotometer and spectra retained. Center and select procedures using Infrasoft International software (version 2) were implemented, resulting in 90 and 70 spectrally different LGS and CS samples retained for NIRS equation development. Forages were evaluated for CP,ADF CP,NDF, NDF CP, 48 hr in vitro NDF digestibility (dNDF, % of DM), fat, and ash which are required for the NRC, 2001 summative (forage energy) prediction model. Lignin was not determined and dNDF was substituted as the digestible NDF fraction as prescribed by the NRC, 2001. The NIRS cross validations ($r^2$) for CP, ADF CP, NDF, NDF CP, dNDF, fat and ash were 0.97, 0.70, 0.96, 0.35, 0.87, 0.52, and 0.51 for CS and were 0.93, 0.71, 0.94, 0.75, 0.79, 0.53, and 0.73 for LGS, respectively. Data suggest NIRS prediction of ADF CP, NDF CP, fat, and ash content of forages has limitations. Data also suggest prediction of dNDF via NIRS has limitations and may be co-dependent with NDF prediction. Nutrient composition of each forage as determined by laboratory chemistry (LC) or NIRS was then used in NRC, 2001 summative (forage energy) prediction models and TDN for each forage was determined. The TDN determinations for the forages were compared to 48% in vitro, organic matter (DOM, % DM) digestibility. The relationship ($r^2$) between NRC, 2001 predicted TDN and dOM was 0.98 and 0.98 for LGS and CS, respectively, when components were determined LC. When NIRS was used to determine model components, the relationship between NRC, 2001 predicted TDN and dOM of forages was 0.78 for CS and 0.69 for LGS. Data indicates some nutrient components in forage required by the NRC, 2001 summative (forage energy) models are poorly predicted by NIRS, ultimately reducing the utility of NIRS to predict forage energy content.

Key Words: Feed sampling, Quality control, Quality costs

T196 Optimal sampling schedule of diet components. B. Cobanov* and N. R. St-Pierre, The Ohio State University.

Various recommendations have been issued regarding sampling schedules of diet components, especially forages. Their bases are unclear and none are justified from an economic standpoint. The process of forage removal from storage can be conceptualized as a quality control issue that can be monitored using a Shewhart X-bar chart. This procedure requires three inputs: number of samples (n), frequency of sampling (h), and control limits (L). All three affect the performance of the chart and, thus, the total cost of quality. A quality cost function made of four parts is proposed: cost per cycle while the process is in-control (A); cost per cycle while the process is out-of-control (B); cost per cycle for sampling and analyses (F); and expected duration of a cycle (D). A = Co / J, where Co is quality cost/d while producing in control, and J = 1/mean time process is in control. B = C1 (E - r - A2h + T1 + T2) + sY/Av + W, where C1 is quality cost/d while producing out of control, E = time to sample and analyze one item, $\tau = (1-(1+Jh)e^{-Jh})/(1+e^{-Jh})$ and is the expected time of occurrence of the assignable cause given that it occurs between the $i^{th}$ and the $(i+1)^{th}$ sample, $A_1 = 1/(1-\beta)$ and is the average run length while out of control, $T_1$ is the expected time to discover the assignable cause, $T_2$ is the expected time to fix the diet, $b$ is the probability(out of control signal — process is out of control), and $a = (1-\beta)/(1-\tau)$ and is the expected number of samples taken while in control, $\alpha = 1/\tau$ and is the average run length while in control, $\alpha$ is quality cost/d while producing out of control, $W = \text{cost to fix the diet}$. F = [$(n + b)/n + 1/J (1/1-\tau + A_2h + T_1 + T_2)$, where $a$ is the fixed cost per sample, and b is the cost per unit sampled. D = $1/J (1+Jh/e^{-Jh})$. The total quality cost per day (TCQ) = $(A+B+F)/D$. The TCQ function can be optimized with respect to n, h, and L to yield an optimal sampling schedule. Because of the highly nonlinear structure of the TCQ function, gradient-based optimization algorithms are not well suited for the optimization task. Instead, a modified genetic algorithm is proposed.

Key Words: Feed sampling, Quality control, Quality costs
mixing for 2 min, and then centrifuging. Samples were submerged in H:IP and stored in the dark at 8 °C at all times. The solvent from each extraction was partially evaporated and the fatty acids methylated by methanolic HCl. Repeated extractions increased the percentage of total fatty acids (P < 0.01) recovered from the DM. The concentration of fatty acids in the alfalfa after three extractions was 4.0%. The first, second and third extractions resulted in 92.6%, 4.77%, and 2.56% of the total fatty acids extracted, respectively. There was no effect of extraction on the proportion of 16:0, 18:0, 18:1 and 18:2 fatty acids (P > 0.05). However, the proportion of 18:3 in the extract decreased (P < 0.01) from the first to the second extraction. Therefore, the ratio of saturated to unsaturated fatty acid tended to increase from the first to the third extraction. The results of this experiment revealed that the profile of fatty acids can vary with the number of extractions performed. The higher amount of 18:3 in the first extraction may reflect the higher proportion of linolenic acid in the more easily extracted plant fractions.

Key Words: Alfalfa, Fatty acids, Fatty acid extraction

T198 The relationship between non-structural carbohydrates and total dry matter yield in cool season grasses. T. Downing1, A. Buyse1, and M. Gamrot1, 1Oregon State University.

The efficiency of grass nitrogen utilization by ruminants tends to be low, due partly to the slow rate of energy release in the rumen. When additional sugars are introduced to the rumen, microbial protein is increased. Recent research reports indicate forages bred for higher soluble sugars can increase milk production and animal growth rates over grasses with average sugar content. Additional work has suggested forage carbohydrate differences influence nitrogen utilization, as indicated by changes in nitrogen excretion in the urine. Authors theorized this was primarily due to differences in the microbial capture of rumen degradable nitrogen. Very little work has been done looking at the natural variations between cultivars in sugar content or the relationship between total non-structural carbohydrates and yield. The objectives of this trial were to evaluate the non-structural carbohydrate variation found in modern cool season grasses by studying the season and variety within an experiment. The data presented here are from a randomized block design replicated three times. Four commercially available varieties of orchard grass (Dactylis glomerata), eleven ryegrasses (Lolium perenne) and two brome grasses (genus Bromus) were included in the study. Plots were harvested mechanically throughout the growing season and yield data recorded. Total non-structural carbohydrates were analyzed each sampling day in April, July and October from each variety. Annual dry matter yields ranged from 14,446 to 21,550 kg per hectare averaging 18220 ± 1667. Average total non-structural carbohydrate values ranged from 14.7% to 22.5% averaging 19.3% ± 2.6. Total nonstructural carbohydrates and yield for each variety were compared using correlation analysis. For all varieties, total nonstructural carbohydrate values were negatively correlated (-.67) with total annual yield. Analysis of each variety by cutting indicated that the early (April) and late (October) total non-structural carbohydrate values were also negatively correlated with yield, -.52 and -.73 respectively. The mid-season cutting, however, showed a positive correlation (.16) between yield and total non-structural carbohydrate levels in grasses tested.

Key Words: Non-structural carbohydrates, Cool season grasses

T199 Influence on ration formulation of on-farm variability in methionine and lysine content of alfalfa haylage and corn silage. M. J. Stevenson1, A. Buyse1, 1Degussa Canada Inc., Burlington, ON; 2 Maple Leaf Feeds Agresearch, Burford, ON.

This study was conducted to determine the baseline variability of nutrients, including amino acids, in haylage and corn silage from a well-managed dairy farm. Samples were taken weekly over a 5-month period, a total of 21 indinisamples for the 21 feeding periods (P<0.05) standard deviations and coefficients of variation are shown below for the various nutrient analyses. CV's were generally above 10% for trace minerals and below 10% for macrominerals. The higher CV's associated with MET and LYS in corn silage reflect the low contents and have minimal effect on metabolizable supply. Sample rations using 10 kg DM from either of these forages were evaluated in the 2001 NBC dairy ration balancing program. Adjustment of methionine content +/- one S.D. from the mean did not affect duodenal methionine flow, and adjustment of lysine +/- one S.D. from the mean varied duodenal lysine flow by one gram. Effects of variation in amino acid content of forages can be negligible on well-managed dairy operations.

Key Words: Methionine, Lysine, Forage

T200 Effect of different storage forms of alfalfa hay on the digestion characteristics in Holstein steers. M. Lopez1, M. Cervantes1, and J. Guerre2. 1ICA. Universidad Autónoma de Baja California, Mexicali, 2Desert Research and Extension Center, University of California, Davis.

An experiment was conducted to evaluate the effect of different storage forms of alfalfa hay on the duodenal flow (DF) and the apparent intestinal digestibility (AID) of amino acids in Holstein steers. The forage was harvested in June, dried on the field, baled, and stored for six months under different conditions. The maximum air temperature at the site where the experiment was conducted ranged from 40 to 49°C. Five steers each adapted with cinnamal in rumen, proximal duodenum, and distal ileum, were used according to a 5 x 5 Latin square design. Treatments were: T1) hay stored under a metal roof, T2) hay stored in an oven at 45°C, T3) hay stored inside a refrigerated room at 22°C. The results were: DF (g/d). Arg 36.1, 27.3, 28.8, 36.0, 23.5; His 16.3, 12.4, 13.4, 15.8, 11.2; Ile 39.5, 30.8, 32.4, 38.9, 26.1; Leu 63.3, 48.8, 52.5, 63.6, 42.4; Lys 50.2, 38.3, 41.2, 42.7, 34.1; Met 29.4, 22.3, 24.1, 29.2, 22.7; Thr 51.5, 51.7, 53.6, 57.2, 53.8; Lys 59.6, 50.2, 38.3, 41.2, 37.6, 27.6; Thr 37.8, 29.7, 31.7, 38.4, 26.4; AID (%), Arg 68.7, 67.1, 67.6, 72.6, 67.9; His 50.6, 49.5, 50.8, 54.3, 52.8; Ile 58.9, 56.0, 56.5, 63.2, 57.2; Leu 59.1, 58.6, 56.8, 63.6, 57.6; Lys 59.6, 59.0, 60.5, 63.6, 61.8; Met 56.6, 56.1, 58.0, 61.2, 58.2; Phe 63.7, 59.5, 61.9, 66.8, 60.8; Thr 51.5, 51.7, 53.6, 57.2, 54.8; Arg 68.7, 67.1, 67.6, 72.6, 67.9; His 50.6, 49.5, 50.8, 54.3, 52.8; Ile 58.9, 56.0, 56.5, 63.2, 57.2; Leu 59.1, 58.6, 56.8, 63.6, 57.6; Lys 59.6, 59.0, 60.5, 63.6, 61.8; Met, 56.6, 56.1, 58.0, 61.2, 58.2; Phe 63.7, 59.5, 61.9, 66.8, 60.8; Thr 51.5, 51.7, 53.6, 57.2, 54.8, respectively. The DF of all the amino acids was higher (P<.01) when steers were fed the hay either stored without cover or inside the oven, as compared with the other storage conditions. Storing the hay inside a cool room produced the lowest DF of all the amino acids. The AID of all the amino acids was higher when the steers consumed the hay stored inside the oven; no difference was observed between the other storage systems. These data suggest that alfalfa hay stored at high temperatures produces bypass proteins in steers without affecting the intestinal digestibility of amino acids.

Key Words: Alfalfa hay, Storage, Amino acid digestibility

T201 Effect of method of conservation on the n-alkane C31 concentration of alfalfa and two temperate grasses. M. R. Reyes-Reyes1, S. E. Buntin1, E. S. Barajas-Torres2, I. C. Gavilan-Garcia2, and F. A. Castrejon-Pineda1, 1 Facultad de Medicina Veterinaria y Zootecnia, 2 Facultad de Quimica, Universidad Nacional Autonoma de Mexico.

The objective of the present study was to compare the effect of two methods of herbage conservation (freezing in liquid nitrogen or refrigeration) on the C31 concentration of two grasses (ryegrass and kikuyu grass) and alfalfa.

METHODOLOGY: Perennial ryegrass (Lolium perenne) and kikuyu grass (Pennisetum clandestinum) samples were collected at a site located at 2,800 m above sea level, where the mean temperature is 9.9 °C and mean annual rainfall is 1,800 mm. Alfalfasamles (Medicago sativa L. var. Puebla 76) were collected at a site located at 2,250 m above sea level, where the mean annual temperature oscillates between 15.0 and 13.1 °C.
12 and 18 °C and the mean annual rainfall is 625 mm. The aerial part of several plants from each forage species was collected, thoroughly mixed and sub-sampled. Refrigerated samples were kept in sealed plastic bags in a plastic cooler with blue ice. Frozen samples were placed inside small plastic bags and frozen in liquid nitrogen. The samples were transported to the laboratory and 24 hours later they were freeze-dried. Freeze-dried forage samples, worked in triplicate, were ground (1 mm) and subjected to a Soxhlet extraction, using an internal standard (C15) and n-heptane. The saponification procedure used ethanolic KOH and the reflux time was 3.5 hours. Samples were purified using a silica gel and n-heptane. The saponification procedure used ethanolic KOH and the reflux time was 3.5 hours. Samples were purified using a silica gel and n-heptane. The saponification procedure used ethanolic KOH and the reflux time was 3.5 hours. Samples were purified using a silica gel and n-heptane. The reflux time was 3.5 hours. Samples were purified using a silica gel and n-heptane.

RESULT: The forage x method interaction was significant (P<0.01). Refeeding did not decrease the concentration of C15 in alfalfa (218.2 vs 239.3 mg/Kg) and kikuyu grass (41.8 vs 50.7 mg/Kg), but in ryegrass (36.9 vs 36.3 mg/Kg) (SEM=2.9).

CONCLUSION: Freezing in liquid nitrogen appears to be a better method of forage conservation for n-alkane analysis than refrigeration, but there may be forage species differences.

Key Words: n-Alkane, Forages, Conservation

T202 The effect of milling on physical material lost through dacron bags of 53 micron pore size. C. W. Cruywagen*1, G. Bunge, and L. Goosen, 1University of Stellenbosch, South Africa.

Dacron bags of 53 μm pore size are typically used in in sacco trials to determine nutrient degradability values. The standard procedure recommended by the 2001 NRC Nutrient Requirements of Dairy Cattle involves the milling of feed samples through 2.2 mm screen. A certain proportion of a feed sample would be milled to extremely fine particles (EFP) that could potentially be washed out of the dacron bag. The proportion of EFP would depend on the type of feed, e.g. hay vs silage, alfalfa vs. wheat straw, etc. The presence of EFP could over estimate the soluble fraction of a nutrient which is usually determined by calculating the nutrient loss following a washing cycle in water. In the present study, samples of alfalfa hay and wheat straw were sieved through a 60 μm stainless steel mesh. The material that passed through the mesh screen is referred to as fine material (FM), while the material remaining on the screen is referred to as coarse material (CM). For both alfalfa hay and wheat straw, samples of FM, CM and unsieved material (UM) were analyzed for NDF and were also used in dacron bags to determine dry matter (DM) losses into water during a 15 minute washing machine cycle. The NDF content (%±SD) of FM, CM and UM was 52.5 (±1.5), 43.5 (±1.0) and 49.6 (±0.7), respectively, for alfalfa hay and 62.1 (±0.4), 49.7 (±0.9) and 60.2 (±0.1), respectively, for wheat straw. For alfalfa hay, DM losses (%±SD) from dacron bags after washing were 57.8 (±4.4), 25.6 (±0.3) and 32.5 (±0.6) for FM, CM and UM, respectively and for wheat straw DM losses were 62.2 (±2.9), 25.6 (±0.8) and 32.2 (±0.4) % for FM, CM and UM, respectively. It was concluded that significant amounts of sample material could potentially be washed out from dacron bags during a water washing cycle and that soluble nutrient fractions of feedstuffs could be over estimated if care is not taken. More research is required to determine magnitudes and composition of fractions and nutrient losses due to washing cycle before final recommendations can be made.

Key Words: Particle size, In sacco, NDF

T203 Measuring detergent insoluble protein and fiber in corn silage using crucibles or filter bags. G. Ferreira1,2 and D. R. Mertens2, 1Univ. of Wisconsin, 2USDA-ARS, US Dairy Forage Research Center, Madison, WI.

Objectives of this research were to compare the crucible (CR) and filter bag (FB) methods of measuring detergent insoluble protein and fiber in corn silage and to evaluate the differences in neutral detergent insoluble protein with or without the use of sodium sulfite and amylase. Thirty-three diverse corn silages (14.9 to 37.1% ADF and 26.8 to 57.4% soluble protein with or without the use of sodium sulfite and amylase). In the present study, samples of alfalfa hay and wheat straw were sieved through a 60 μm stainless steel mesh. The material that passed through the mesh screen is referred to as fine material (FM), while the material remaining on the screen is referred to as coarse material (CM). For both alfalfa hay and wheat straw, samples of FM, CM and unsieved material (UM) were analyzed for NDF and were also used in dacron bags to determine dry matter (DM) losses into water during a 15 minute washing machine cycle. The NDF content (%±SD) of FM, CM and UM was 52.5 (±1.5), 43.5 (±1.0) and 49.6 (±0.7), respectively, for alfalfa hay and 62.1 (±0.4), 49.7 (±0.9) and 60.2 (±0.1), respectively, for wheat straw. For alfalfa hay, DM losses (%±SD) from dacron bags after washing were 57.8 (±4.4), 25.6 (±0.3) and 32.5 (±0.6) for FM, CM and UM, respectively and for wheat straw DM losses were 62.2 (±2.9), 25.6 (±0.8) and 32.2 (±0.4) % for FM, CM and UM, respectively. It was concluded that significant amounts of sample material could potentially be washed out from dacron bags during a water washing cycle and that soluble nutrient fractions of feedstuffs could be over estimated if care is not taken. More research is required to determine magnitudes and composition of fractions and nutrient losses due to washing cycle before final recommendations can be made.

Key Words: Particle size, In sacco, NDF

T204 Orchardgrass soluble carbohydrate and digestibility levels in sward horizons under defoliation sequences initiated in morning and evening. T. C. Griggs1, J. W. MacAdam1, H. F. Mayland2, and J. C. Burns3, 1Utah State University, Logan, UT, 2USDA-Agricultural Research Service, Kimberly, ID, 3USDA-ARS, Raleigh, NC, and North Carolina State Univ., Raleigh, NC.

Diurnal cycles of nonstructural carbohydrates (TNC) in forage canopies, and higher TNC levels for hay cut in evening than in morning, have been documented. Temporal patterns of TNC and dry matter digestibility (DMD) have not been assessed in sward horizons under rotational grazing. Timing of herbage allocation in pastures may impact the daily balance of sward photosynthetic gain and respiratory loss and therefore energy intake by livestock. Our objective was to compare TNC and DMD levels in horizons of an orchardgrass sward under sequential clipping during a 24-hr period initiated in morning (AM) or evening (PM). Vegetative orchardgrass initially 40 cm tall was clipped to remove 0.33 of current sward height every 6 hr to a final stubble height of 8 cm. Clipping sequences were initiated at 7 AM and 7 PM in October, 2000 and June and August, 2001 in a randomized block design with 3 replications. Only the uppermost horizon in sequentially-clipped patches was analyzed at each time point. Whole-canopy control samples were also collected at each time point and sectioned into horizons. All samples were analyzed for levels of TNC and in vitro true dry matter digestibility. Conditions varied from cool and cloudy with little diurnal temperature fluctuation in October to high irradiance, temperatures, and temperature fluctuations in summer. Diurnal patterns of TNC and DMD levels were dissimilar among seasons. Levels of TNC and DMD in individual horizons of control samples were representative of those in uppermost horizons in clipped treatments. In October, horizon TNC levels increased throughout each 24-hr period, but to a greater extent in the PM treatment. In summer, horizon TNC levels decreased over 24 hours in the PM treatment, but increased and decreased diurnally in the AM treatment. Mean diurnal TNC levels for AM and PM treatments were 13.4 vs. 14.8, 8.8 vs. 8.2, and 5.8 vs. 7.1% for October, June, and August, respectively. In all seasons, DMD decreased from approx 47.2% NDF for CR or FB, respectively. Except for ADICP, ICP differed between CR and FB. The in-house FB method obtained results similar to the CR method for NDF. Small statistical differences in ADF and ICP between CR and FB may not be important in relation to variation in fiber analyses among laboratories.

Key Words: Fiber, Insoluble protein

T205 Nutritional quality of seventy four accessions of elephantgrass (Pennisetum purpureum Schum) from Embrapa’s Brazil collection. A. V. Pereira1, H. Carneiro1, F. de S. Sobrinho1, and M. Villaquian2, 1EMBRAPA CNPGL, Minas Gerais, Brazil, 2E. (Kika ) de la Garza. American Institute for Goat Research, Langston, OK.

Elephant grass is an important forage in Brazilian livestock production systems, especially for dairy cattle production. For several years Embrapa, Brazil’s national agriculture research service, has conducted...
plant breeding studies on elephantgrass and has developed several accessions. However, Embrapa has not evaluated the nutritional quality of the various accessions of elephantgrass. The objective of this study was to determine nutritional quality of Embrapa’s elephantgrass collection. Over a 3-yr period, CP, in vitro and in vivo digestibilities (DIG), lignin (L), cellulose (C), and silica (S) of leaf blade and of whole green chopped plants of 74 elephantgrass accessions were evaluated at three different cutting (harvesting) periods of 30, 60, and 90 d. Data were analyzed as a complete randomized block with in two replicates. The statistical model included forage type (leaf vs whole plant), accession, cutting day, all two-way interactions, and the three-way interaction. The greatest variability (P < 0.02) was found at 60 d among all accessions. Differences (P < 0.05) were found among accessions in nutritional quality except C, L, and S. Crude protein decreased sharply with age from 17 to 4% CP for 30 to 90 day old grasses. For in vitro DIG, largest variability was from 68 to 49% for 30 to 90 day old grasses (P < 0.02). Considering the sharp decrease in CP, elephantgrass should be grazed around 30 d and no more than 60 d. For green chopping, CP after 60 d is considered extremely low for rumen function. The differences among nutritional qualities in the elephantgrass accessions could be responsible for wide differences in growth and lactation performance of grazing ruminants. Further research by plant breeders is needed to improve Embrapa’s elephantgrass accessions in CP, and in vitro DIG.

**Key Words:** Elephantgrass, Nutrition Quality, Accession

**T206 Yield and growth of Panicum maximum Jacq under different fertilization levels with N and P in humid tropical forest conditions. A. Rodriguez-Petit* and J. Zambrano, Universidad Nacional Experimental Sur del Lago.**

An experiment was carried out to evaluate the yield and growth of the guinea grass (Panicum maximum Jacq) under different levels of N and P. The soils was taxonomically classified as Inceptisols, with pH 5.6. Three levels of N (0, 100 and 200 kg/ha/year) and three of P (0, 50 and 100 kg/ha/year) were evaluated in a design of split-pot with factorial arrangement in the secondary plot and four replications. The variables were height (H), total yield (TY), leaf yield (LY), stem yield (SY) and dead material yield (DMY) and were measured every 7, 21 and 35 days in three 35 day cycles. The guinea grass showed significant differences (Ps0.01) for H, the highest value (172.33 cm) was obtained with the interaction of 200 kg N/ha and 100 kg P/ha. The highest values to H, L and SY were observed at the 35 day by the simple effect of 200 kg N/ha (3940.31, 2381.47 and 1403.18 kg/MS/ha, respectively). The DMY not show statistical differences by treatments effect. The best to TY, LY and SY were observed at the 35 day by the simple effect in three 35 day cycles. The guinea grass showed significant differences dead material yield (DMY) and were measured every 7, 21 and 35 days with the application of 200 kg N/ha/year and 100 kg of P/ha/year.

**Key Words:** Panicum maximum, Fertilization, Yield

**T207 Evaluation of energy efficiency and CO2 emission from forage production systems. M Wachendorf*, M Kelm, and F Taube, University of Kiel, Kiel, Germany.**

Fossil energy use in agriculture is an important indicator for both the use of limited fossil resources and the release of carbon dioxide (CO2) and other combustion gases. Based on experimental data, gathered within an integrated project on nitrogen fluxes in intensive dairy farming, the efficiency of the dairy farming systems can be improved substantially by a change from N-fertilized grass-only swards towards unfertilized clover/grass swards and silage maize.

**Key Words:** Forage production, CO2 emission, Energy efficiency

**T208 Impact of maturation on cell wall degradability in corn stem internodes. H. G. Jung*, USDA-ARS, St. Paul, MN.**

Degradability of forage cell wall (CW) material declines with maturity; however, the causes for this decline have not been adequately described. Stem CW development and degradability were observed in three non-related corn hybrids. The fourth above-ground stem internode was collected in 1998 and 1999 from a randomized complete block design field trial with two replications. Sampling began when the internode was 1-cm long (late June) and subsequent samples were collected 2, 4, 8, 12, 19, 26, 40, 68, and 96 d later. Internodes were analyzed for CW concentration and composition, and 24- and 96-h in vitro rumen degradability. While small significant differences were observed in CW development and degradability of the three corn hybrids, impact of maturity was much greater and all hybrids responded similarly to maturation. Stem internodes increased in length and diameter until 12 d after sampling began. CW concentration was 31% of internode OM in the first samples and did not change during the next 8 d of development. Subsequently, CW concentration increased at each sampling until a maximum (73%) was reached 26 d after sampling began, later CW concentration declined (minimum of 55%) because of sucrose accumulation in the stem. CW glucose and xylose concentrations increased from 35 and 18% of CW, respectively, in the first sample to 52 and 24% of CW 12 d later. In contrast, K-ion lignin concentration declined from 11% of CW to 6% by 8 d after sampling had begun and then increased to 20% of CW by d 40. Degradability of internode CW polysaccharides was high and unchanged through d 4 (88 and 93% after 24 and 96 h, respectively), but then declined steeply to 26 and 39% (24 and 96 h, respectively) by d 68. Lignin polysaccharide cross-linking by ferulic acid matched the beginning of the decline in CW degradability better than lignin concentration because these ferulates began to increase in concentration at the same time as the decline in degradability started whereas lignin concentration was still decreasing. These data indicate that the decline in CW degradability associated with maturation of grasses is a function of both lignin and ferulate cross-linking.

**Key Words:** Corn Stem, Cell Wall, Degradability

**Dairy Foods: Cultured dairy products and dairy proteins**

**T209 Dissociation of casein supramolecules. B. S. Oomen* and D. J. McMahon, Department of Nutrition and Food Sciences, Utah State University.**

Microstructure of dissociated caseins in bovine milk was studied using transmission electron microscopy. Cold and warm milk was treated with excess EDTA and glucono-δ-lactone to dissociate the colloidal casein aggregates. This treatment repeated 100 times, of all caseins were adsorbed on to parlodion coated copper grids. Parlodion coated copper grids were coated with poly-L-lysine to improve the adsorption of protein to to the film. These grids were stained using uranyl acetate and oxalic acid, flash frozen in liquid nitrogen-cooled Freon 22, and freeze dried so that the native casein structure could be preserved. Grids were viewed using a transmission electron microscope and images were photographed at various magnifications ranging from 7,000x, to 250,000x at 80 kV. Cold milk EDTA-treatment resulted in linear and spherical aggregates of proteins. Warm milk EDTA- treatment resulted in filigreed ring-like protein aggregates. Fixing of the colloidal casein particles using gluteraldehyde before EDTA-treatment preserved the supramolecular structure of ca...
seine. Reduction of pH first resulted in small protein aggregates which further dissociated out of the supramolecule. This study reveals the various types of aggregation behavior of caseins when calcium is removed from the colloidal casein structure.

Key Words: Casein micelle, Acid, Calcium


Milkfat globule membranes (MFGMs) were prepared from bovine milk according to standard procedures. MFGMs and peptide hydrolysates, generated by incubation with immobilized trypsin, were screened for antimicrobial activity using three foodborne pathogens: Escherichia coli 0157:H7, Listeria monocytogenes, and Salmonella typhimurium. Two probiotic microorganisms, Lactobacillus acidophilus and Lactobacillus gasseri, were also included for evaluation purposes. Assays were performed on beef heart infusion (BHI) plates seeded with lawns of indicator cells, and protein/peptide fractions were spotted to monitor the zone of inhibition (ZOI). Initial results showed that these samples were active against S. typhimurium and E. coli 0157:H7. During the course of our studies, we have determined that bacteriostatic/bactericidal effects were most likely due to the generation of hydrogen peroxide (H2O2) by xanthine oxidase (XOX), a major protein constituent of the MFGMs. Similarly, purified XOX, evaluated under identical experimental conditions, showed analogous data trends including inhibitory effects with respect to L. monocytogenes. Probiotic Lactobacillus strains were only marginally affected. Microbial growth patterns were not influenced, however, when XOX was substituted with MFGM hydrolysates, and XOX were evaluated for activity using Luria-Bertani (LB) test plates. Thus, the mechanism of this action was attributed to catalysis of purine substrates present in BHI but lacking in LB media. Furthermore, addition of catalase to XOX samples totally abolished the antibacterial effects, and microbial growth was not impaired when XOIs assays were performed using BHI plates under anaerobic conditions. Apparently, proteolysis of MFGMs using immobilized trypsin did not completely eliminate the catalytic (antimicrobial) capacity of XOX; whereas, sequential treatment with pepsin at pH 3.5 followed by digestion with trypsin at pH 8.1 resulted in complete inactivation of both enzymatic and bactericidal functions. Ultimately, antimicrobial properties of XOX were entirely associated with the oxidase form of the enzyme resulting in the production of H2O2 as the active inhibitory component.

Key Words: Milk enzymes, Antimicrobial proteins, Bactericidal reagents


The present study was carried out to examine the efficiency of microcapsules and a stability of lactase in vitro in the simulated gastric and intestinal conditions. As a coating materials, medium-chain triacylglycerol (MCT) and polyglycerol monostearate (PGMS) were used. The highest efficiency of microencapsulation was found in the ratio of 1:1 as coating to core material with both MCT (91.5%) and PGMS (75.4%). In a subsequent experiment, lactose content was measured to study a microcapsule stability. Lysis of microcapsules made by MCT in simulated gastric fluid was proportionally increased such as 3% in pH 5 and 30% in pH 2 for 20 min incubation. In the case of PGMS microcapsule, 11-13% of lactose was hydrolyzed at 20 min in all pHs and also very little amount (less than 3%) of lactose was hydrolyzed after 20 min in all pHs. The highest percentages of lactose hydrolysis in MCT and PGMS microcapsules were 68.8 and 60.8% in pH 7 and 8 during 60 min, respectively. Based on the data, the lactase microcapsules seemed to be stable when they stay in the stomach, and hydrolyzed rapidly in small intestine where the bile acid was excreted.

Key Words: β-galactosidase, Stability of microcapsule, Lactose


This study was carried out to investigate the addition of water-soluble isoflavone into milk by means of microencapsulation technique. The yield of Microencapsulation, sensory attributes, and capsule stability of water-soluble isoflavone microcapsules in milk were measured during 12 days. Coating materials used were polyglycerol monostearate (PGMS) and medium-chain triacylglycerol (MCT), and core material was water-soluble isoflavone. The encapsulation yield of water-soluble isoflavone with MCT was 74.5 % and was 67.2 % with PGMS when the ratio of coating material to core material was 15:1. The rates of water-soluble isoflavone release were 15, 20, and 25% when stored at 4, 20, and 30 for 12 days in milk, respectively. In sensory evaluation, beany flavor and color of microcapsuled water-soluble isoflavone added milk were significantly different from control and unencapsulated water-soluble isoflavone added milk, however, bitterness was not significantly different. In vitro study, microcapsules of water-soluble isoflavone in simulated gastric fluid with the range of 3 to 6 pHs were released 3.0 to 15.0%, however, the capsules in simulated intestinal fluid with pH 7 were released 95.7% for 40 min incubation time. In conclusion, this study provided that MCT and PGMS as coating materials were suitable for the microencapsulation of water-soluble isoflavone, and the capsule containing milk did not affect to sensory attribute.

Key Words: Isoflavone, Microencapsulation, Milk

T213 FAT free sugar free plain set yogurt fortified with folic acid. C. A. Boeneke* and K. J. Ariyana, Louisiana State University Agricultural Center, Baton Rouge, LA.

Folic acid fortification is used in the prevention of neural tube defects such as spina bifida and anencephaly, heart defects, facial clefts, urinary tract abnormalities, and limb deficiencies. Although yogurt is not a good source of folic acid, fortification could aid in prevention of above-mentioned defects. Incorporation of yogurt with folic acid may or may not change its physico-chemical characteristics. Fat free sugar free yogurt was manufactured using 0, 25%, 50%, 75% and 100% of the recommended daily allowance of 400 micrograms of folic acid. Treatments included addition of folic acid at these levels before and after pasteurization. The objective was to examine the effects of folic acid on viscosity, pH, TA, syneresis, color, composition, and folic acid concentration in the product at one, three, and five week intervals. Data were analyzed using the General Linear Model procedure with a completely randomized block design by the Statistical Analysis System. Significant differences were determined at P<0.05 using Duncan’s Multiple Range Difference Test. There were no significant differences in viscosity over the five week period. No significant differences were found in pH or syneresis of samples. Folic acid fortified yogurts showed significantly higher (P<0.05) b* values than control indicating they were more yellow in color. There were no differences in the electrophoretic mobilities of the protein/peptides in the samples. Control yogurt had significantly higher (P<0.05) mean flavor scores than yogurts with folic acid when tested by a trained sensory panel. Folic acid fortification of yogurt impacted some of its physico-chemical attributes.

Key Words: Folic acid, Microstructure, Milk

T214 Microstructure of folic acid fortified fat free sugar free plain set yogurt. K. J. Ariyana*, 1Louisiana State University Agricultural Center, Baton Rouge, LA.

Folic acid is used in preventing birth defects of the spine and brain, hardening of arteries and colon cancer. Yogurt is not good source of folic acid. Earlier experiments on fortifying yogurt with folic acid revealed that at a high level of folic acid fortification, the yogurt had a powdery mouth-feel. This powdery mouth-feel may be due to localized protein aggregations. The objective was to study the microstructure of folic acid fortified yogurt. Folic acid was added before and after pasteurization viz. during mix preparation and after culture addition. Folic acid was added at one quarter and one half the recommended daily allowance. The microstructure was studied using scanning electron microscopy and transmission electron microscopy. Control yogurt and folic acid fortified yogurts showed the network of casein micelles in chains and clusters. Clusters in the folic acid fortified yogurts were larger (P<0.05) compared to the control. Also the folic acid fortified yogurts had significantly (P<0.05) more clusters of casein micelles per unit area compared to the control. These increased localized casein micelle aggregations were a factor contributing to the powdery mouth-feel of folic acid fortified yogurts.

Key Words: Structure, Fermented, Network
This study was carried out to investigate the development of cholesterol-removed whipping cream. Cream with 36% milk fat was treated for cholesterol removal with 10% β-cyclodextrin, 40°C stirring temperature, 400, 800 and 1,200 rpm stirring speeds, and 10, 20 and 30 mins stirring time. The group of emulsifier and stabilizer was selected 0.3% β-cellulose, 0.3% sugar ester, 0.2% avicell, 0.3% sodium alginate, and 0.3% sucrose for making the cholesterol-removed compound whipping cream. The overrun percentage was the highest with 150%, and the foam stability was the most stable with 1.0ml defoamed cream when the ratio of cholesterol-removed whipping cream and palm oil whipping cream was 8 : 2. TBA values of the cholesterol-removed compound whipping cream were initially 0.08 and 0.15 after 4 week storage at 4°C for sample. This result was not significantly different from cholesterol-removed whipping cream. In sensory evaluation, the scores of texture, cream flavor, color and overall acceptability in samples were not significantly different from cholesterol-removed whipping cream. In conclusion, cholesterol-removed compound whipping cream appeared to be stable under various experimental optimum conditions. Therefore, this study suggested the possibility of cholesterol-removed whipping cream in industry.

**Key Words:** Cholesterol removal, β-cyclodextrin, Compound whipping cream

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**Key Words:** Cholesterol removal, β-cyclodextrin, Compound whipping cream


**T217 Aerobic endospore distribution in a process to produce high phospholipid ingredients from commercial reconstituted buttermilk.** L. Lassonde* and R. Jimenez-Flores, Cal Poly DPTC.

Bacterial endospores survive standard industrial processes to become food spoilage organisms when later reconstituted with water and exposed to appropriate environments to induce germination and growth. The objective of the study was to 1) Isolate and characterize a library of wild-type *Bacillus spp.* from a variety of commercial buttermilk powder (BMP) including endospore counts, metabolic activity and germination rates; 2) Characterize rejection of endospores in a pilot scale cold microfiltration process on reconstituted BMP; and 3) Characterize the survivalability of endospores when exposed to super critical CO₂. The library of endospores isolated from commercial reconstituted BMP consists of 80 well-characterized strains of bacilli. Biological comparisons are possible at DPTC with bacilli from different dairy products. The process used reconstituted BMP (20 L per batch and 10% TS) and subjected to a micro-filtering 0.8μm filtration at 4°C, to enrich phospho-lipids into the retentate. Dialfiltration with distilled water was added through the system three times the original volume of the reconstituted buttermilk (60 L). Both retentate and permeate were analyzed for TPCs, mesophilic and thermophilic endospore counts to determine endospore counts in the retentate. Mesophilic-spore counts in retentate and permeate were consistently >10² cfu/ml and <25 cfu/ml respectively. Retentate and permeate thermophilic spore counts were >10²cfu/ml and <5cfu/ml respectively. The original BMP had meso- and thermophilic counts of 10² and 10¹ cfu/ml. The total balance of spores in the system resulted in a retention of between 75 to 98% of the total spores, and no significant difference between mesophilic and thermophilic counts. Supercritical inactivation of spores show a complex, thermal/supercritical lethal curve. It is apparent that the overall composition of the process interferes with the spores exposed to the treatment. Destruction rates were measured between 90 to 99.9% of the original spores in the retentate.

**Key Words:** Buttermilk powder, Microfiltration, Bacillus

**T218 Time-intensity measurement of “creaminess” in dairy mixes.** T. M. Krue*1, K. Adhikari1, H. Heymann2, and I. U. Gruen1, 1 University of Missouri-Columbia, 2 University of California-Davis.

Time-intensity (T-I) analysis is a descriptive analysis where a single attribute is tracked as it changes over a period of time. Temporal measurements have mainly been done on flavor release attributes of foods during eating. Texture attributes have mostly been evaluated using unipoint measurements. Therefore, the objective of the present study was to determine if the attributes that constitute creaminess could be evaluated by T-I analysis. Five combinations of dairy mixes with varying fat content were chosen for evaluation. The intensities of “fattiness”, “smoothness”, “fattiness”, “thickness” were measured individually for each dairy mix by a panel of 5 trained judges. All the samples were randomized, served in 50-ml deli cups and coded with 3-digit random numbers for taste evaluations. Two replications were carried out and the data was collected on Compusense 5. Attribute intensity was measured every 0.1 second for a total of 20 seconds. Data analysis (Unscrambler®) included Non-centered Principal Component Analysis (PCA) to extract Non-centered Principal Time-Intensity Curves (NPTIC) by using the panelists’ responses. Product differences were further analyzed by using Partial Least Square Regression (PLSR). The variance explained by the first two principal components for “smoothness”, “fattiness” and “thickness” were 69 and 17%, 84 and 9%, and 93 and 3%, respectively. Results from “smoothness” showed the best pattern depending on the fat content. Probably the absence of any perceptible particles in the mixes governed the randomness of the results. On the other hand, both “fattiness” and “thickness” were perceived by the judges to be part of creaminess and the results showed distinct differences between low fat and high fat dairy mixes. It might be concluded that temporal measurements of “fattiness” and “thickness” could be used to determine creaminess of liquid dairy products. The “smoothness” of the products might not contribute much towards the perception of creaminess.

**Key Words:** Dairy mixes, T-I analysis, PLSR

**T219 Identification of aroma compounds in whey powder.** S. Mahajan, M. Qian*, and L. Goddik, Oregon State University.

Volatile compounds from whey powder were extracted with pentane-diethyl ether and followed by solvent assisted flavor extraction. The aroma concentrates were analyzed by gas chromatography/mass spectrometry and mass spectrometry. Acetic, benzoic, butanoic, hexanoic, octanoic were the major acidic compounds identified in the whey. Other acidic compounds identified were formic, propanoic, 2-methylpropanoic and 3-methylbutanoic acids. Major neutral compounds identified were dimethylbutanol, maltol, 2-furanmethanol, dihydro-3-hydroxy-2(3H)-furanone, hydroxymethylfuranone and ethyl acetate. The odor-active compounds were studied using an Osme technique.

**T220 Ingredient interactions with derivatized whey protein powders.** J. D Firebaugh* and C. R. Daubert, North Carolina State University, Raleigh, NC.

Justification: Whey protein was modified to produce powders capable of thickening similar to pregelatinized starches. A basic understanding of ingredient interactions with the new whey ingredient will encourage optimal incorporation into dairy foods.
Objective: To investigate pH and salt interactions with a derivatized whey protein powder.

Methods: Whey protein isolate (WPI) solutions were modified through acid and thermal treatments, then spray dried into powders. Samples were prepared by hydrating the derivatized powders in deionized water and adjusting the sample pH from 3.35 to 4.0, 4.5, and 5.0 with 6M HCl. Salt studies were prepared by hydrating the derivatized ingredient in 0.05M, 0.10M, and 0.15M NaCl solutions and adjusting to pH 4.0 with 6M HCl. Physical properties were determined for each solution. Specifically, rheological properties of solutions were obtained using a controlled-stress rheometer with concentric cylinder geometry at 25°C. A water absorption index was evaluated and calculated as the weight of gel obtained from 1g of dry sample post hydration.

Results: Water absorption and viscosity were affected by pH. The derivatized ingredient was calculated to have a water absorption index of 7.5 at native pH (3.35). As pH was raised to the isoelectric point, the absorption index decreased significantly. For viscosity assessment, a 50 1/s shear rate was selected for all comparisons. As the pH was elevated from 3.35 to 4.0, 4.5, and 5.0 an 8% protein solution displayed a decreasing viscosity, ranging from 1000 mPa s to <100 mPa s (pH 5.0). As the ionic strength of the solutions was decreased at a constant pH of 4.0, the viscosity increased from 1.5 mPa s (0.15M NaCl) to 3.5 mPa s (0.05M NaCl).

Significance: Information on derivatized protein interactions with other ingredients common to dairy foods will expedite the development of applications with the novel dairy ingredient, particularly in those foods desiring an all-natural, or all dairy, food label.

Key Words: Whey, Rheology, Stabilizer

T221 Effect of drying methods on the physical and chemical properties of whole milk powder. L. F. Osorio1, J. U. McGregor2, J. S. Godber3, and N. Y. Farkye4, 1Escuela Agrícola Panamericana, Zamorano, Tegucigalpa, Honduras, 2Food Science and Human Nutrition Dept., Clemson University, Clemson, SC, 3Food Science Dept., LSU Ag Center, Baton Rouge, 4Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.

The composition and properties of the milk, manufacturing procedures, thermal processing during manufacture, and drying technique are important variables that affect the quality of milk powders. Milk powders are used widely as food ingredients because they provide many functional properties. The objectives of this study were to evaluate the effect of various drying technologies on the physical-chemical stability of whole milk powder (WMP). WMP was manufactured by three different drying technologies: commercial spray; pilot spray and pilot pulse. Samples were evaluated for their physical-chemical characteristics and oxidative stability. Samples were stored at 45°C for 50 days in an incubator to accelerate oxidation. Samples were tested every 10 days for oxidation progress. Commercial spray dried WMP produced significantly less free fat, which suggests more efficient drying in terms of forming complete powder granules. Physical and chemical differences existed when comparing commercial spray drying and pilot spray drying, and continuous operating temperature and air flow of commercial dryers resulted in powders with better color and solubility values. Commercially dried WMP was more stable to oxidation compared to pilot spray dried and pilot pulse dried WMP. The two pilot scale technologies produced close to four times more mg m sodiumdihyde/kg than commercial spray dried WMP. Our results call into question the practical value of conclusions obtained from WMP research based on the use of pilot scale dryers.

Key Words: Whole milk powder, Functional properties, Drying technology

T222 Effect of drying technologies on the microstructure of whole milk powder. L. F. Osorio1, J. U. McGregor2, J. S. Godber3, and N. Y. Farkye4, 1Escuela Agrícola Panamericana, Zamorano, Tegucigalpa, Honduras, 2Food Science and Human Nutrition Dept., Clemson University, Clemson, SC, 3Food Science Dept., LSU Ag Center, Baton Rouge, 4Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.

The functional properties of dried milk products are related to the physical structures of the milk powder particles. Particle structure is influenced by the conditions of drying and by the various atomizing systems employed by the drying technologies. Scanning Electron Microscopy (SEM) is an appropriate technique to study the surface morphology as well as the internal structures of the milk powder particles and their relation to functional properties. The objectives of this study were to evaluate the effect of drying technologies on the microstructure of whole milk powder (WMP) manufactured using commercial spray, pilot spray and pilot pulse dryers. Powder samples produced using all three dryer technologies were evaluated using a Hitachi S-3500 N SEM. We were able to observe hydrated samples of the powder by using variable pressure to simulate an environmental SEM. Pilot spray dried WMP had more broken granules than commercial dried WMP. The granule distribution was less uniform than commercial drying and small granules were entrapped in larger broken granules. Pilot dried powders had a higher free fat content that may have been related to a higher percentage of broken granule particles. Pilot pulse drying produced WMP granules with black indentions on the surface which could be burned crystallized lactose. Granule size varied greatly in the pilot spray dried powders. Pilot pulse dried WMP did not have as many broken granules as pilot spray dried WMP. Pilot pulse dried WMP was expected to have better solubility because of more wrinkled surfaces when compared to spray drying. Our insolubility test did not support this physical characteristic. Spray drying produced large central air vacuoles whereas as pilot pulse drying produced numerous air vacuoles inside the granule. This may lead to an increase in particle density since less air is present inside the granules. This observation is a potentially important discovery because a larger increase in the number of oxygen containing vacuoles may cause an increase in the oxygen surface contact area, promoting and accelerating oxidation in pilot pulse dried WMP.

Key Words: Whole milk powder, Microstructure, Drying technologies


A mixture for emulsions with 10% protein and 20% butter oil were prepared by dispersing sweet whey protein concentrate (SWPC), acid whey protein isolate (AWPC) + glycomacropeptide (GMP) in distilled water. The mixture was heated to 65°C and homogenized at 20 and 90 MPa. Whey protein emulsions were heated to 90°C for 30 min in a closed water bath to form gels. The addition of GMP to the AWPC emulsion did not cause a reduction (p<0.05) in the diameter of the fat globules after homogenization at 20 and 90 MPa. The mean particle size (d50) of the emulsion made from SWPC was significantly lower (p<0.05) at 90 MPa lower (p<0.05) than the d50 of particles in the emulsion made from AWPC + GMP that was homogenized at 90 MPa. However, the d50 in the emulsion made using SWPC was not different (p>0.05) from d50 in the emulsion prepared from AWPC after homogenization at 90 MPa. The differences in particle size attributed to homogenization pressure were not different. Gels made using AWPC and AWPC + GMP had a higher shear stress at fracture (hardness) than gels made using SWPC. The shear stress at fracture of gels made using AWPC and homogenized at 20 MPa was 13.48 kPa and increased to 23.81 kPa when the emulsions were homogenized at 90 MPa. The shear stress at fracture of gels made using the AWPC + GMP emulsion homogenized at 20 MPa was 15.06 kPa and increased to 22.07 kPa when homogenization was homogenized at 90 MPa. The shear stress at fracture for gels containing AWPC + GMP was similar to the shear stress value at fracture for gels made from AWPC. Gels made using SWPC emulsions exhibited a higher shear strain (p<0.05) at fracture and had a more rubbery texture than gels made from AWPC and AWPC + GMP which had a lower shear strain at fracture value and a brittle texture.

Key Words: Glycomacropeptide, Whey protein gels, Homogenization pressure

T224 Rheological properties at fracture of thermally-induced whey protein with lecithin emulsion gels. G. Perez-Hernandez1, R. Suhareli, and R. L. Richter, Texas A&M University, College Station, TX.

The purpose of this research was to evaluate the effect of the type of lecithin and homogenization pressure on the fractural properties of heat-set, whey protein emulsion gels. Mixtures for emulsions that contained 20% butteroil, 10% protein (WPC 80), and 0% lecithin or 1% deoiled soy lecithin (w/trivialonic) or 1% deoiled acetylated lecithin (ionic) were prepared. Mixtures were heated to 65°C and homogenized at 20 and 90
MPa. The emulsions were heated at 90°C for 30 min to form gels. The gels were stored overnight at 4°C and fractional properties were measured in a Hamann torsion gelometer. Emulsions homogenized at 90 MPa exhibited yield stress which indicated that conformational changes of the protein occurred which exposed reactive groups of the proteins. Gels from emulsions homogenized at 90 MPa had higher shear stress at fracture and lower shear strain at fracture compared to gels from emulsions homogenized at 20 MPa. The increased surface area of protein-coated oil droplets and greater availability of reactive groups after homogenization at 90 MPa might have contributed to more intermolecular disulfide bonding during heat treatment. Gels that contained lecithin had lower shear stress and higher shear strain at failure at both homogenization pressures. SDS-Page showed protein displacement from droplets in emulsions with lecithin that were homogenized at 20 MPa but no protein displacement when homogenized at 90 MPa. The type of lecithin did not affect the fractional properties of gels, but witeinteron lecithin displaced more protein from the lipid surface than did the ionic lecithin. However, this did not affect the apparent shear rate. Interaction between lecithin with protein at the interface or with protein in the aqueous phase might have been responsible for the rheological changes of the gels.

Key Words: Whey protein gels, High homogenization pressure, Lecithin

T226 Impact of flax oil emulsion composition on the oxidative stability of omega-3 enriched milk beverages. S. Lamothe*, G. Trudeau2, and M. Britten1, 1FRDC, Agriculture and Agri-Food Canada, St-Hyacinthe, QC, Canada, 2Agropur, Granby, QC, Canada.

Milk enriched with flax oil could provide consumers with a means to meet the recommended daily intake of omega-3 fatty acids without changing eating habits. However, flax oil is extremely susceptible to oxidation. Pre-homogenization of flax oil in controlled conditions is proposed to uncapsulated treatments during storage. In sensory aspects, the yogurt sample added with uncapsulated iron and vit C, regardless of capsule, showed a significantly high score of astringency, compared with those of control and other groups. A significantly strong sourness was observed in treatment containing capsulated iron and uncapsulated vit C at every time intervals. The present study provides evidence that microencapsulation of iron with PGMS is effective for iron fortification in drink yogurt.

Key Words: Iron fortification, Microencapsulation, Yogurt


Rheological properties of concentrated skim milks, with a total solids content of 45%, made from skim milk with defined genetic variants of β-lactoglobulin were studied as a function of shear rate and storage time at 50°C. The effects of heat treatment of skim milk at 90°C for 10 min prior to evaporation on apparent viscosity were also determined. All samples showed a decreasing apparent viscosity with increasing shear rate, with the presence of a yield stress. During storage of the concentrated milk, the apparent viscosity and yield stress were markedly, and that the age-dependent increase in viscosity in concentrated milks prepared from heat-treated skim milk was much more pronounced than those prepared from unheated skim milk. The increase in apparent viscosity and yield value with storage time was notably different for milks containing different genetic variants. Unheated concentrated milks containing the B variant of β-lactoglobulin showed a most rapid increase in apparent viscosity with storage time while the viscosity increase was slower in the concentrate containing the A variant. By contrast, heat-treated concentrated milks containing the A variant of β-lactoglobulin showed the most rapid increase in viscosity with storage time while the viscosity increase was slowest in the concentrate containing the AB variant. The changes in apparent viscosity of concentrated milk were largely reversible under high shear during the early stages of storage, but samples stored for long time showed irreversible changes in apparent viscosity. Particle size analysis confirmed irreversible aggregation and fusion of casein particles during storage.

Key Words: Concentrated milk, Genetic variants, Rheology

T228 Effect of pore size and temperature on the fractionation of buttermilk using microfiltration. P. Morin*, R. Jimenez-Flores, and Y. Pouliot1, 1Centre de recherche STELA, Université Laval, Quebec, Canada, 2Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.

Buttermilk is a unique dairy source of milk fat globule membrane (MFGM) lipids such as phospholipids and sphingolipids that have been recognized for their functional and nutraceutical properties. MFGM lipids can be isolated by solvent extraction but this approach is not suitable for dairy processing plants. Membrane processing such as crossflow microfiltration can be the first step to selectively concentrate buttermilk lipids which could be used to create novel functional ingredients. The use of microfiltration (MF) for the separation of MFGM lipids in buttermilk is restricted by the presence of caseins and whey proteins. A better knowledge of factors improving protein and lipid separation in buttermilk microfiltration is needed. Crossflow MF with 3 pore size (1.4 µm, 0.8 µm, 0.1 µm) and 3 temperatures (50°C, 25°C, 7°C) was carried out on fresh or reconstituted buttermilk. Transmission of lipids through the membrane was significantly (p<0.05) lower with the 0.1 µm membrane compared to the 0.8 and 1.4 µm membranes. However, retention level of proteins was the highest (78.3 %) using the 0.1 µm membrane and the lowest level was obtained using the 0.8 µm membrane (38.5 %). Temperatures tested did not induce significant (p>0.05) differences in protein transmission level and lower fat transmissions were observed at 25°C. Temperature increases had an important positive effect on permeation fluxes. Superior fat retention was also noticed using fresh buttermilk by opposition to reconstituted buttermilk. Phospholipids analysis

showed relative transmission of all main species of phospholipids found in buttermilk (phosphatidylethanolamine, phosphatidylcholine and sphingomyelin) at every combination of pore size, temperature and buttermilk type.

**Key Words:** Buttermilk, Microfiltration, Phospholipids


Addition of carbon dioxide at low pressures to raw milk was investigated as a non-thermal method to improve the keeping quality of raw milk. Our objective was to determine the effect of carbon dioxide on the indigenous microorganisms in raw milk. Raw milk was treated with carbon dioxide pressures between 68kPa and 689kPa and temperatures 20°C, 10°C and 6.1°C for 1 and 4 days. Survivor curves were expressed as log10(survivors) vs. time. Milk treated with 68kPa CO2 and held at 10°C demonstrated a lower growth rate compared to the untreated control. Higher pressures resulted in a reduction in numbers of survivors compared to initial counts. Treatment at 689kPa and 6.1°C resulted in an inactivation of approximately 1 log cycle after 4 days, while the untreated control increased by 2 log cycles. Enumerating for gram-negative bacteria and Lactobacillus spp. in the treated milk, treated to 6.1°C for 4 days did not show changes in proportions of these groups at all pressures. These data indicate that holding milk at low carbon dioxide pressures inactivates indigenous microorganisms in milk and may be a strategy for holding/shipping raw milk.

**Key Words:** Shelf life, Carbon dioxide, Milk

T230 Observation of bacterial exopolysaccharide in dairy products using cryo-scanning electron microscopy. A. Hassan1, J. Frank2, and M. Elsoda3, 1The University of Georgia, USA, 2Alexandria University, Egypt.

Cryo-scanning electron microscopy was used to visualize the microstructure of two types of cheese (karish and feta) and milk fermented with differentropy and nonropy strains of lactic acid bacteria. Specimen frozen in liquid nitrogen slush were transferred in a frozen state and under vacuum into the preparation chamber where they were fractured, etched and coated with gold. Specimen were then transferred under vacuum onto the cold stage and imaged using scanning electron microscopy. Milk fat and exopolysaccharide (EPS) were visible in pores within the protein network. Cheese and fermented milk made with EPS-producing cultures exhibited a porous structure in which the largest pores were associated with visible EPS. A compact structure with small pores was seen in cheese and milk fermented with EPS non-producing cultures. Exopolysaccharide and protein appeared to be segregated in both cheese and fermented milk. Exopolysaccharide formed a network-like structure. Differences were observed in the microstructure of EPS between moderatelyropy and highlyropy strains. A relatively long etching (sublimation) time caused EPS to appear as thin filaments similar to those seen with conventional scanning electron microscopy.

**Key Words:** Cryo-scanning electron microscopy, Exopolysaccharide, Fermented dairy products

T231 Fat-level dependent impact of selected flavor volatiles in strawberry-flavored ice creams. S. T. Loeb1, I. U. Gruen1, H. Heymann2, K. Adhikan3, L. N. Fernandol, and R. D. Linhardt1, 1University of Missouri, Columbia, 2University of California, Davis.

Consumer demand for healthier foods has led to an increase in development of reduced fat food products. Because many reduced fat products are not well accepted due to their overall flavor and texture profiles, it is necessary to study flavor-food interactions in order to produce more appealing low-fat and no-fat products. The objective of this study was to determine the effect of full fat (10%) and low fat (4%) ice cream on the overall flavor and odor profile of selected artificial strawberry flavor components.

Ice cream with 4 and 10% fat levels were flavored with an artificial strawberry flavor composed of five components (cis 3-hexen-1-ol, ethyl-3-methyl-3-phénylglycidate, furanole, γ-undecalactone, α-ionone).  To determine the effect of fat on the individual flavor components, each of the five components were individually spiked at 200% of the base level to the flavored ice cream mixes before freezing. The spiked and control ice creams were then analyzed using general descriptive analysis by a panel of 11 trained judges.

The attributes were considered under appearance, flavor (aroma and taste), mouthfeel and aftertaste. All 10% ice creams were perceived to have a flavor high in ethyl-3-methyl-3-phénylglycidate (candy-like), furanole (cooked sugar), sweetness, creaminess, condensed milk and milk. The mouth feel was creamier, smoother and it imparted a greater mouth-coating impression. The 4% ice creams seemed to be impacted more by: iciness, cis 3-hexen-1-ol (leaf-like), γ-undecalctone (peach), and α-ionone (violet/woody).

The results indicated faster release of phénylglycidate and furanole in 10% fat ice creams while in 4% fat ice creams the release was faster for hexenal, undecalactone and ionone. It can be concluded that fat level affects the perception of flavor compounds differently depending on factors such as hydrophobicity and interactions with lipids and proteins.

**Key Words:** Ice cream, Strawberry flavor, Descriptive analysis


This study was carried out to investigate the fortification of vitamin C into milk by means of microencapsulation technique. The TBA value, sensory attributes, stability and bioavailability of iron microcapsules in milk during storage were measured. Coating materials used were polyglycerol polyricinoleate (PGMS) and medium-chain triacylglycerol (MCT), and core materials were L-ascorbic acid and ferric ammonium sulfate. The yield of microencapsulated vitamin C was 95 % with MCT and was 94 % with PGMS when the ratio of coating material to core materials were 15 : 1, 5 : 1, respectively. The rate of vitamin C release was 4-9% when stored at 4°C for 30 days, and temperature lower than 20°C did not affect adversely vitamin C release in the milk during the storage. The TBA value was significantly lower in microencapsulated than those in unencapsulated vitamin C during storage. In sensory evaluation, the degree of sourness and off-taste were slight and total acceptability was moderate in 10mg vitamin C microencapsule -fortified milk at 8 day storage. In vitro study, microcapsules of vitamin C in simulated gastric fluid with the range of 2 to 5 pHs were released 4.7-13.2%, however, the capsules in simulated intestinal fluid with pH 8 were released 94.0% during 40 min incubation time. In the bioavailability of iron in vivo, transferrin saturation value of microencapsulated vitamin C and iron was two and half times higher than that of unencapsulated. In conclusion, this study provided that MCT and PGMS as coating materials were suitable for the microencapsulation of vitamin C and the microcapsules were effective on the bioavailability of fortified iron in milk.

**Key Words:** Vitamin C and Iron, Microencapsulation, Milk


The effectiveness of added antioxidants against oxidation off-flavor development in light-exposed milk was evaluated using sensory and gas chromatographic analysis. Sensory similarity testing showed no perceivable difference between control milk and milk with added (i) α-tocopherol (0.05%) and (ii) α-tocopherol (0.025%) and ascorbic acid (0.025%), but did show a difference when adding ascorbic acid alone (0.05 %) (n = 30, β = 0.05, α = 0.30). Subsequently, sensory difference testing showed a significant difference in oxidation off-flavor between light-exposed control milk and light-exposed milk with added α-tocopherol (0.025%) and ascorbic acid (0.025%), while addition of α-tocopherol (0.05%) alone showed no significant difference (n = 24, β = 0.40, α = 0.05). Gas chromatographic analysis verified chemically the extent of oxidation for various antioxidant treatments. Since pentanal is a common light-oxidation by-product, its concentration was monitored to determine the effect of fat on the individual flavor components, each of the five components were individually spiked at 200% of the base level to the flavored ice cream mixes before freezing. The spiked and control ice creams were then analyzed using general descriptive analysis by a panel of 11 trained judges.

The attributes were considered under appearance, flavor (aroma and taste), mouthfeel and aftertaste. All 10% ice creams were perceived to have a flavor high in ethyl-3-methyl-3-phénylglycidate (candy-like), furanole (cooked sugar), sweetness, creaminess, condensed milk and milk. The mouth feel was creamier, smoother and it imparted a greater mouth-coating impression. The 4% ice creams seemed to be impacted more by: iciness, cis 3-hexen-1-ol (leaf-like), γ-undecalctone (peach), and α-ionone (violet/woody).
T234 The storage stability of IGF-I fortified dairy products and its improvement by microencapsulation. S. H. Kang¹, J. W. Kim², J. Y. Imm³, S. J. Oh⁴, and S. H. Kim². ¹Seoul Dairy Cooperatives, ² Korea University, Division of Food Science, ³ Kookmin University, Dept. Food & Nutrition, ⁴ Korea Yakult Co. Ltd.

The objectives of this study were to examine the stability of IGF-I fortified dairy products during storage and to suggest a process to improve storage stability. Powdered colostrum whey was used as a source of crude IGF-I and fortified to fresh milk, dried milk powder and yogurt at the level of 200 ng/mL. The changes of IGF-I content in the fortified dairy products during storage were determined by radiimmunoassay using 125I at typical storage conditions. As a way to improve storage stability, IGF-I was encapsulated by surface reforming process (hybridization) using enteric coating materials (Sturether and Eudragit L100-55) and the changes of IGF-I content were monitored. The IGF-I content in the fortified milk and dried powder was maintained during the tested period (12 days for milk, 4 weeks for dried powder) but significant decrease (p < 0.05) was found during the storage of yoghurt for 3 wks. When the Powdered colostrum whey was coated with enteric wall materials before fermentation, the IGF-I content in fortified yoghurt was maintained during fermentation and no significant differences was found. Therefore, the enteric coating of IGF-I prior to fermentation can be used as an effective way to prevent degradation of IGF-I during fermentation.

Key Words: IGF-I, Storage, Enteric coating materials

T235 Use of chemical mutagenesis approach and spiral-sheet bioreactor for the production of lactose free milk. S. A. Ibrahim¹, M. M. Salameh¹, G. Shahbazi¹, R. R. Shaker², and V. Shirley¹. ¹North Carolina A&T State University, ² Jordan University of Science and Technology.

Lactose intolerance is the inability to digest milk sugar, lactose, causing gastrointestinal symptoms of flatulence, bloating, cramps and diarrhea in some individuals. About 75% of the world’s population and approximately 90% of black Americans have some difficulty digesting lactose. Commercial lactase products are not usually the best choice for lactose intolerance, because even when these treatments provide relief they often produce other digestive tract distress symptoms. The purpose of this research was to develop a procedure that can reduce lactose content in milk. In this research, chemical mutagenesis was used to produce a cold resistant, over producing mutant of lactic acid bacteria that hydrolyzes lactose to glucose at refrigerated temperature. Lactobacillus helveticus was tested by a single exposure to two chemical mutagens, ethyl methane sulfonate (EMS) and N-methyl-N-nitro-N-nitosoguanidine (MNNG). To screen for β-galactosidase (β-gal) over-producing mutants, optimized EMS and MNNG mutant pots for L. helveticus were plated on BHI agar containing 5-bromo-4-chloro-3-indolyl-β-D-galactopyanoside (X-gal). Colonies that exhibited a blue color were selected for quantitative β-gal activities using the o-nitrophenyl-β-galactoside (ONPG) assay. Three mutants were obtained that exceeded the wild strain β-galactosidase activity levels (70 vs. between 80 and 320 Miller units, respectively). Mutants were then immobilized on a spiral-sheet bioreactor for continuous conversion of lactose into glucose at 4 C. Approximately 65% of lactose was converted into glucose. This technology has the potential for helping dairy farmers increase the market for dairy foods, address public health concerns and enhance the nutritional quality and safety of dairy foods.

Key Words: Lactobacillus helveticus, Lactose free milk

T236 Milk protein composition and its role in the phase separation phenomenon in soft-serve ice cream. C. Vega* and D. Goff, University of Guelph, Guelph, ON, Canada.

Incompatibility between milk proteins (especially casein) and polysaccharide stabilizers, such as Locust Bean Gum (LBG), renders a characteristic phase separation phenomenon in soft serve ice cream mixes subject to long storage periods. The inclusion of k-carrageenan in levels above 0.015% is effective in avoiding such event, but the mechanism is not well understood. An study of the composition of the milk protein revealed that casein micelles seem to be necessary to allow k-carrageenan to be functional. The use of sodium caseinate (NaCas) instead of skim milk powder (SMP) at a constant protein content and casein: whey protein ratio, at equal polysaccharide (LBG, k-carrageenan) concentrations, showed that the SMP system is more stable against separation. This suggests that k-carrageenan interacts with k-casein and, since the latter is still attached to the casein micelle in SMP and not in NaCas, it is possible for the stabilizer to better “hold” the SMP mix from wheying-off. Analysis of different whey to casein ratios (at constant protein concentration) have shown that as casein proportion diminishes (from 70 to 10%), the polydispersity and instability of the mix decreases. This suggests that casein induces polydispersity, which in turn manifests as instability during storage. This finding is consistent with the fact that as emulsifier (polmo) content is decreased (from 0.3 to 0%), the proportion of protein exposed in solution to interact with LBG, hence less separation. This event occurs at constant k-carrageenan concentration leading to the conclusion that, as the proportion of this stabilizer versus casein increases, it becomes more efficient.

Key Words: Carrageenan, Ice cream, Casein

T237 Optimization of Solid Phase Microextraction (SPME) for the analysis of volatile compounds in milk. H. Clarkson*, S. Duncan, and S. O'Keefe, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Solid Phase Microextraction (SPME) is a relatively new technique for analysis of volatile compounds. The sensitivity of milk compounds to light wavelengths and impact on odor and flavor needs further study. Several carbonyl compounds, including ketones, aldehydes, acids and dimethyl sulfide, contribute to the odors and off-flavors produced in milk due to light exposure. Application of SPME to this purpose requires additional knowledge of methodology variability. Water and milk were spiked with 1-hexen-3-one, dimethyl sulfide, pentanal and butyric acid as representative compounds. Volatiles were trapped by SPME, condensed by cryofocusing, and quantified by gas chromatography. Equilibration time (12, 17, 22, 32, and 37 minutes) and SPME detection of compounds in headspace of water and milk. Equilibration time (12, 17, 22, 32, and 37 minutes) and SPME detection of compounds in headspace of water and milk. Variation in detection of representative compounds was found for milk among the SPME fibers.

Key Words: SPME, Milk, Volatiles
ABSTRACTS
POSTERS, Wednesday, June 25, 2003

* Author Presenting Paper

Physiology: Metabolism, growth, and stress

W1  Identification and initial characterization of the adipocyte hormone adiponectin in Holstein bull calves. R. C. Cheatham*1, P. C. Gentry1, G. C. Duff1, and R. J. Collier1, 1University of Arizona.

The importance of adipose as a secretory organ has become apparent in recent years. Adipose tissue plays an important regulatory role in energy metabolism and nutrient partitioning. Adiponectin, a hormone exclusively secreted by differentiated adipocytes, promotes fatty acid utilization by liver and skeletal muscle and reduces plasma glucose without influencing insulin or glucagon concentrations in mice. To date, adiponectin has only been identified in humans and rodents. The objective of our study was to determine if adiponectin is expressed in bovine adipose and to characterize its expression in growing calves. An 880 bp adiponectin cDNA was created by RT-PCR of bovine adipose total cellular RNA and verified by sequence analysis. The resulting PCR product indicated 93% and 95% sequence identity with mouse and human adiponectin, respectively. Adiponectin expression was characterized in abdominal adipose tissue collected from Holstein bull calves sacrificed at 4 d (n=3), 4 wk (n=6) and 12 wk (n=5) of age. All calves were fed colostrum for at least three feedings, then fed a commercial milk replacer. Beginning on d 12, calves were offered a corn-based starter feed free choice. At slaughter, tissues were collected and snap frozen in liquid nitrogen, then stored at -80C until RNA was isolated. Adiponectin mRNA was detected on all days, indicating a likely role for this hormone in both preruminant and ruminant animals. As in other species, adiponectin appears to be adipose-specific. Adiponectin was not detected in muscle, liver or pooled RNA representing all regions of the bovine digestive tract. Amplification of the housekeeping gene G3PDH positive control verified integrity of the template and PCR reaction. Experiments to assess adiponectin expression in adult animals under different dietary conditions are underway, as is further work characterizing adiponectin in growing calves.

Key Words: Adiponectin, Adipose, Calves


Bovine somatotropin (bST) treatment in vivo alters adipose tissue metabolism by enhancing lipolytic response to adrenergic agonists. We examined the impact of bST and lactation on basal and stimulated lipolytic rates with isoproterenol (ISO; 10^-5 nM), adenosine deaminase (ADA; 0.75 U/mL), ISO plus ADA in short-term (2h) incubations of ovine adipose tissue. The anti-lipolytic effect of phenylisopropyladenosine (PIA; non-hydrolyzable adenosine analog) was evaluated at various concentrations (0.5, 1.5, 3, 100 nM). Sixteen lactating Santa Ines ewes were randomly assigned to two groups. They received two s.c. injections, with a 14 day interval, starting at d 13 postpartum with either bST (160 mg) or Vitamin E (control). Eight similar nonlactating ewes received vitamin E. Omental adipose tissue biopsies were taken on d 8 after the second bST or vitamin injection. The lipolytic rate was determined by NEFA release in media as µEq of oleic acid.2h−1.g−1 tissue. Basal lipolytic rates did not change with lactation or with bST treatment in vivo (P>0.05). ISO stimulated lipolytic rate increased compared to basal and was higher for the adipose tissue from lactating ewes treated with bST (P<0.05). The lipolytic rate for adipose incubated with ADA was higher than basal for lactating ewes treated with bST (P<0.01), and there was no difference between lactating and nonlactating ewes. The PIA effects were evaluated by the inhibition of ISO+ADA lipolysis, and adipose tissue from lactating ewes treated with bST showed a reduced response to PIA. The results demonstrate that in vivo somatotropin treatment increases maximal lipolytic rates and decreases the antilipolytic effect of PIA in omental adipose tissue in ewes.

Key Words: Somatotropin, Adenosine, Lipolysis
W3 Feeding Holstein cows anionic and cationic diets prepartum coupled with short dry periods and bST.

M. S. Gulay*, M. J. Hayen, and H. H. Head, University of Florida, Department of Animal Sciences.

Eighty-four Holstein cows were used to evaluate effects of prepartum anionic (-10 to -15 mEq/100g DM) or cationic (+20 mEq/100g DM) diets with low K (1.14 % of DM) on prepartum and postpartum DIM, BW and BCS, and subsequent MY. Treatments were in a 3x2x2 factorial arrangement that included dry period (30 d dry, 30 d dry+3ECP, and 60 d dry), diet, and prepartum and postpartum bST (POSILAC®10.2 mg/d). No interactions of bST or dry period length with prepartum diet were detected for any measure. No significant effects of prepartum diet on prepartum DIM, BW or BCS were observed. During the postpartum period (wk 1 through 14), no differences in mean BW or BCS were detected between prepartum diets fed. Decreases in BW and BCS were seen during the first 6 wk postpartum. Mean DIM during the first 28 d postpartum were similar for cows fed anionic and cationic diets prepartum (25.5 kg/d and 26.1 kg/d, respectively). No differences due to prepartum diet were observed for mean milk or 3.5 % FCY yields or for milk composition during the first 10 wk of lactation. Similarly, mean MY of cows during the first 21 wk did not differ significantly due to prepartum diet fed (anionic diet = 38.6 kg/d vs cationic diet = 38.5 kg/d). Feeding the anionic diet did not significantly improve either prepartum or postpartum concentrations of Ca. Cows fed the prepartum anionic and cationic diets had similar mean serum concentrations of Ca (9.35 mg/dL vs. 9.34 mg/dL), and only 8 cows fed each diet had serum concentrations of Ca less than 7 mg/dL the day following calving. No cases of clinical hypocalcemia were observed irrespective of diet fed. In conclusion, it appears that cationic diet with low K during prepartum period increased MY without adverse effects on milk composition or on health and differences were not lost completely during later lactation.

Key Words: Anionic-cationic, Milk yield, Transition period


Objective was to determine whether injections of bST during transition period improvedDMI, BW, BCS and MY. Eighty four multiparous Holstein cows were assigned to a 3x2x2 factorial design that included prepartum and postpartum bST, dry period (30 d dry, 30 d dry+ECP, and 60 d dry), and cationic or anionic or cations and anions injections of bST began ±21 d (±3 d) before expected calving date and through 42 d (±2 d) postpartum (C, n=42 vs I, n=42: 0 vs 10.2 mg bST/d, POSILAC®). At 56 d (±2 d), cows in both groups were injected with 500 mg bST/14 d. No interactions of dry period length or prepartum diet with bST treatment were detected for any measure. No significant effects of prepartum diet fed or dry period length were observed for DMI, BW, BCS, or MY. During the prepartum period no differences were detected between treatment groups for mean BW (C=668 vs I=682 kg) or BCS (C=3.38 vs I=3.42). Birth weights of calves did not differ between groups (C=38.3 vs I=36.5 kg). Mean BW (C=688 vs I=682 kg) and BCS (C=688 vs I=682 kg) were not affected by treatment during postpartum period. bST did not affect mean DIM during prepartum (C=16.1 vs I=16.9 kg/d) or first 28 d postpartum (C=25.7 vs I=25.9 kg/d). Mean energy status of cows during the first 4 wk postpartum was negative and did not differ between groups (C=−18.25 vs I=−16.07 Mcal/d). During first 10 wk bST-injected cows had greater mean milk, 3.5 % FCY, and SCM yields (39.6 kg/d, 42.1 kg/d and 40.5 kg/d, respectively) than non-injected cows (36.7 kg/d, 38.9 kg/d and 37.5 kg/d, respectively). No differences were observed in percentages of protein (2.86 vs 2.87 %) or fat (3.93 % vs 3.96 %) due to bST, but non-injected cows had greater SCC than bST- injected during the first 10 wk of lactation (527 vs 323x103). When both injected and non-injected cows received a full dose of bST at d 60 the increase in milk production was maintained better through 21 wk in the bST-injected cows (C=37.5 vs I=40.5 kg/d; P<0.05). No prepartum or postpartum health problems or apparent calving problems were associated with bST.

Key Words: Transition cows, bST, Milk yield

W6 Effect of low dose of bovine somatotropin (bST) on hormone, IGF-I and metabolite concentrations during the transition period. M. S. Gulay*, M. J. Hayen, and H. H. Head, University of Florida.

Experiment was designed to evaluate concentrations of hormones (ST and INS), growth factor (IGF-I), metabolites (glucose and NEFA) and Ca in plasma of 80 Holstein cows injected biweekly with bST during the transition period (C, n=40 vs I, n=40: 0 vs 10.2 mg bST/d, POSILAC®). Biweekly injections of bST were started prepartum 21 d (±3 d) before expected calving date and through 42 d (±2 d) postpartum. No differences were detected for mean concentrations of glucose (I=70.6 vs C=69.3 mg/dL) or NEFA (I=265.0 vs C=273.5 µEq/L) between bST treatment groups during the overall postpartum period (d −21 to d −1), but ST (I=8.19 vs C=5.51 ng/mL; P<0.01), IGF-I (I=318.7 vs C=285.2 µEq/L; P<0.01), and INS (I=8.85 vs C=1.06 µEq/L; P<0.01) did differ during prepartum period. No differences were detected for mean concentrations of INS (C=0.62 vs I=0.58 ng/mL), glucose (C=61.9 vs I=62.1 mg/dL or NEFA (C=584.3 vs I=634.2 µEq/L) due to bST treatment during the overall postpartum period (d 1 to 28). Cows in non-bST group had lower mean concentrations of ST in plasma (5.52 ng/mL) than cows in bST-injected group (10.33 ng/mL; P<0.01). Mean concentrations of IGF-I during the overall postpartum period also were greater for the bST treated group (I=150.2 vs C=117.4 ng/mL; P<0.01) and they were maintained greater (+27.9%) than non-bST group throughout the early postpartum period. Concentrations of Ca during the 2 wk before 2 wk after calving did not differ significantly due to treatment (I=9.28 vs C=9.414 mg/dL). Although serum Ca concentrations were least the day following calving, only 16 of the 80 cows had concentrations of Ca less than 7 mg/dL at that time (I=5 and C=11 cows). Changes in concentrations of metabolic hormones, IGF-I and blood metabolites due to injections of 10.2 mg bST/d during transition period likely improve metabolic status of the cows during early lactation without causing calving or health problems prepartum or postpartum.

Key Words: bST, Hormones, Transition period

Key Words: Transition cows, bST, Milk yield


Objective was to evaluate effects of injecting a low dose of bST (0.4 mL, 10.2 mg/d, POSILAC®) during prepartum and/or postpartum periods on milk yield (MY) and composition, BW and BCS. Multiparous Holstein cows were assigned randomly to a 3x2x2 factorial arrangement of treatments (TRT) to give four groups (1=non bST, n=26; 2= bST postpartum, n=25; 3= bST prepartum, n=27; 4= bST prepartum and postpartum, n=25). Bi-weekly injections of bST were in left or right ischiorectal fossa and began 3 wk before expected calving date and continued through 70 DIM; beyond 70 DIM all cows were injected biweekly with POSILAC® (500 mg/14 d). Significant effects of bST (P<0.0579) were detected on mean daily MY through 70 DM; means for the four TRT groups were 33.93, 36.48, 37.76 and 40.33 kg/d, respectively; all TRT means differed (P<0.063) except for 2 vs. 3. No effects of calving season (SEA) were detected on MY (P=0.6656), nor TRT or SEA effects on BW (P=0.2817 and P=0.4297) or BCS (P=0.4315 and P=0.5158). Mean BW and BCS for the four TRT groups were 659.1 and 3.14, 659.6 and 3.09, 659.5 and 3.10, 680.4 and 3.16, respectively. No effects of bST were detected on percentages of milk fat (P=0.8825) or protein (P=0.5336); mean percentages for TRT groups during first 70 DIM were 3.82 and 2.99, 3.78 and 2.95, 3.85 and 2.88, 3.72 and 2.91, respectively. No significant effects of TRT were detected on somatic cell count (SCC, P=0.5331); TRT means were 540, 608, 326 and 576 x 103 cells/mL milk. During 70-150 DIM, when all cows were injected with full dose of bST, increases in POSILAC® increases in MY still were detected but magnitude of effects were reduced to about one-half of previous differences. Means for the four TRT groups were 36.97, 38.08, 39.61 and 40.63 kg/d, respectively. We concluded that injecting bST during prepartum and/or postpartum periods increased MY without adverse effects on milk composition or on health and differences were not lost completely during later lactation.

Key Words: Milk Yield, Dairy cow transition period, bST
The ability of recombinant bovine somatotropin (rbST) to enhance milk yield is compromised during periods of undernutrition, such as the period immediately following parturition. This has been attributed, in part, to decreased hepatic growth hormone (GH) dependent production of IGF-1 in liver. Our goal was to develop a chronic animal model to study the basis of this impairment. Six non-pregnant, late-lactating dairy cows were subjected to two 14 d periods when they were offered a high or low plane of nutrition. The high plane of nutrition provided 120% of predicted energy requirements whereas the low plane provided only 33% of maintenance requirements. During each feeding period, excipient or rbST (40 mg IM, daily) was administered in a single reversal design with 4 d periods separated by a 2-d interval. Blood samples and liver biopsies were obtained on the fourth day of excipient or rbST treatment. The shift from the high to the low plane of nutrition resulted in lower plasma IGF-1 (157 vs 69 ng/ml, p < 0.01) even though the plasma concentration of GH increased (5.9 vs 9.8 ng/ml, p < 0.01). The plasma concentration of insulin was also reduced underfeeding. More importantly, administration of rbST increased the plasma concentration of IGF-1 to a greater extent during the high plane of nutrition (104 vs 210 ng/ml, p < 0.01). The plasma concentration of GH decreased during the low plane of nutrition (57 vs 81 ng/ml, p < 0.01). Surprisingly, rbST caused similar increases in IGF-1 gene expression in liver at both feeding levels. We conclude that in late-lactating dairy cows, a severe nutritional insult is not sufficient to completely block GH-dependent IGF-1 synthesis.

Key Words: GH resistance, Liver, IGF-1


We used cDNA microarray technology to study mammary gene expression in dairy cows. Mammary tissue was collected by percutaneous biopsy at -14, +1, and +14 d relative to parturition from 2 multiparous Holstein cows fed according to current NRC recommendations throughout the dry period and the first 49 d postpartum. A microarray consisting of 7,872 cDNA inserts was constructed from a collection of clones selected from placenta and spleen cDNA libraries. Annotation was based on similarity searches using BLASTN and TBLASTX against the human and mouse UniGene databases. A total of 6,626 sequences (84%) have significant similarity to human or mouse genes and could be assigned as putative orthologs. Gene Ontology terms were annotated to the sequence and putative functions assigned. Cy3- and Cy5-labelled cDNA from tissue and a universal control sample (derived from a mixture of cattle tissues not including liver or mammary tissue) were used for hybridization. Three exogenous plant genes were used as spiking controls for data normalization. A parametric test using the cross-gene error model with log-transformed ratios in GeneSpring was used. Preliminary data analysis demonstrated clear increases over time in the expression (fold-change expressed as tissue/universal control) of genes with known or unknown functions associated with metabolism that accommodate copious milk synthesis. Large fold-changes in mRNA expression were detected between -14 and +14 d for stareryl-CoA desaturase, xanthine dehydrogenase, fatty acid binding proteins-3 and -5, fatty acyl-CoA lysase-2, transport proteins (ABCG2, ABCA1, TAP1), GLUT1, IGFBP3, Lpin-1, SPP1, kinases (Janus, pyruvate dehydrogenase-4, myosin light-chain), PDH kinase-4, pyruvate dehydrogenase-4, dihydrolipoamide dehydrogenases, catalase, aminopeptidase, fatty acyl-CoA acyltransferase-2, sterol-C4 methyl oxidase, fatty acid transporter-2 (SLC27A2), fatty acyl-CoA lyase-2, carnitine-palmitoyltransferase-1 and -2, acetyl-CoA oxidase, and acetyl-CoA acytransferase-2 increased over time. Among genes involved in glucose metabolism, the pyruvate dehydrogenase complex (PDHB), PDH kinase-4, and two dehydrogenase and dehydrogenases also increased over time. mRNA expression by +14 d of genes associated with cholesterol synthesis (sterol-CoA methyl oxidase), androgenic metabolism (sterol carrier protein-2), IGF-1 and -2 metabolism (IGFBP4), and antioxidiant activities (catalase, selenoprotein P) was markedly upregulated. Results demonstrate the power of microarrays to study patterns of gene expression in bovine liver.

Key Words: Microarray, Liver, Dairy cow

W10 Preliminary evaluation of a sustained-release delivery system of porcine (p) somatotropin (ST) in pigs. H. S. Ringrose1, K. E. Goven1, T. A. Haagland1, S. Martinod2, and S. A. Zinn1, 1University of Connecticut, 2Smart Drug Systems, Inc.

To begin evaluation of sustained-release of porcine (p) somatotropin (ST) from covered-rod implants (CRI), 3 experiments (Exp.) were conducted. In Exp. 1, 6 formulations of CRI were individually incubated in 0.05 M PBS (3 mL; pH 7.5; 20°C) for 14 d and was used in Exp. 2 and 3. Yorkshire-crossbred pigs (Exp.2: n=38; Exp.3: n=40) were housed (2 pigs/pen) in a climate-controlled barn and given ad libitum access to a pelleted feed (16% CP, 1% lysine) and cholesterol synthesized (sterol-CoA methyl oxidase), steroids (sterol carrier protein-2), IGF-1 and -2 metabolism (IGFBP4), and antioxidiant activities (catalase, selenoprotein P) was markedly upregulated. Results demonstrate the power of microarrays to study patterns of gene expression in bovine liver.

Key Words: Microarray, Liver, Dairy cow


We used cDNA microarray technology to study hepatic gene expression in periparturient dairy cows. Five Holstein cows fed according to current NRC recommendations throughout the prepartum period and the first 49 d postpartum were used. Liver was biopsied at -65, -30, -14, +1, +14, +28, and +49 d relative to calving. A microarray consisting of 7,872 cDNA inserts was constructed from a collection of clones selected from placenta and spleen cDNA libraries. Annotation was based on similarity searches using BLASTN and TBLASTX against the human and mouse UniGene databases. A total of 6,626 sequences (84%) have significant similarity to human or mouse genes and could be assigned as putative orthologs. Gene Ontology terms were annotated to the sequences and putative functions assigned. Cy3- and Cy5-labeled cDNA from tissue and a universal control sample (derived from a mixture of cattle tissues not including liver or mammary tissue) were used for hybridization. Among genes involved in glucose metabolism, the pyruvate dehydrogenase complex (PDHB), PDH kinase-4, and two dehydrogenase and dehydrogenases also increased over time. mRNA expression by +14 d of genes associated with cholesterol synthesis (sterol-CoA methyl oxidase), androgenic metabolism (sterol carrier protein-2), IGF-1 and -2 metabolism (IGFBP4), and antioxidiant activities (catalase, selenoprotein P) was markedly upregulated. Results demonstrate the power of microarrays to study patterns of gene expression in bovine liver.
W11  Actions of lipopolysaccharide, prostaglandin-F2α, and the nitric oxide generator, sodium nitroprusside dihydrate, on oocyte maturation and embryonic development.  J. Hernández-Cerón1*, C. C. Chase2*, and P. J. Hansen3*, Dept. of Animal Sciences, University of Florida.

Mastitis and immunization against constituents of organisms causing mastitis can reduce fertility of cattle and sheep, respectively. Here, it was hypothesized that these effects are mediated via actions of lipopolysaccharide (LPS), prostaglandin-F2α (PGF), and nitric oxide on oocyte maturation and embryonic development. To evaluate effects on oocyte maturation, oocytes were matured with various concentrations of LPS, PGF, or the nitric oxide generator, sodium nitroprusside (SNP). Following maturation, oocytes were fertilized and cultured until d 8 after insemination. To test effects on embryo growth, oocytes were matured and fertilized and cultured after fertilization with LPS, PGF, or SNP. Addition of 100 and 1000 ng/ml LPS and 50 and 100 ng/ml PGF to oocyte maturation medium reduced (P<0.05) the proportion of oocytes that became blastocysts at d 8 after insemination. For example, the least-squares means for percent oocytes that became blastocyst was 29, 26, 26, 21, 24, 14, and 13% (pooled SEM=4.7%) for oocytes cultured with 0, 0.01, 0.1, 1.0, 10.0, 100.0, and 1000.0 ng/ml LPS, respectively (n=80-136 oocytes/group in 4 replicates). When added after fertilization, in contrast, neither LPS nor PGF reduced development to the blastocyst stage. Addition of SNP during oocyte maturation was without effect on the proportion of oocytes that became blastocysts. However, addition of 10 mM SNP to culture medium after fertilization blocked development to the blastocyst stage (P<0.001) while 0.1 and 1 mM SNP did not affect development (percent oocytes to blastocyst at d 8 after insemination = 15, 15, 15, and 0%; pooled SEM=2.2%; n=144-151 oocytes/group in 5 replicates). Results indicate that LPS, PGF, and NO can have adverse effects on oocyte function (LPS, PGF) and embryonic development (NO). It is concluded that increased local synthesis of PGF and NO may mediate effects of mastitis or immune activation on fertility in cattle. It is unlikely, however, that the direct action of LPS on the oocyte is an important cause of infertility in mastitis because effects of LPS on oocyte maturation occurred at concentrations higher than seen in peripheral circulation during mastitis.

Key Words: Oocyte, Embryo, Mastitis

W12  Postpartum changes in hormones and metabolites during early lactation in summer and winter calving Holstein cows.  L. I. Nordbladh*, A. E. Sweetman, and C. S. Whisnant, North Carolina State University, Raleigh, NC.

Heat stress is known to decrease milk production and reproductive performance in dairy cattle. The mechanism of action is uncertain. The purpose of the current experiment was to compare levels of metabolic hormone and metabolites in early lactation dairy cows in heat stress or cool environments. A total of 18 Holstein cows (Summer (S) n = 11; Winter (W) n = 7) were used. Maximum and minimum temperatures and relative humidity were collected daily for calculation of temperature humidity index (THI). Blood samples were collected within 24 hours after calving and then weekly thereafter for 12 weeks during both seasons. Plasma concentrations of progestosterone (P4), thyroxine (T4) and beta-hydroxybutyrate (BHBA) were determined using radioimmunoassay (P4, T4) or commercial kit (BHBA, Sigma). Differences between seasons in concentrations of hormones and BHBA were determined using ANOVA with the GLM procedure of SAS for repeated measures. THI was greater during the period of sampling for S cows compared with W cows. The THI during S (70.2) was classified as mild heat stress. Based on serum P4 cows calving during S had a longer interval to first ovulation (47.3 ± 4.5 d) than those calving during W (32.5 ± 2.3 d). Serum T4 concentrations were higher (P<0.01) in W calving cows (5.5 ± 0.3 µg/dL) than in S calving cows (1.8 ± 0.3 µg/dL) for the first 8 weeks postpartum but were not different for weeks 9 through 12. Concentrations of BHBA did not differ between S calving (9.4 ± 3.5 mg/dL) and W calving (8.1 ± 2.9 mg/dL) cows but did decline over time postpartum (P<0.05) during both seasons. Reduced T4 concentrations in heat stressed early lactation dairy cows appeared to be associated with a delay in first postpartum ovulation.

Key Words: Heat Stress, Thyroxine, Dairy Cow

W13  Differences in sensitivity to heat shock between preimplantation embryos from heat-tolerant (Brahman and Rosominiuano) and heat-sensitive (Angus) breeds.  J. Hernández-Cerón1*, C. C. Chase2*, and P. J. Hansen3*, Dept. de Reproducción, Universidad Nacional Autónoma de México, México D.F., 2USDA-ARS Subtropical Agricultural Research Station, Brooksville, FL, 3Dept. of Animal Sciences, University of Florida, Gainesville, FL 32611-0910.

Certain heat-tolerant breeds of cattle have acquired mechanisms to protect cells against damage from high temperature. Exposure of embryos to 41°C reduced development more for Holstein and Angus (An) embryos than for Brahman (Br) embryos. The Rosominiuano (Ro) is a Bos taurus from Colombia. Like Br, Ro is a tropically-adapted breed. It is not known, however, whether this breed, distinct in origin from Br, has evolved to possess cellular adaptations to heat shock. A study was performed to test whether Br and Ro embryos survive heat-shock better than An embryos. Cows (n=14 An, 17 Br, and 15 Ro) were slaughtered in groups of 2-3 per breed (5-6 replicates). For each replicate, oocytes were pooled within breed and oocytes harvested and fertilized with semen from a pair of bulls of the specific breed. A different pair of bulls was used for each replicate. At d 4 after insemination, embryos ≥8 cells were randomly assigned to control (38.5°C) or heat shock (41°C for 6 h) treatments. Development to blastocyst was determined on d 8. The proportion of oocytes that cleaved at d 4 tended to be highest for Ro (54 ± 8.4%, 50 ± 7.7%, and 70 ± 7.7% for An, Br and Ro; Ro vs others, P=0.07). The proportion of cleaved embryos that were ≥8 cells at d 4 after insemination (P=0.05) were 37% for Br (76 ± 8.1%), 42% and 77 ± 7.4% for An (for An, Br, and Ro). Heat shock caused a reduction in the proportion of embryos that became blastocysts at d 8 (P<0.001). At 38.5°C, there were no significant differences in development between breeds. Among embryos exposed to 41°C, however, development was lower (P<0.05) for An than for Br and Ro. Furthermore, there was a An vs (Br + Ro) x temperature interaction (P=0.09) because heat shock reduced development more for An (30.3% ± 4.6% at 38.5°C vs 4.9 ± 4.6% at 41°C) than for Br (25.1 ± 4.6% vs 13.6 ± 4.6%) and Ro (28.3 ± 4.1% vs 17.5 ± 4.1%). There were no effects on cell number of d 8 blastocysts. Results demonstrate that embryos from thermotolerant breeds (Br and Ro) are more resistant to elevated temperature than embryos from a thermosensitive breed (An). Thus, the process of adaptation of Br and Ro breeds to hot environments resulted in both cases in selection of genes controlling thermotolerance at the cellular level. (USDA-IAFS 2001-52101-11318 and TSTAR 2001-34125-11150).

Key Words: Embryo, Heat shock, Breed

W14  Differences in sensitivity to heat shock between preimplantation embryos from heat-tolerant (Brahman and Rosominiuano) and heat-sensitive (Angus) breeds.  J. Hernández-Cerón1*, C. C. Chase2*, and P. J. Hansen3*, 1Dept. de Reproducción, Universidad Nacional Autónoma de México, México D.F., 2USDA-ARS Subtropical Agricultural Research Station, Brooksville, FL, 3Dept. of Animal Sciences, University of Florida, Gainesville.

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Key Words: Embryo, Heat shock, Breed
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Key Words: Embryo, Heat shock, Breed

W15 Heat shock protein-70 is upregulated in retained testicles of cryptorchid stallions. J. N. Oyarzo1, 2, P. C. Gentry3, G. R. Dawson4, R. L. Ax1, and R. J. Collier4, 1 University of Arizona, Tucson AZ.

Heat shock proteins (HSP) are a class of molecular chaperones that protect the three-dimensional structure of proteins subjected to thermal stress. Heat shock proteins have been implicated in fertility of several species, but have not, to date, been characterized in stallions. Lower levels of HSP in equine cryptorchid (Br) and normal testis (Ro) have been associated with decreased semen quality in boars. In the desert southwest US, environmental heat stress could further potentiate the decline in stallion sperm quality typical of summer months. Our objectives were to assess HSP expression in ejaculated sperm and testicular tissue. Heat shock protein 25, HSP40, HSP70 and HSP90 were assessed by Western blot using commercially available anti-human HSP antibodies validated for use with equine samples. Exp. 1, HSP expression was determined in archived semen samples from four fertile stallions collected in January (low temperature, short photoperiod) and July (high temperature, long photoperiod), as well as in fresh and fresh frozen semen samples collected in August and September. Heat shock proteins were not detected in any semen sample, indicating that ejaculated stallion sperm do not express HSP at levels detectable by this method. In experi- mental stallions, testosteronel level expression is correlated with daylength, decreasing with decreasing photoperiod. Experiment 2 was designed to assess the effect of testis temperature independent of testosterone levels. Heat shock protein profiles were assessed in testicular tissue from three cryptorchid stallions castrated in January and February. HSP40 and HSP70 were detected in both normal descended and retained testes, however, HSP70 were increased two fold in retained testes relative to paired descended testicles, indicating that maintenance at core body temperature upregulates HSP70. Immunochemical detection of HSP in the retained testes suggest a role for HSP in maintenance of stallion sperm quality in vivo and may be useful in assisted reproductive techniques in horses.

Key Words: Stallion, Testes, Heat shock protein

W16 Nucleotide and predicted amino acid sequence of equine bmal1: a key biological clock component showing high homology to human bmal1. B. A. Murphy* and B. P. Fitzgerald, 1University of Kentucky, Lexington, Kentucky.

The mammalian master circadian clock resides in the suprachiasmatic nucleus (SCN) of the hypothalamus and drives daily variations in many physiological, biochemical and behavioral processes. The SCN receives input from peripheral circadian systems, especially now that the impracticality of sacrificing the experimental animals may be overcome by non-invasive peripheral detection of molecular clock components.

Key Words: Circadian, Bmal1, Equine

W17 Characterization of soluble CD14 in bovine milk. J.-W. Lee*, 1 X. Zhao1, and M. J. Pape1, 1Department of Animal Science, McGill University, 2IDRL, USDA-ARS, Beltsville, MD.

Soluble CD14 (sCD14) has been shown to prevent death induced by “septic shock”, inhibit dissemination of pathogens, stimulate lymphocyte proliferation, and facilitate phagocytosis of bacteria. It has been proposed that sCD14 in human milk plays a role not only in breast-feeding associated benefits, but also in protecting the mammary gland from bacterial infections. However, sCD14 in bovine milk has not been well documented. In the present study, milk samples from 10 lactating cows (396 functional quarters) were assayed for sCD14 to determine whether stage of lactation (0-4, 5-99, 100-200 and >200 d), somatic cell count (SCC) or intramammary infection affect concentration of sCD14 in milk. The average concentration of sCD14 was 6.90 ± 0.17 µg/ml, was the highest 0-4 d postpartum (11.39 ± 0.49 µg/ml) and the lowest 100-200 d postpartum (4.56 ± 0.27 µg/ml). The concentration of sCD14 was lower in milk with a SCC < 250,000/ml (6.13 ± 0.28 µg/ml) than that of milk with a SCC > 750,000/ml (7.05 ± 0.29 µg/ml). No difference was found between non-infected and infected quarters. Results indicate that the concentration of sCD14 in bovine milk is close to the range of sCD14 in body fluids from other species, and can be affected by stage of lactation and SCC. The high content of sCD14 in milk 0-4 d postpartum may be associated with the known protective role of colosturin for the calf.

Key Words: CD14, Bovine, SCC

W18 Effects of recombinant bovine growth hormone on levels of the bacteria Edwardsiella ictaluri in channel catfish (Ictalurus punctatus). B. C. Peterson* and A.L. Bilodeau, 1USDA/ARS.

Research was conducted to examine the immunoregulatory role of recombinant bovine growth hormone (rbGH, Posilac) in channel catfish, challenged with Edwardsiella ictaluri (E. ictaluri). A total of 240 fish (3.7 ± 7 g) were assigned randomly to four treatments with three replicates each. The treatments were 1.) Con-Exposed (Sham injected by needle puncture and challenged with E. ictaluri), 2.) Con-Nonexposed (Sham injected by needle puncture and not challenged), 3.) rbGH-Exposed (Posilac, injected at 30 µg/g BW and challenged with E. ictaluri), and 4.) rbGH-Nonexposed (Posilac, injected at 30 µg/g BW and not challenged). Treatments were then randomized to one of each sampling day (1 and 5). Fish were maintained in 24, 120-L tanks (10 fish/tank) for three weeks prior to challenge. During this time, fish were injected (rbGH or sham) and specific growth rates were assessed. Fish were challenged (rbGH or sham) two days prior to challenge with E. ictaluri. A genetic assay utilizing real-time PCR was used for detection and quantification of E. ictaluri and mortality was recorded daily. Specific growth rate was higher (P = 0.06) in rbGH-treated fish compared to sham injected controls (3.5 vs 3.0) prior to challenge. All non-exposed fish tested negative for the presence of E. ictaluri throughout the trial. On days 1 and 5, rbGH-Exposed fish exhibited lower (P < 0.05) levels of E. ictaluri when compared to Con-Exposed fish (0 vs 3.254 ± 2.927) (cell-equivalents/100 mL whole blood) and (10.230 ± 5.813 vs 62.294 ± 34,315) (cell-equivalents/100 mL whole blood), respectively. Mortality was similar between rbGH-Exposed and Con-Exposed throughout the study. Reduced levels of E. ictaluri in rbGH-Exposed fish suggest an immunoregulatory role for rbGH in channel catfish.

Key Words: rbGH, Edwardsiella ictaluri, Catfish
W19 Effect of Iranain Kilka fish meal on performance and some blood metabolites in early lactating dairy cows. A.R. Heravi M1, M. Danesh Mesgaran1, D. Zamiri2 and F. Eftekhary1. 1Department of Animal Science, Ferdowsi University of Mashhad, Iran, 2Department of Animal Science, Shiraz University, Shiraz, Iran.

Twelve multiparous Holstein cows at 27 days in milk were used in a randomized design, with repeated measures analysis, of 8 weeks to evaluate the feed intake, milk yield and composition, blood metabolites (glucose, urea N, soluble protein and cholesterol) and progesterone when soybean meal (SBM) was replaced with different levels of Iranian Kilka fish meal, KFM. A fish sp. located in the Caspian Sea. On a dry matter (DM) basis, the control diet (T1) consisted of alfalfa (25.2%), corn silage (15.2%), ground barley (22%), ground corn (8.4%), soybean meal (7.9%), cottonseed meal (2.5%), cottonseed (4.9%), wheat bran (6.5%), beet pulp (5.9%), urea (0.1%), limestone (0.1%), dicalcium-phosphate (0.3%), salt (0.2%) and a mineral-vitamin complex (0.8%). In T2 and T3, 28.5 and 35.30% of SBM was replaced with KFM. Dry matter intake of the cows fed T1, T2 and T3 was 23.5, 23.8 and 22.3 0.16 kg/d, respectively, and was not affected by diet (P=0.09). Milk yield (38.51, 37.7 and 39.25 0.24 kg/d); milk fat (3.06, 2.64 and 2.53 0.084%); and milk protein (2.757, 2.88 and 2.967 0.21 %) were not significantly influenced by the experimental diets. At 35 d in milk, ovarian cycles were synchronized using the Pre-Synchronization/Ovsynch protocol. Plasma cholesterol and progesterone concentrations were not affected by diets on day of first GnRH (61 d in milk) or PG injection (68 d in milk) in Ovsynch protocol. At 80 DIM, blood was collected from coccygeal vessels at 0, 1.5, 3 and 4.5 hours after the morning feed. Plasma glucose, urea nitrogen and soluble protein were not significantly affected by the diets but plasma glucose and soluble protein varied over time (P<0.01). It may be concluded that the replacing SBM with KFM in the diets designed for early lactating cows did not alter the lactational performances, blood metabolites and progesterone concentration.

Key Words: Fish meal, Ovsynch, Blood metabolites

Lactation Biology

W22 Characterization of a 4,600 gene bovine microarray. C.M. Stiening1, J. Hoyoig1, A. Hoying1, D. Henderson1, P. Gentyl1, Y. Kobayashi1, and R. Collier1, 1Univ. of Arizona, 2Michigan State Univ.

A cDNA microarray containing approximately 4600 ESTs was created to evaluate differential gene expression in dairy and beef cattle, with attention to mammary, pituitary and gastrointestinal tissues. Of the 4600 sequences printed, 1526 were generated from mammary tissue, with 540 of those (“Lactation” subgroup) from a subtracted cDNA library (lactating minus involuted tissue) and the remaining 986 (“Non-lactation” subgroup) from the reciprocal library (involuted minus lactating tissue). Approximately 1000 non-redundant pituitary sequences were spotted, and the majority of the remaining 2000 sequences represent the complete GI tract from esophagus to colon. The pituitary and digestive tract ESTs came from sequenced cDNA libraries that were virtually subtracted to minimize redundancy. Printing was conducted at the Univ. of Arizona Genomics Research Lab. Each sequence was spotted in triplicate in an environmentally controlled workstation using a 48-pin print head. Spot morphology and hybridization parameters were evaluated using 3 standard tests. First, SybrGreen was used to verify the presence of DNA in each spot. Second, a random Cy3-labeled oligo (9-mer) was used to validate hybridization competency. Lastly, parameters of the hybridization protocol were evaluated using a same-sample test in which half of the sample was labeled with Cy3 and the other half with Cy5. A preliminary study was next analyzed to obtain initial estimates of variance. Two cDNA arrays arranged in an incomplete block design on dye and treatment were analyzed using statistical package “R”. Rough estimates of array variance (confounded with dye variance) and average pooled gene variance were calculated, with array variance = 4.1 x 10^-7, gene variance = 0.313, and a mean absolute difference between treatment groups of 1.02 (natural log scale). These preliminary results suggest consistency in printing and hybridization techniques and help establish confidence in our ability to produce robust microarray results with minimal extraneous (non-genetic) sources of variation.

Key Words: Cow, Mammary gland, Adrenergic receptors

W23 Effects of varying energy intakes on the deposition of type IV collagen (Col IV) and fibronectin (FN) in the mammary tissue of pre-pubertal heifers. J. W. Forrest1, R. M. Akers1, R. E. Pearson2, E. G. Brown3, M. J. VandeHaar1, and M. S. Weber Nielsen2, 1Virginia Tech, Blacksburg, VA, 2Michigan State University, East Lansing, MI.

Our objective was to determine the effects of energy intake on the extracellular matrix of mammary parenchyma. At 2 wk of age, Holstein calves were assigned to 1 of 4 treatments (HH, HL, LL, and LL) with 2 levels of energy intake (High or Low) during 2 periods of growth (2 to 8 and 8 to 14 wk of age). At 14 wk, parenchyma at the stromal interface (I), mid-gland (M), and above the cistern (C) were collected from each calf, fixed, and embedded in paraffin, resulting in 30, 21, 24, and 27 samples, respectively, for each treatment. Immunocytochemical staining of sections allowed visualization of Col IV and FN. Images representing 4 increasing grades (1,2,3,4) were used to quantify protein intensities. Neither feeding level nor zone affected the frequency or intensity of Col IV staining. Average Col IV staining intensity in the basement membranes (BM) of terminal ductular units (TDUs) and subtending ducts (SUBs) was 1.5, however, staining was observed more frequently around the large mammary ducts were investigated as well as adrenergic receptor mRNA expression. Milk flow of one quarter was recorded in 10 cows without or with additional α- and β-adrenergic receptor stimulation in the bovine mammary gland affects milking characteristics such as milk yield and peak flow rate. The aim of this study was to detect correlations between milkability, receptor binding capacity and receptor expression at the mRNA level. In addition, dose-response relationships of α- and β-adrenergic receptor stimulation were evaluated after application of α- and β-adrenergic agonists, respectively. Density of adrenergic receptor binding sites in the region around the large mammary ducts were investigated as well as adrenergic receptor mRNA expression. Milk flow of one quarter was recorded in 10 cows without or with additional α- and β-adrenergic receptor stimulation in 3 dosages each. After slaughter, mammary tissue was taken from the region around the large mammary ducts in the previously investigated quarters. Protein and RNA were extracted for measuring α1-, α2-, and β2-adrenergic receptor binding sites and mRNA expression levels by real-time RT-PCR. Peak flow rate without additional adrenergic receptor stimulation was negatively correlated (p<0.05) with α2-adrenergic receptor binding (maximal binding capacity Bmax) and positively correlated with α2-adrenergic receptor expression at the mRNA level (p<0.05). During α-adrenergic receptor stimulation, there was a negative correlation (p<0.05) between milkability and α2-adrenergic receptor mRNA expression, whereas during β-adrenergic receptor stimulation no correlations were detected. Dose-response relationships existed during α-, but not during β-adrenergic receptor stimulation. Significant changes (p<0.05) of milk yield and peak flow rate mainly occurred after α-adrenergic receptor stimulation. In conclusion, high mRNA expression or binding levels of adrenergic receptors are not necessarily related to according changes of milk yield and peak flow rate. To influence milking characteristics, individual reactions of the cow on adrenergic stimulation have to be considered.

Key Words: Cow, Mammary gland, Adrenergic receptors

In cattle, prepubertal mammary development is characterized by a period of allometric growth. During this period, ductal epithelium elongates into the mammary fat pad (FP). This growth is orchestrated by signals of both local and systemic origin and likely requires the interaction between the FP and the developing parenchyma. The goal of this study was to determine whether the expression of key regulatory genes, such as IGF-I and estrogen receptor-alpha (αER), vary within each compartment during mammary development. To answer this question, we collected mammary tissues from 200 kg prepubertal Holstein heifers. Total RNA was extracted from these tissues and specific transcripts were quantified by ribonuclease protection assays. Parenchyma was collected from the cisternal region, the region adjacent to the FP boundary, and from a region equidistant to the aforementioned region (medial). The FP was sampled near the abdominal wall (dorsal region) near the supra mammary lymph node (caudal region) and adjacent to the parenchymal boundary. αER transcript was detected in all samples and there were no differences in expression within the various parenchymal or FP regions. Similarly, expression of the IGF-I gene did not differ across the different FP regions. However, in the parenchyma, expression of this transcript tended to be lower (P < 0.08) in the cisternal region than in either the medial region or the region adjacent to the FP boundary. These data demonstrate that αER transcript is expressed uniformly throughout the parenchyma as well as the FP. Likewise, IGF-I expression is uniform throughout the FP. However, IGF-I transcript abundance tends to be greater in parenchymal tissues collected dorsal to the cisternal region.

Key Words: IGF-I, Estrogen receptor-alpha, Mammary development

W25 Expression of translation initiation factors in mammary glands of lactating and dry dairy cows. C. A. Toerien*, J. P. Cant, and C. K. Stewart, Univ. of Guelph, ON, Canada.

Factors regulating processes and machinery involved in milk protein production were investigated using mammary glands from 12 non-pregnant dairy cows in late lactation (>250 DIM; 17 kg milk/d). For 42 d, 6 cows were milked as previously (LACT) while 6 cows were dried off (DRY). Cows were then slaughtered and mammary glands and tissue samples were milked as previously (LACT) while 6 cows were dried off (DRY). Cows were slaughtered and mammary glands and tissue samples were obtained. Quantitative histological analyses were performed on regions of interest (ROI) on micrographs of parenchymal tissue (n=4/group). Numbers of alveoli (15 ROI, magnification 40x) and lobules (9 ROI, magnification 2.5x) were similar (P>0.1) in both groups. Mammary size (P=0.07) and parenchymal weight, cell number, cell size and RNA content (P<0.05) were lower in DRY cows. Levels of main eukaryotic translation initiation factors (eIF), eIF2 and eIF4E, were also lower in DRY cows (75% and 67%; P<0.05). Together with a 44% decrease (P<0.05) in mRNA:DNA ratio that is maintained in lactation, this indicates decreased translational capacity in DRY cows. In both groups, a large percentage (48 to 60%) of intracellular eIF4E was bound to the eIF4E sequestering protein, eIF4BP1, a complex that renders eIF4E biologically inactive. Active (phosphorylated) ribosomal protein S6 (pS6) and its kinase, p70 S6K, facilitate synthesis of parts of translational machinery. In DRY cows, phospho-pS6 and -p70 S6K were respectively maintained at 58% and 65% of that of LACT cows. This indicates a maintenance of cell signals involved in synthesis of translational machinery and mirrors the maintenance of RNA:DNA in DRY glands at 56% of LACT. In conclusion, the more pronounced decrease in expression of eIF2 than eIF4E following involution seems to indicate that eIF2 is most likely responsible for the decrease in translational capacity in lactation. However, the presence of the eIF4E-eIF4BP1 complex suggests there is an excess capacity for translation up-regulation in both lactating and dry dairy cows.

Withdrawal of lactogenic and mammogenic hormones had an adverse effect on the ability of mammary glands to produce milk protein.

Key Words: Initiation factors, mRNA translation, Mammary involution


IGF-I plays a critical role in mammary cell proliferation and apoptosis. Studies in transgenic mice with mammary-specific IGF-I over-expression have reported reduced apoptotic loss of mammary cells in late lactation, with minimal effects in early lactation. The impact of mammary over-expression of IGF-I in pigs has not been previously reported. The objective of the present study was to determine the effect of mammary-specific transgenic over-expression of IGF-I on mammary epithelial cell apoptosis. IGF-I hemizygous transgenic swine over-expressing IGF-I under the direction of the bovine alpha-lactalbumin promoter (IGF) and non-transgenic (CON) gilts had litter size normalized to 10 piglets at farrowing and piglets were allowed to suckle until d 21 postpartum. On d 4 post-weaning (d 25 postpartum), animals underwent a surgical biopsy and blood and milk samples were collected. Serum IGF-I on d 4 post-weaning was not affected by mammary over-expression of IGF-I. IGF-I content in mammary secretions from d 4 post-weaning was approximately 46-fold higher (575 ± 271 µg/L) than CON (16.6 ± 1.2 µg/L) sows (p≤0.01). The predominant IGF binding proteins (IGFBP) in mammary secretions were IGFBP-2 and IGFBP-5, both of which were significantly higher in mammary secretions of IGF vs. CON sows (p≤0.05). The presence of apoptotic cells was determined in mammary tissue by Tunel assay and apoptotic cells were expressed as a percentage of total cell count. Mammary tissue from CON pigs had a significantly (p<0.05) higher percentage of apoptotic cells than IGF transgenic sows (7.5 ± 1.7 vs. 4.6 ± 1.5 %, respectively) at d 4 post-weaning. Thus, over-expression of IGF-I results in increased IGFBP-2 and IGFBP-5 in mammary secretions during involution. However, programmed cell death in mammary tissue is lower in IGF transgenic sows, which could potentially prolong the process of involution. (Funded by the USDA CSREES under project NRICGP 00-35206.)

Key Words: IGF-I, Mammary gland, Apoptosis


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Lactation can be induced in non-pregnant animals by steroid hormone treatment. These effects may be transmitted by estrogen receptors (ERa and ERb) or progesterone receptors (PR). Our aim was to study the expression of ERa, ERb and PR mRNA and protein during mammogenesis, lactogenesis, galactopoiesis (early, middle and late) and involution in the bovine mammary gland (total n=53 cows). The mRNA was assayed by means of real time RT-PCR (LightCycler) and the protein by immunohistochemistry and Western blotting. Both ERa and PR were expressed in fg/g total RNA range. Higest mRNA expression was found for ERa (285 fg/g) and PR (63 fg/g) in tissue of non-pregnant heifers followed by a significant decrease at lactogenesis (17 and 7 fg/g) with remaining low concentrations during lactation and the first 4 wk of involution. In contrast, expression of ERb was in the at/g total RNA range. Immunolocalization for ERa revealed a strong positive staining in nuclei of lactocytes in non-pregnant heifers, became undetectable during pregnancy, lactogenesis, and was again detectable 14-28 d after milking was stopped. In contrast, the PR is localized in nuclei or cytoplasm of mammary epithelial cells during all stages examined. The ERa, ERb and PR protein was found in all mammary gland stages examined by Western blotting. The signal for ERa is less abundant in tissue of heifers and at involution (4 wk). The ERb protein showed increased abundance in lactation (in heifers and at 4 wk after milking was stopped). For the PR, 3 obvious isoforms (A, B and C) were found. But only the isoform B remains during the stages of lactogenesis.
galactopoiesis and involution. In conclusion, the data for ER and PR show clear regulatory changes suggesting involvement of these receptors in bovine mammary gland function.

Key Words: Steroid receptors, Mammary gland, Bovine


The expression patterns of progesterone receptor (PR) mRNA and protein in the bovine mammary gland were characterized during various stages of mammary development and pregnancy. Mammary parenchyma was obtained from prepubertal heifers, pregnant heifers, non-lactating pregnant cows, lactating pregnant cows and lactating non-pregnant cows (n = 3 animals/stage). Samples were evaluated for PR mRNA by quantitative real-time RT-PCR and PR protein by western blotting and immunohistochemistry. Results indicated mean PR mRNA abundance was greatest in prepubertal heifers and lactating pregnant cows, but extremely low to non-detectable throughout most of gestation in heifers. Compared to prepubertal heifers, mean expression of PR mRNA was 6-10 times lower in non-lactating pregnant and lactating non-pregnant cows, although expression among non-lactating pregnant cows was highly variable. A similar pattern of expression was reflected in analyses of PR protein. Preliminary results of western blot analysis suggested the presence of two isoforms of PR of approximately 78 and 135 kDa, presumably representing PR-A and PR-B, respectively. Quantities of the PR-A and PR-B isoforms differed by physiological state. Our results demonstrate that PR expression in the bovine mammary gland is developmentally and hormonally regulated.

Key Words: Progesterone receptor, Mammary gland, Bovine

W29 Mammary mRNA expression of bovine haptoglobin and LPS-induced alterations. S. Hiss1, M. Mielenz2, S. Schmitz3, R. M. Bruckmaier2, and H. Sauerwein1, 1Institute of Physiology, Biochemistry and Animal Hygiene, Bonn University, Germany, 2Institute of Physiology, Techn. Univ. Munich, Germany.

Haptoglobin (Hp), an acute phase protein secreted from the liver, is discussed as a useful marker for animal health. Compared to non-ruminant species, Hp concentrations in blood are physiologically low in cattle, but the increased during inflammatory processes is more pronounced. Elevated Hp concentrations have also been reported in milk during mastitis. Our previous work using a highly sensitive Hp ELISA to characterize Hp concentrations in milk after intramammary lipopolysaccharide (LPS) challenge indicated that Hp in milk might be derived from lobulo-alveolar lactating tissue. Our results demonstrate that PR expression in the bovine mammary gland is developmentally and hormonally regulated.

Key Words: Haptoglobin, Mammary gland, Bovine

W30 mRNA expression of apoptosis-related genes in mammary tissue and milk cells in response to LPS treatment and during subclinical mastitis. A. Didier and R. M. Bruckmaier*, Institute of Physiology, Technical University of Munich, Germany.

Development of clinical or subclinical mastitis due to immunocompromised mammary gland physiology leads to additional costs and economical loss in the dairy industry. Our objective was to determine if induction of apoptosis in immune cells and udder tissue may contribute to impairment of immune response in the gland. In two experiments, mammary gland biopsies, udder tissue and somatic milk cells were investigated for alterations in mRNA expression of apoptosis-related genes (Caspase-3, Caspase-7 and FAS) by using real-time RT-PCR. Experiment I (6 cows) was performed on mammary gland biopsies after intramammary LPS infusion to mimic mastitis. All factors under study showed a significant increase in mRNA expression during the sampling period of 12 h in comparison to untreated control quarters (P < 0.0001 for all genes after 3 and 6 h). FAS expression reached highest levels after 3 h of LPS infusion. Experiment II included a total of 15 cows. All control animals (n = 8) had a somatic cell count < 150,000 cells/ml. Another 7 cows had partially elevated SCC with at least one quarter > 150,000 cells/ml. At slaughter, milk cells and udder tissue were sampled and subjected to real-time RT-PCR. For milk cells, no significant differences in mRNA expression could be found comparing control cows with those having partially elevated SCC. In udder tissue, FAS and Caspase-3 expression was significantly higher in quarters with elevated SCC as compared to controls (P < 0.03 for FAS and P < 0.01 for Caspase-3). In summary, apoptosis-related gene expression is altered and may be an important factor in mammary gland immune defense under various in-vivo conditions. Increased expression of apoptosis-related genes may therefore be a factor leading to impairment of udder health.

Key Words: Apoptosis, Mammary gland immunology, Real-time RT-PCR

W31 Gene expression profiles in porcine mammary gland tissue during formation of colostrum. P. M. Schnulle and W. L. Hurley*, University of Illinois, Urbana.

Formation of colostrum is important for the newborn mammal. The goal of the project was to profile expression patterns of genes thought to be involved in colostrum formation in porcine mammary tissue during the periparturient period. Mammary gland tissue was collected by punch biopsy from 6 sows between 2 and 6 days prepartum, within 24 hours of parturition, and on days 3 and 6 postpartum. Total RNA was extracted, reverse transcribed, and polymerase chain reactions with primers specific for the cDNAs of interest were performed under optimized conditions. Densitometry of PCR products was standardized against 18s rRNA expression. The expression level of the neonatal Fcgamma receptor (FcRn) was 3X higher at 2 to 3 days prepartum compared to the day of parturition (P < 0.05), but was significantly different on other days. Beta2-Microglobulin expression also was increased on the day of farrowing (by 10X; P < 0.05). Alpha-Lactalbumin expression, used as a marker of lactogenic period and on the day of parturition than in the postpartum period (P < 0.05). Alpha-Lactalbumin expression, used as a marker of lactogenesis, was increased by 2.5X on the day of farrowing when compared to the prepartum period (P < 0.05). Polymeric immunoglobulin receptor expression also was increased on the day of farrowing (by 10X; P < 0.001), and was positively correlated with alpha-lactalbumin expression (P < 0.001). Results indicate that expression of beta2-microglobulin may affect the functional role of the FcRn expressed during colostrum formation. Furthermore, expression of annexin II light chain is associated with colostrum formation in the porcine mammary gland. Multiple IgG binding proteins may have a role in transepithelial immunoglobulin transport during colostrum formation.

Key Words: Colostrum, Immunoglobulin transport, Mammary gland
The pattern of expression of TJ proteins was investigated during engorgement of rat and bovine mammary glands. An increase in mammary TJ permeability was previously shown to occur within 24 h of milk accumulation. The expression of occludin and claudin-1, the major integral transmembrane components of TJ, was determined in two experiments. In experiment 1, Sprague-Dawley rats at peak lactation (d 16) had three abdominal inguinal glands on one side sealed to induce mammary engorgement, the remaining glands were not sealed and acted as suckled controls. Mammary tissue was collected post-mortem at 0, 6, 12, 18, 24 and 36 h after teat sealing (n = 6 rats per time point). In experiment 2, alveolar mammary tissue was collected post-mortem from 42 mid-lactation Holstein Friesian dairy cows at 0, 6, 12, 18, 24, 36 and 72 h following the last milking (n = 6 cows per time point). Immunoblotting showed a characteristic multiple banding pattern for occludin between 60 and 80 kDa. The higher molecular weight (MW) bands were highly phosphorylated and resistant to NP-40 detergent extraction, suggesting they predominantly derive from the tight junction complex. Occludin expression declined during mammary engorgement in rat and bovine glands (P < 0.05). Claudin-1 migrated in SDS-PAGE as two bands at 22 and 28 kDa. In rats, expression of the 28 kDa band declined within 12 h of mammary engorgement (P < 0.05), while that of the 22 kDa band, along with lower MW degradation products, increased (P < 0.05). Both bands were expressed at low levels by 36 h of mammary engorgement. In contrast, claudin-1 protein expression did not alter with engorgement in bovine mammary glands (P > 0.05). Occludin and claudin-1 expression showed large individual animal to animal variation. Furthermore, the response to mammary engorgement was locally regulated as no changes were detected in suckled control rat mammary glands. Between species variation in the pattern of TJ protein expression suggest that the increase in TJ permeability during milk accumulation is regulated differently between rats and dairy cows.

Key Words: Tight junction, Lactation, Mammary engorgement

Impact of 5α-dihydrotestosterone on musculoskeletal status of mature laying hens. T. D. Faidley*, S. E. Nicolich, and D. R. Thompson, Merck Research Laboratories, Somerville, NJ.

Genetic selection for improved egg production has resulted in aged laying hens that are fragile and depleted of muscle. Selective androgen receptor modulation may offer potential to improve musculature and skeletal structure of these birds. "Spent hens" have become more of a liability than an asset to the industry. We hypothesized that compounds such as 5α-dihydrotestosterone (DHT) may result in muscle and bone gain, thus improving the health and value of aged layers. Subcutaneous injections of 3 mg/kg DHT (5X weekly) were compared to saline injections in mature laying hens (n = 10). Hens were housed individually in cages and allowed unlimited access to feed and water. After 3 weeks, DHT treatment decreased (P < 0.05) egg production (0% vs. 60%), feed consumption (72 g/d vs. 126 g/d), weight gain (-13 g vs. 58 g), and breast fillet as a % of carcass weight (7.2% vs. 8.1%). DHT treatment increased (P < 0.05) comb redness (α+, 20 vs. 13); and weights of comb (31.2 g vs. 2.2 g), heart (10.6 g vs. 8.1 g), thigh muscle (72.9 g vs. 64.9 g), and metatarsus (23.1 g vs. 21.8 g). DHT treatment had no significant effect on weight of carcass (1337 g vs. 1227 g), whole breast (302 g vs. 325 g), or femur (9.8 g vs. 9.3 g). Breast fillet weight tended to decrease (P < 0.01) with DHT treatment (97 g vs. 103 g). In summary, DHT treatment was successful in halting egg production and in decreasing feed consumption, however, musculoskeletal effects were inconclusive. Further research is needed to determine if anabolic treatment of aged laying hens can improve welfare and/or economics of egg production.

Key Words: Androgen, Anabolic, Laying hens

Developmental regulation of glucosidase II in mouse mammary gland. J. Feng* and I. K. Vijay, University of Maryland, College Park.

The mammary gland synthesizes and secretes large amounts of well-characterized glycoproteins of the milk fat globule membrane and α-lactalbumin during lactation. Previous studies from our laboratory have shown that several glycosyltransferases of the dolichol cycle are coordinately regulated during the growth and differentiation of the mammary gland as it cycles between dormancy and lactation. We have hypothesized that the processing glucosidases I and II would follow a similar pattern of expression in coordination with the glycosyltransferases. The developmental regulation of glucosidase II was investigated in mouse mammary gland. Glucosidase II is a heterodimer of a catalytically active subunit (α subunit) and a smaller subunit (β) that contains the signal for endoplasmic reticulum (ER) retention. Mouse mammary glands at different stages of development (n = 30 for virgin and post-lactating glands; 20 for all the other stages) were examined for glucosidase II mRNA by RT-PCR (both α and β subunits), immunoreactive α and β subunits, and enzyme activity. All three parameters showed a similar pattern, i.e., they were low in tissues from virgin animals, increased steadily during pregnancy and lactation, reaching a peak around mid-lactation, and declined sharply in glands from post-lactating animals. At mid-lactation, glucosidase II α and β subunits mRNA level increased 4-fold relative to the virgin stage. The immunoreactive protein of the two subunits also had 5 and 7-fold increases, respectively. The glucosidase II activity increased nearly 5-fold in mid-lactation compared to virgin stage. These data suggest possible transcriptional and post-transcriptional modulation of glucosidase II during development of the mouse mammary gland. Further, the striking similarity in the regulation of this enzyme and the previously studied glycosyltransferases, when combined with the data on the developmental profile of glucosidase I, indicates that common regulatory signaling cascades may control the enzymes of the glycosylation machinery in the mammary gland. (Supported by N.I.H. grant GM59943.)

Key Words: Glososylation, Glucosidase II, Mammary gland

Impact of 5α-dihydrotestosterone on musculoskeletal status of mature laying hens. W34 T. D. Faidley*, S. E. Nicolich, and D. R. Thompson, Merck Research Laboratories, Somerville, NJ.


ABSTRACT: Under-nutrition during early gestation can affect muscle development. Our purpose was to determine if fetal growth was affected by nutrient restriction of the gestating ewe. Control (C) ewes were fed 100% of the National Research Council (NRC) recommended diet for gestating ewes. Nutrient restricted (NR) ewes were fed 50% of NRC recommendations during days 28 to 78 of gestation. Control and NR ewes were euthanized (d 78 gestation) prior to removal of gravid uteri. The head and internal organs were removed after the fetus(es) were taken from the uterus. Eviscerated ewes and fetuses were hung by the Achilles tendons for 24 to 34 h at 4 °C or 15 °C, respectively. Subsequently, ewe and fetus Longissimus dorsi (Ld) and Semitendinosus (St) were removed. Whole body, eviscerated body, Ld, and St weights were recorded. Whole body weight tended (P = 0.07) to be lower in NR ewes, although ewe eviscerated weight was not different (P = 0.13). Fetal whole body (P = 0.49) and eviscerated weights (P = 0.58) were not different. However, fetal Ld weight as percentage of fetal whole body weight and as percentage of eviscerated fetal weight were different because Ld weights of NR fetuses tended to be heavier (P = 0.10) than C fetuses, 3.34 and 2.92 g, respectively. This relationship was not found for fetal St (P = 0.51). Ewe Ld and St weights were not different (P > 0.10) as percentage of ewe whole body and eviscerated weight. Nutrient restriction of ewes during 28 to 78 d of gestation causes differential changes in muscle development.

Key Words: Fetus, Nutrient restriction, Muscle growth
W36  Dietary supplementation of nucleosides in late pregnant and lactating rats. C. M. De Jesus Arias*, C. E. Oliver, W. L. Keller, and C. S. Park, North Dakota State University, Fargo ND/USA.

The objective of this study was to evaluate if the inclusion of nucleosides in the diet of pregnant and lactating rats increases pup performance and immune status. Thirty-two female Sprague-Dawley rats, approximately 14 wk of age and 14 d of gestation, were randomly assigned to either control (nucleotide-free semi-purified diet; Purina Basal Diet # 5755,Ralston Purina, Richmond, IN) or nucleoside (control diet with nucleosides) treatments. The nucleosides were suspended in water by weight in the following proportions: adenosine (1.11), guanosine (1.17), uridine (1.01), cytidine (1.01), and thymidine (1.00). Rats were dosed by gavage daily beginning on d 14 of gestation through d 19 of lactation. Control rats received water, and treatment rats received nucleoside suspension at 0.64 mg/g body weight per d. Dams were weighed every 3 d during gestation and lactation. Feed intake was recorded every other day. On d 3 of lactation, litters were adjusted to 8 pups per dam. Litters were weighed every 3 days through d 19 of lactation. Upon sacrifice, blood was collected from dams (control, 1 dam; treatment, 2 dams) and pups on d 3, 10, 15, and 19 of lactation. Milk yield was estimated on d 15 of lactation. Milk was collected by miniaturized suction apparatus on d 3, 10, 15, and 19 of lactation. Serum and milk immunoglobulin G2α (IgG2α) concentrations were measured by ELISA. The average daily feed intake of the dams was not different between groups (control, 25.7 ± 9.4 g; treatment, 25.6 ± 10.4 g). The average daily gain from d 3 to d 15 of treatment periods was approximately 20% higher than that of control pups. Milk yield and IgG2α concentration in the dam’s milk (averaged over the trial) were not different between groups. In the treatment group, a significant (P = 0.02) correlation (r = 0.61) existed between pup serum concentrations of IgG2α (averaged over the trial) and milk IgG2α (averaged over the trial). Our results indicate that nucleoside supplementation affects pup performance and serum IgG2α concentration.

Key Words: Nucleosides, Pup performance, IgG2α

W37  Effects of specific conjugated linoleic acid (CLA) isomers on growth characteristics in obese Zucker (fa/ fa) rats. S. R. Sanders1, M. K. Teachey1, A. Ptock2, K. Kraemer2, O. Hasselwander2, E. J. Henrikson1, and L. H. Baumgard2, 1University of Arizona, Tucson AZ, 2BASF AG, Ludwigshafen, Germany.

Growing female obese Zucker (fa/ fa) rats were treated (via intra-gastric gavage) for 21 d with either 1 vehicle (corn oil, 2 ml/kg body weight (BW)), 1 CLA mixture [50:50 cis-9, trans-11 CLA; 18:0/C18:0, C16:0/C18:0, C18:1/C18:1, and C18:2/C18:1], 3 cis-9, trans-11 CLA, or 4 trans-10, cis-12 CLA [all at 1.5 g CLA/kg BW]. Average daily gain (g/d) was significantly (P<0.05) reduced by trans-10, cis-12 CLA and the CLA mixture (2.50, 1.95, 2.69 and 1.39, for treatments 1, 2, 3 and 4, respectively). There was no treatment effect on average whole-body (minus heart and liver) composition (dry matter basis): fat (70.2%), protein (21.0%) and ash (4.3%). Compared to cis-9, trans-11 CLA, Zucker rats treated with trans-10, cis-12 and the CLA mixture had more carcass water (38.0, 40.8, 37.0 and 39.0% for treatments 1, 2, 3 and 4). There was no treatment effect on soleus and plantaris muscle weights. Treatment had no effect on heart or liver weight, nor heart or liver weight as a percentage of body weight, but trans-10, cis-12 CLA significantly increased liver lipid content (25.0, 22.0, 24.4 and 31.0% for treatments 1, 2, 3 and 4). Carcass fatty acid analysis indicated cis-9, trans-11 CLA content averaged 0.2, 2.0, 1.9 and 0.5 and trans-10, cis-12 CLA averaged <0.1, 1.2, 0.5 and 1.7 g/g of fat for treatments 1, 2, 3 and 4. Liver fatty acid analysis indicated cis-9, trans-11 CLA averaged 0.2, 1.3, 1.6 and 0.7, and trans-10, cis-12 CLA averaged <0.1, 0.7, 0.5 and 1.4 g/g of fat for treatments 1, 2, 3 and 4. Ratios of C16:0/C16:1 and C18:0/C18:1 (a proxy of Δ9-desaturase capacity) were not affected in hepatic lipids (9.8 and 1.8, respectively). The palmitate ratio was unaffected in carcass fats (4.3) but trans-10, cis-12 increased the ratio of C18:1/C18:0 (0.14, 0.12, 0.13 and 0.17 for treatments 1, 2, 3 and 4). Similar to previous reports, CLA increased hepatic lipid content, but the ability of CLA to alter body composition in obese Zucker rats remains questionable.

Key Words: CLA, Zucker Rat, Body Composition

W38  Body composition and carcass fatty acid profiles in hybrid striped bass treated with recombinant bovine somatotropin (rbST). S. R. Sanders1, J. L. Collier2, L. H. Baumgard1, and R. J. Collier3, 1University of Arizona, 2Aquatica Tropics Inc., Tucson, AZ.

Eleven hybrid striped bass initially weighing 10 g were injected with passive integrated transponder tags and sorted into two 160 L tanks housed in an unheated greenhouse for 196d. Fish were randomly assigned to either IP injections of 0.5 ml rbST (100 mg/g body weight [BW]) or normal saline 4x during the first 33d. After 33d, both groups were untreated, managed identically and harvested on d196. Fish were fed floating steelhead pellets 2x/d to achieve a total daily intake of 3-5% BW. Immediately after the 4th IP injection, due to ambient temperature changes, water temperature decreased from 22 to 17C, resulting in all fish consuming little if any feed. Feed intake resumed as temperatures returned to 22C (54d post 4th IP injection). Overall (d1-196) average daily gain (ADG) was not affected by treatment (557 mg/d), but ADG during IP injections (d1-56) was increased 42% by rbST, although not significant (P=0.1). Overall fish length gain was not altered by treatment (5.1 mm/d) however, during the IP injection phase, rbST increased (P<0.001) fish length gain (9.3 vs. 6.8 mm/d). Whole body composition analysis 140d post rbST administration indicated no difference in carcass dry matter (30.6%), fat (35%), protein (47.6%) or ash (16.6% [fat, protein and ash reported on a dry matter basis]). Fatty acid analysis indicated fish treated with rbST tended (P=0.11) to have a higher unsaturated fatty acid content (71.5 vs. 68.5%) and reduced de novo fatty acid contribution (C12-C14:1; 62 vs. 70 mg/g of fat). Fish treated with rbST had increased (P=0.05) proportions of long chain PUFAs (>C20:1; 177 vs. 129 mg/g fat), but no difference in the Δ9-desaturase index (C16:0/C16:1; C18:0/C18:1). Carcass composition analysis indicates the beneficial effects of rbST on nutrient partitioning in young hybrid striped bass are lost or diluted over time (140d) following rbST treatment cessation; preliminary data suggest rbST enhances ADG and has beneficial effects on carcass fatty acid profile.

Key Words: rbST, Fish, Body composition

W39  Effect of restricted post-weaning growth resulting from reduced floor and feeder space on pig growth performance in a wean-to-finish system. B. F. Wolter1, M. Ellis2, J. M. DeDecker2, B. P. Corrigan2, S. E. Curtis2, E. N. Harr3, and D. M. Weibel3, 1The Maschhoffs LLC, Carlyle, IL/USA, 2University of Illinois, Urbana, IL/USA, 3United Feeds, Inc., Sheridan, IN/USA.

The effect of reduced post-weaning growth resulting from restricted floor and feeder-trough space on subsequent growth to slaughter was investigated in a wean-to-finish system. The study was carried out from weaning (5.5 ± 0.01 kg BW; 17 d of age) to end of wk 25 post-weaning. Pigs (n=1,728) were used in a randomized block design with a 2 x 2 x 2 factorial arrangement of treatments: 1) floor space (High [0.630 m²/pig] vs Low [0.315 m²/pig]), 2) feeder-trough space (Unrestricted [4 cm/pig] vs Restricted [2 cm/pig]), and 3) duration of floor- and feeder-trough-space treatment (12 vs 14 wk post-weaning). The study was carried out in two periods; Period 1 was from weaning to the end of the treatment period (i.e. wk 12 or wk 14 post-weaning); Period 2 was from the end of the treatment period to wk 25, during which pigs on all treatments had the same floor and feeder space. During Period 1 both Low floor space and Restricted feeder space reduced ADFI (P < 0.05), but ADG was only reduced by Low floor space (P < 0.01). Pigs on treatment for 14 compared to 12 wk had higher (P < 0.01) ADG and ADFI. Neither feeder space nor treatment duration affected growth performance during Period 2. However, during Period 2 pigs on the Low compared to High floor space had increased ADG and G:F with the difference being greater for pigs on treatment for 14 than 12 wk (floor space x treatment duration interaction; P < 0.05). However, Low floor-space pigs tended (P = 0.06) to be lighter than High floor-space pigs at the end of Period 2. Carcass measures at end of Period 2 were not influenced (P > 0.05) by any treatment. In summary, pigs with restricted growth due to Low floor space and Restricted feeder space had lower ADG and feed efficiency in the subsequent period to wk 25 post-weaning.

Key Words: Feed trough, Floor space, Pigs
**W40** Refolding and purification of unprocessed porcine myostatin expressed in *E. coli*. H. J. Jin, Y. S. Kim*, and M. A. Dunn, University of Hawaii, Honolulu HI.

Myostatin is a growth and differentiation factor that suppresses skeletal muscle growth. Like many other TGF-β family members, it is expressed as a prepropeptide that yields a mature form of myostatin after proteolytic processing at the paired basic residues (Arg-Lys-Arg-Arg). Since unprocessed pure myostatin is not currently available, the objective of this study was to purify unprocessed, refolded, porcine myostatin expressed in *E. coli*. Recombinant myostatin inclusion bodies harvested from *E. coli* were solubilized (1 mg/ml) in a buffer solution (50 mM CAPS, pH 11.0 containing 0.3% N-lauroylsarcosine and 1 mM DTT). Then, the inclusion body solution was diluted 100 times with refolding buffer (10 mM Tris buffer containing reduced and oxidized glutathione, pH 8.5) and incubated at 4°C for 7 days. After dialysis in 20 mM Tris buffer (pH 8.5), the myostatin containing solution was subjected to anion exchange chromatography, and fractions containing the recombinant refolded myostatin were collected and combined. The combined solution was subjected to size exclusion chromatography to further purify the refolded myostatin. The purified myostatin formed a monomer under reduced conditions, and a dimer under non-reduced conditions in SDS-PAGE analysis. Upon incubation with furin, an endopeptidase cleaving the paired basic residues, the unprocessed recombinant myostatin (50 kD) yielded 37 kD and 15 kD proteins, corresponding respectively to the prodomain and mature form of myostatin. Based on the current biochemical results, it is concluded that the refolded native form of unprocessed myostatin could be obtained from *E. coli* expressed inclusion bodies with high efficiency (15% yield) and that the unprocessed myostatin is a substrate for furin.  

**Key Words:** Protein purification, Myostatin, Furin

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**W41** Effect of flax supplementation and a combined trenbolone acetate and estradiol implant on muscle satellite cell activity in beef cattle. J. D. Dunn*, A. T. Waylan, J. P. Kayser, E. K. Sissom, and B. J. Johnson, Kansas State University, Manhattan.

Objectives of this study were to evaluate the effects of 5% ground flaxseed (FLAX) and a combined TBA/E2 growth promotant, Revalor-S, (IMP) on muscle satellite cell proliferation and differentiation. Sixteen yearling crossbred steers (initial BW = 397 kg) were randomly assigned to one of four treatments: 1) FLAX/IMP, 2) No FLAX/IMP, 3) FLAX/No IMP, 4) No FLAX/No IMP. Steers were allowed ad libitum access to a 93% concentrate diet for the entire study. Biopsy samples (3.5 g) were obtained from the longissimus muscle on d 0, 14, and 28. Satellite cells were isolated from the biopsy samples by enzymatic digestion and differential centrifugation. Satellite cells from each steer were resuspended in Dulbecco’s Modified Eagle Medium (DMEM) with 10% fetal bovine serum and plated on two wells of two four-well tissue culture plates coated with reduced growth factor matrigel. Cultures from each steer were stained 24 h post-plating with Hoechst 33342 and nuclei were counted. At 96 h post-plating, cultures from each steer were put into a fusion-promoting media of DMEM with 5% horse serum and 1.5 µg/ml BSA-lysinic acid. At 192 h, cultures were stained and counted for total and myotube nuclei. FLAX or IMP had no effect on satellite cell activity. However, nuclei at 24 h post-plating increased (P < 0.001) from d 0 to 28 whereas total nuclei 192 h post-plating were unchanged (P > 0.10). Myotube nuclei increased (P < 0.05) from d 0 to 28 and thus fusion percentage also increased (P < 0.05) from d 0 to 28. Cell yield per g of muscle tissue also increased (P < 0.05) from d 0 to 28 while number of doublings decreased (P < 0.001). These data suggest satellite cells were activated in situ over the 28 d period and that the cells lost proliferative capacity when placed in culture. Also, the increases in myotube nuclei and fusion percentage over time indicate that isolated satellite cells became more inclined to differentiate into muscle over the feeding period regardless of FLAX or IMP.  

**Key Words:** Satellite cell, Beef cattle, Trenbolone acetate

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**W42** Walking temporal variables of the sound and lame dairy cow. M. C. Nicodemus* and A. M. Chapa, Mississippi State University, Mississippi State, MS.

Lameness in dairy cattle is associated with milk production loss emphasizing the importance of early lameness detection. The human eye is limited in detecting subtle lameness so that additional detection methods are needed. Kinematic analysis has been effective in measuring subtle equine lameness, but research in dairy cattle is lacking. The objectives of this study were to determine the sound and lame walking temporal variables of dairy cows. 5 sound lactating dairy cows and 5 lame cows with a lameness score between 3-5 were freely walked at a consistent velocity (1.2-1.4 m/s) through an enclosed, calibrated runway. 4 consistent, straight strides with easily detected hoof impacts were used from each cow. 60 Hz frame-by-frame analysis determined stride duration and the following temporal variables, which were calculated as percent of stride: stance durations, limb supports, and advanced placements and lift-offs. Means (SD) were calculated and paired t-tests performed to determine significant differences between left and right variables (P < 0.05) in which variables were collapsed if no significant differences were found. The sound and lame walks were 4-beat stepping gaits with a lateral footfall sequence and alternating periods of bipedal and tripedal support. The sound walk was symmetrical as the left and right variables were insignificantly different while the lame walk demonstrated asymmetry. Stride duration was similar for both walks (sound: 1302±66 ms; lame: 1332±157 ms). In both walks the forelimbs spent 69±2% of the stride in stance and 67±4% in the hind with a 4±2% increase in stance in the lame walk. The majority of the stride in both gaits was spent in tripedal support (sound: 71±2%; lame: 78±4%) with equal bipedal support in the sound walk (diagonal: 13±2%; lateral: 16±3%) and unequal in the lame walk (diagonal: 7±4%; lateral: 15±5%). Advanced placements and lift-offs were regular in the sound walk, but the lateral and diagonal advanced lift-offs were irregular for the lame (lateral: RH-RF=23±1%, LH-LF=25±4%; diagonal: RF-LH=31±1%, LF-RH=33±3%). Understanding the sound and lame walking temporal variables of the dairy cow will assist in the early detection of lameness.  

**Key Words:** Dairy cow, Temporal variables, Lameness

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**W43** Effect of melengestrol acetate (MGA) on bovine muscle satellite cell proliferation and differentiation. E. K. Sissom*, J. P. Kayser, A. T. Waylan, J. D. Dunn, and B. J. Johnson, Kansas State University, Manhattan.

Melengestrol acetate (MGA) increases growth rate and inhibits estrus in feedlot heifers, but the effect of MGA on skeletal muscle growth and differentiation has not been studied. The purpose of these experiments was to investigate the effects of MGA on cultured bovine muscle satellite cell proliferation and differentiation. Satellite cells were used to assess the effects of MGA in a dose titration (0, 1 nM, 10 nM, 100 nM, 1 µM, 10 µM, and 100 µM) study on [3H]-thymidine incorporation (TI). Cells were plated in Dulbecco’s Modified Eagles Medium containing 10% fetal bovine serum. MGA was added at 0 or 48 h after plating. At 72 h, [3H]-thymidine was added and incubated for 3 h. Cultures were allowed to differentiate, and nuclei were stained at 168 h with Hoechst 33342 to determine the effect of MGA (10 nM and 100 µM) addition the first 48 h on extent of differentiation and absolute myotube nuclei number. MGA addition resulted in a dose-dependent decrease (P < 0.05) in DNA synthesis as measured by TI. The addition of 1 nM MGA did not affect (P > 0.05) TI in bovine satellite cells as compared to a control medium (no MGA). The addition of 10 nM, 100 nM, and 1 µM MGA to cultures of proliferating bovine satellite cells reduced TI approximately 27, 25, and 28%, respectively, as compared to a control medium. MGA doses of 10 and 100 µM further reduced TI approximately, 50 and 57%, respectively, as compared to control cultures. MGA addition (10 nM) did not alter (P > 0.10) the extent of differentiation or myotube nuclei number at 168 h. However, 100 µM MGA addition reduced (P < 0.05) both fusion percentage and myotube nuclei number as compared to control cultures. These data obtained with concentrations ≥ 10 nM, a concentration several orders of magnitude greater than observed in vivo, suggest that MGA has pharmacological effects on bovine muscle cell proliferation and differentiation. This in vitro test system may be useful for evaluation of mechanism for anabolic compounds.  

**Key Words:** Melengestrol acetate, Bovine, Muscle
Holstein bull calves were euthanized at 4 wk (n = 6) or 12 wk (n = 5) of age. Calves were fed milk replacer until 12 d of age, then a corn-based starter feed was offered ad libitum. At slaughter, abdominal (kidney) fat, skeletal muscle and hepatic tissue were snap frozen in liquid nitrogen, then stored at -80°C until assayed. In skeletal muscle and liver tissue, few differences between specific fatty acids, besides the trans profile, or Δ⁹-desaturase ratios due to age were detected. In skeletal muscle, age significantly increased the content of trans-10, trans-11, and trans-12 from 5.0, 1.7 and 1.1 to 26.3, 3.2 and 2.1 mg/g of fat, respectively. Furthermore, skeletal muscle trans-10, cis-12 CLA content increased (P<0.09) from 18 to 47 mg/g of fat. In abdominal fat, cis-9 trans-11 CLA was unaffected by age and averaged 1.2 mg/g of fat. In hepatic tissue the trans profile remained stable with increasing age averaging 1.3, 2.3, 35.1 and 5.3 mg/g for trans-6, trans-9, trans-10 and trans-11 C₁₈:₁ respectively, but trans-12 C₁₈:₀ increased (P<0.05) from 1.9 to 3.0 mg/g of fat from wk 4 to 12. Hapatic trans-10, cis-12 and cis-9, trans-11 CLA content did not change with age and averaged 2.8 and 2.5 mg/g of fat. In abdominal fat, cis-9, trans-11 and trans-10, cis-12 CLA increased (P<0.05) from wk 4 to 12 (1.4 to 2.1 and <0.1 to 1.0 mg/g of fat). Similar to hepatic tissue and skeletal muscle, the trans profile markedly increased with age and this was especially true for trans-10 C₁₈:₀ which increased from 18 to 47 mg/g of fat respectively. Adipose ratios of C₁₄:₀/C₁₄:₁, C₁₆:₀/C₁₆:₁, and C₁₈:₀/C₁₈:₁ (proxy for Δ⁹-desaturase) increased with age (P<0.05) suggesting an increase in rumen biohydrogenation and/or a decrease in the Δ⁹-desaturase system. Concentrations of C₁₂:₀, C₁₄:₀, and C₁₄:₁ decreased (P>0.05) symtomatic of a decrease in de novo synthesis and/or an increase in long chain fatty acid (>C₁₆:₁) incorporation, which was observed. Overall as calves aged, products of rumen biohydrogenation tended to accumulate in tissues while de novo synthesized fatty acids decreased in content.

Key Words: Fatty acid, CLA

### Table 1: AN CN SN NE

<table>
<thead>
<tr>
<th>Empty Body Composition (%)</th>
<th>AN</th>
<th>CN</th>
<th>SN</th>
<th>NE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>55.69</td>
<td>54.21</td>
<td>57.64</td>
<td>52.00</td>
</tr>
<tr>
<td>Ether Extract</td>
<td>20.70</td>
<td>22.30</td>
<td>18.59</td>
<td>24.68</td>
</tr>
<tr>
<td>Protein</td>
<td>18.94</td>
<td>18.84</td>
<td>19.06</td>
<td>18.70</td>
</tr>
<tr>
<td>Ash</td>
<td>4.67</td>
<td>4.65</td>
<td>4.71</td>
<td>4.62</td>
</tr>
<tr>
<td>Energy (Mcal/kg)</td>
<td>3.02</td>
<td>3.16</td>
<td>2.82</td>
<td>3.38</td>
</tr>
</tbody>
</table>

| Period gain rates (kg/day) | Water | 0.63  | 0.44  | 0.70  | 0.36  |
|                           | Ether Extract | 0.41  | 0.44  | 0.37  | 0.45  |
|                           | Protein      | 0.25  | 0.20  | 0.26  | 0.18  |
|                           | Ash          | 0.066 | 0.053 | 0.068 | 0.050 |
|                           | Energy (Mcal/day) | 5.25 | 5.22  | 4.98  | 5.24  |

### Key Words: Body composition, Tissue deposition rates, Nellore crossed beef cattle

### W45 Tissue deposition rates and empty body composition of purebred and crossbred Nellore bulls. A. Berndt¹, G. M. da Cruz², G. F. Alleoni², M. Alencar³, and D.P.D. Lanna¹,¹ESALQ/USP, Piracicaba, SP, Brazil, ²CPPSe, EMBRAPA, Sao Carlos, SP, Brazil, ³IZ, Nova Odessa, SP, Brazil.

Nellore (NE) and crossbred Canchim x Nellore (CN), Angus x Nellore (AN) and Simental x Nellore (SN) young bulls with initial empty body weight of 294.3 kg were fed for 92-161 days. The diet had 60% corn silage and 40% concentrate, 13.8% CP and 75.7% TDN on a dry matter basis. Daily empty body gains (kg/day) were 1.34 (AN), 1.12 (CN), 1.39 (SN) and 1.03 (NE). To obtain baseline body composition 14 animals of the same group were slaughtered before feedlot. Animals were slaughtered when estimated hot carcass weight was greater than 225 kg and ultrasound backfat thickness over 4 mm. Results are presented on table 1. Data were analysed by GLM proceeding of SAS (SAS, 2001). Cross-breeding greatly improved growth rates and protein deposition rates, particularly for Angus and Simental. Nellore purebred and Canchim crossbred had the fattest gain. Angus and Simental were leaner at the same empty body weight. Cross-breeding improves the potential for carcass production from Nellore cows, however calves have increased net protein and energy requirements.

### Key Words: Beef cattle, Growth, Hormonal system

### W47 Parameters for a refined model of ruminant growth and composition. J. W. Oltjen⁴, A. B. Pleasants⁴, T. K. Soboleva⁵, and V. H. Oddy⁶, ¹University of California, Davis, California, ²Ag Research, Hamilton, New Zealand, ³Meat and Livestock Australia, Sydney, Australia.

We have refined the prediction system for ruminant animal growth and composition developed previously (Oltjen et al., 2000, Modelling Nutrient Utilization in Farm Animals, pp. 197-209, CAB International, New York). The model represents body protein in two pools, viscera (v) and non-viscera (m). Using sheep datasets (Ferrell et al., 1986, Brit.

<table>
<thead>
<tr>
<th>Empty Body Composition (%)</th>
<th>Water</th>
<th>55.69</th>
<th>54.21</th>
<th>57.64</th>
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<td>3.16</td>
<td>2.82</td>
<td>3.38</td>
<td></td>
</tr>
</tbody>
</table>

| Period gain rates (kg/day) | Water | 0.63 | 0.44 | 0.70 | 0.36 |
|                           | Ether Extract | 0.41 | 0.44 | 0.37 | 0.45 |
|                           | Protein       | 0.25 | 0.20 | 0.26 | 0.18 |
|                           | Ash           | 0.066| 0.053| 0.068| 0.050|
|                           | Energy (Mcal/day) | 5.25| 5.22 | 4.98 | 5.24 |

### Key Words: Body composition, Tissue deposition rates, Nellore crossed beef cattle

The objective of this study was to determine the important parameters that regulate skeletal and longissimus muscle growth of beef cattle. Thirty-five crossbred (Japanese Black X Holstein) steers transported to a farm at 6-10 mo of age were managed under pen conditions. Each of the three pens (6.0 m X 9.5 m each) consisted of 11-12 steers. Serum and plasma samples from the jugular vein (concentrations of 7 hormones and 5 nutrients), ultrasonic images between the 6th and 7th rib (longissimus muscle area (LMA) and beef marbling score (BMS)), physical measurements (body weight and 10 parts of measurements), temperament scores at 5 different handling conditions, and behavioral observations using the instantaneous sampling with 10-min intervals for 2 h after morning and evening feedings (17 behavioral categories) were collected 1, 3, 5 mo after their entry into the farm. The average daily gain (ADG) and increase in LMA (ILMA) were also determined. A factor analysis with principal components and orthogonal varimax rotation determined 8 common clusters of measurements. As for growth-related measurements, ADG, the body weight 1 mo later, chest width, and the frequency of investigitive behavior constituted a cluster. ILMA clustered with triglyceride and total cholesterol concentrations, LMA 1 mo later, and temperament scores at blood sampling and ultrasonic recording. ADG was not correlated with ILMA. BMS: leptin concentrations, thurl width, and the frequencies of lying and eating hay clustered together. Vitamin A concentrations entered a cluster of catecholamine and cortisol concentrations, the frequency of grooming with pen facilities, entry order into the crush, and a temperament score on the scales. Vitamin A concentrations also tended to be correlated with insulin (r = 0.31, P = 0.07) and leptin (r = 0.27, P = 0.12) concentrations. Vitamin A may play an important role in the hormonal system(s) that regulate stress responses and longissimus muscle growth in the cattle.

### Key Words: Beef cattle, Growth, Hormonal system

Composition of empty BW (EBW) was described in terms of ether-extractable lipid (FAT) and fat-free matter (FFM) and the terms dEBW, dFAT, and dFFM were used to represent daily gains in these components. The dFFM is composed of protein, water, and ash, and a model was developed to predict the composition of dFFM. The conceptual approach used in model development was based on experimental data that showed as cattle grew from birth to maturity: a) the water content of FFM decreased and the protein and ash content increased, b) the protein content of FFM increased at a decreasing rate, and c) the protein:ash ratio in the FFM dry matter was fixed. These results suggest that as cattle grow and mature, gains in FFM contain increasing amounts of protein, and the protein content of dFFM would increase at a decreasing rate as the dFFM content of dEBW decreased. Mathematical functions were formulated to represent these concepts, and a set of equations were derived to predict composition of dFFM. The protein content of dFFM was predicted as a function of the fraction of dEBW that was dFFM, FFM content of EBW, and dFFM. A fixed protein:ash ratio of 4.26:1 was used to calculate the amount of ash, and water was obtained as a residual. Gain in EBW, dFAT, and dFFM of Hereford x Angus steers from birth to 500 kg BW was simulated with a previously published model, and the above model was used to predict composition of dFFM. Predictive response curves of the EBW components over the growing period were similar in shape to observed data. Regression analysis was used to investigate the relationship between protein weight and FFM weight. Results showed a linear relationship with no evidence for curvilinearity in the predicted data and two experimental data sets. The coefficient on FFM in the predicted data was 0.249 (SE=0.0008), and in the two sets of experimental data, the coefficients on FFM were 0.247 (SE=0.003) and 0.25 (SE=0.004). These results support the conclusion that the model is capable of accurately representing the real system.

Key Words: Model, Body Composition, Protein


Eighty Holstein heifers averaging 189.6 ± 6.8 kg of BW were used to evaluate the effects of forage level and rumen degradable nitrogen source on feed efficiency, structural growth, and body condition score (BCS). A randomized complete block design was used with heifers blocked according to weight (> 136.1 kg and < 136.1 kg). Heifers were assigned one of four treatment diets that were arranged in a 2 X 2 factorial. Treatments were constructed with two levels of forage (65 or 75%) and two protein sources. Forage sources were a mixture of corn silage and chopped timothy hay. Protein sources were either soybean meal (SBM) or a slow release urea product (Optigen 1200, CPG Nutrients, Syracuse, NY), which was fed at 1.8 ± 0.6% of diet DM on low forage diets and 1.3 ± 0.6% of the diet DM on high forage diets. Body weight was measured weekly on two consecutive days and used to adjust intake to be approximately 2.2% of BW on a DM basis. Diets were fed as a TMR using the Calan Door System for measuring individual DMI. To determine change in structural growth, wither/hip height, hip width, and heart girth were measured weekly. In addition, blood samples were collected weekly 4 hr post feeding, to determine plasma urea nitrogen concentration. Average daily gain and feed efficiency did not differ between rations of different forage level or nitrogen source, averaging 0.87 ± 0.05 kg and 7.4 ± 0.5 respectively across treatments. Similarly, no differences were observed in change of wither/hip height, hip width, or heart girth. No differences were observed in plasma urea nitrogen, which averaged 12.3 ± 0.4 mg/dl across treatments. Results of this experiment suggest that feeding moderately different levels of forage along with either SBM or Optigen 1200, does not result in any significant differences in main or interactive effects in feed efficiency or structural growth. Optigen 1200 can be used in heifer diets to effectively replace SBM as a nitrogen source in either high or low forage rations.

Key Words: Heifer growth, Feed efficiency, Slow release urea
Holstein heifers (N = 715) at AZ, ID, MN and NY were used to determine effects of bST and feeding additional energy and metabolizable protein (MP) on growth of replacement dairy heifers. Heifers were assigned randomly to pens and each site had two pens per treatment. Treatments were in a 2x2 factorial arrangement of three feed management programs with or without POSILAC® (bST; 500 mg/14 d). Feed management programs were restricted intake of a control diet (CECP) to achieve an ADG of 0.6 to 0.8 kg, ad libitum intake of a high-energy diet (HECP), and ad libitum intake of a high energy and high MP diet (HEHP). Intake of CECP-bST heifers was matched to that of their CECP counterparts. The HECP and HEHP diets contained more energy than CECP. Diet CP content varied but HEHP had more MP than CECP or HECP. At treatment initiation, BW averaged 162 (range: 135 to 189) kg and age averaged 172 (range: 128 to 211) d. After the 140-d treatment period, all heifers within a site were fed CECP for an ADG of 0.6 to 0.8 kg until 4 to 6 wks prior to calving. During the 140-d treatment period, ADG for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST heifers was 0.77, 1.13, 1.21, 0.81, 1.13 and 1.29 kg, respectively. From the end of the treatment period to the first post-calving body weight, ADG was 0.62, 0.60, 0.56, 0.64 and 0.64 kg, respectively. The percentage of heifers that became pregnant was 90.8, 85.1, 88.4, 88.9, 90.8 and 94.5% for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST heifers, respectively. Age at calving was 25.2, 22.4, 21.9, 24.9, 22.6 and 21.7 mo for CECP, HECP, HEHP, CECP-bST, HECP-bST and HEHP-bST heifers, respectively. HECP and HEHP increased ADG and decreased age at calving. BST did not significantly affect ADG. High-energy diets and BST did not adversely affect percent of heifers that became pregnant.

Key Words: Heifer, Growth, bST

W52 Associations between first lactation milk yields and pubertal and peripubertal growth rates of Holstein heifers fed diets with different concentrations of protein and energy, protein:energy ratios and injected with bST. T.J. Beloos3, M. Liboni, M.S. Gelay, M.J. Hayen, K.C. Bachman, and H.H. Head, University of Florida.

Holstein heifers that completed 150 DIM were used to evaluate effects of diet, season of calving (SEA), and bST on milk yield (MY), body weight (BW) and body condition score (BCS). They were from a group of 121 Holstein heifers that were raised on four diets and bST in a 2x2x2 factorial arrangement of treatments. Diets fed from 100-120 d of age to 341 Kg BW contained 14% (L) or 19% (H) CP with energy at 100% (L) or 110% (H) of NRC (1989) to give four protein-energy diets LL (n=27), LH (n=21), HL (n=24) and HH (n=20) that contained 50, 55, 65, and 73 g of CP/Mcal ME, respectively. Half the heifers in each group were injected biweekly with bST (POSLAC58 500 mg bST/1.4 mL); 0.2 mL to 181 kg BW, 0.3 mL from 182-273 Kg BW, and 0.4 mL above 273 Kg BW to provide about 5.1, 7.6 and 10.2 mg bST/d, respectively. At 341 Kg BW all heifers were fed the same diet and bST was discontinued. Average daily BW gains (ADGs) to 341 Kg BW were 0.89, 0.972, 1.007 and 0.989 kg/d. Diet affected days to reach final BW, ADG and height at withers (P < 0.01). ADG of bST injected heifers was about 4.1% greater but no effects of bST were detected for other growth measures. No differences in number of inseminations, calving age, or BW and BCS at calving were detected due to diet, bST or SEA. Mean MY through 150 DIM were 29.8 (LL), 30.3 (LH), 29.9 (HL) and 29.5 (HH) kg/d; means did not differ (P=0.9475) and no effects of bST (29.7 vs. 30.0 kg/d; P= 0.6731) or bST*SEA interaction (P=0.4545) were detected. There was a significant effect of SEA on mean MY (P<0.0112); heifers that calved in cooler months produced more milk (2.8 kg/d) but the two- and three-factor interactions among diet, SEA and bST were not significant. During lactation BW and BCS did not differ due to diet, ADG, or bST. Overall, no positive or negative effects of feeding diets with different protein to energy concentrations and ratios or injecting bST were detected on breeding or calving traits or on MY.<eq> Key Words: Heifers, Milk yield, Growth rates

Effects of feeding intensified diets to neonatal calves on growth performance and protein utilization have been described. However, effects of age and accelerated growth on circulating nutritional parameters and vitamin utilization have not been described. The current study evaluated effects of age and plane of nutrition on the plasma concentrations of β-carotene and vitamins D (25-hydroxyvitamin D₃), A (retinol), and E (RRR-α-tocopherol) in milk replacer-fed calves. Twenty-two Holstein bull calves were fed a standard (0.57 kg/d of a 22% CP, 20% fat milk replacer, n=11) or an intensified (1.14 kg/d of a 28% CP, 20% fat milk replacer, n=11) diet from 1 through 7 wk of age. Texturized calf starter was fed ad libitum to calves fed the intensified diet, but limit-fed to calves on the standard diet to target an average daily weight gain of 0.36 kg. Average daily weight gain of the intensified calves (0.58 kg) was greater (P<0.05) than that of the standard calves (0.26 kg). For all calves, β-carotene, retinol, and RRR-α-tocopherol concentrations in plasma decreased markedly (P<0.05) from wk 1 to wk 2 of the study. 25-Hydroxyvitamin D₃ concentrations increased (P<0.05) from wk 1 to wk 2. Concentrations of 25-hydroxyvitamin D₃ in calves fed the standard diet, however, decreased after wk 6, and were lower (P<0.05) than intensified calves by wk 8. Unlike calves on the standard diet, calves fed an intensified diet had decreased (P<0.05) concentrations of retinol and RRR-α-tocopherol by wk 8. These results suggest that feeding an intensified diet during the neonatal period may increase the demand for retinol and RRR-α-tocopherol. These demands are likely associated with increased growth. These age and dietary related changes in vitamin status may impact maturation of neonatal immune function ultimately affecting the neonatal calf’s susceptibility to infectious disease.

Key Words: Calves, Vitamins, Growth


Glucocorticoids influence immune reactions. We have tested whether an enhanced glucocorticoid status induced by DEXA influences proliferation, apoptosis and B- and T-lymphocyte numbers in Peyer’s patches (PP) of ileum and thymus. Calves fed colostrum (C) or a formula (F) that contained no immunoglobulin G, hormones and growth factors. DEXA (30 micrograms/kg body weight × d for 4 d) was injected to calves of GrFD and GrCD. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. Plasma glucocorticoid concentrations in new-born calves are influenced by colostrum (C) feeding and by glucocorticoids. We have tested the hypothesis that a high glucocorticoid status after birth as well as C feeding influence glucocorticoid metabolism in association with an increase of hepatic expression and activities of phosphoenolpyruvate carboxykinase (PEPCK; EC 4.1.1.32) and pyruvate carboxylase (PC; EC 6.4.1.1), two key enzymes of the hepatic gluconeogenesis. PEPCK mRNA was higher (P<0.01) in DEXA-treated calves than in controls on d 1, 2, 4, and 5 and were higher (P<0.05) in C-fed than in F-fed calves on d 4. Plasma insulin concentrations were higher (P<0.001) in DEXA-treated than in non-treated calves with a greater DEXA effect in C-fed calves on d 4 and 5. Mitochondrial PEPCK mRNA was higher (P<0.05) in C-fed than in F-fed calves, but cytosolic PEPCK mRNA showed no group differences. Expression of PC was lower (P<0.001) in DEXA-treated than in non-treated calves and tended to be lower (P<0.01) in C-fed than in F-fed calves. Activities of PEPCK on d 5 decreased (P<0.001) after DEXA treatment. PEPCK activities were higher (P<0.01) in GrCD than in GrFD. Activities of hepatic PC were lower (P<0.01) in DEXA treated than in non-treated calves. Eledated plasma glucocorticoid concentrations after DEXA treatment did not result from increased hepatic gluconeogenic activities, because DEXA did not stimulate hepatic gluconeogenic enzymes. However, C feeding increased glucocorticoid concentrations possibly in part due to elevated hepatic gluconeogenesis.

Key Words: Neonatal calf, Gluconeogenesis, Dexamethasone

Twenty-four female Holstein calves were randomly assigned to one of four treatments to evaluate the efficacy of amino acids as growth hormone (GH) or insulin secretagogues in neonatal dairy calves and to monitor the changes in these responses as calves undergo the transition to becoming functional ruminant animals. Treatments consisted of physiological saline (SAL); arginine (ARG, 0.5 g/kg BW); aspartic acid (ASP, 0.5 g/kg BW); and ornithine (ORN, 0.5 g/kg BW). Challenges were conducted at 1 month of age (prior to weaning) and again at 3 months of age. After an overnight period of feed deprivation, calves were fitted with indwelling jugular catheters, and approximately 1 hour later treatment solutions were infused. Samples of blood were collected via catheters at -30, -20, -10, 0, 10, 20, 30, 40, 50, 60, 75, 90, 105, and 120 min relative to onset of infusions for measurement of plasma GH. Samples collected at minutes -10 through 60 were analyzed for plasma glucose and insulin concentrations. In addition, baseline plasma samples obtained at 0 min were analyzed for thyroid hormone (T4), allantoin, and urea nitrogen (PUN). An acute release of GH was induced (P < 0.05) by ASP in calves at 1 and 3 months of age. Peak concentrations of GH in response to ASP were greater (P < 0.05) in calves at 1 month of age. There was a treatment by time interaction (P < 0.05) in response to ARG and ORN for insulin concentrations, with increases observed 10 to 20 min post infusion. Consequently, glucose concentrations were decreased (P < 0.05) 30 min after infusion in calves infused with ARG and ORN. Baseline concentrations of PUN and albumin were similar for all calves (P > 0.05). Concentrations of T4 were lower (P < 0.05) in PUN-treated calves, but no biological significance of this effect could be determined. These data indicate that ASP is effective in eliciting a GH response in young dairy calves, while ARG and ORN stimulate insulin release.

Key Words: Growth hormone, Insulin, Secretagogue

W60  Cell proliferation and apoptosis rates and B- and T-lymphocytes numbers in gut-associated lymphoid tissues, thymus, and lymphnodes of pre-term and full-term calves. C. W. David, J. Norman, H. M. Hammon, and J. W. Blum*, University of Berne, Berne, Switzerland.

Morbidity and mortality due to insufficient immune functions are high in neonatal calves, especially if born pre-term. In order to study cell proliferation and apoptosis rates and B- and T-lymphocyte numbers in Peyer’s patches (PP) of ileum, thymus, and mesenterial and prescapular lymphnodes (LM and LP) in uninfected pre-term calves (GrP; born 13 d before normal term) on d 1 and in uninfected full-term calves on d 1 and d 5 of life after feeding colostrum (C) for 3 d (GrF). In GrP compared with GrF there were higher (P<0.05) numbers of proliferating and apoptotic cells in interfollicular areas of PP, of T-lymphocytes in follicles and interfollicular areas of PP and within villus epithelia, of proliferating and apoptotic cells in LM and LP, of B-lymphocytes in paracortex and follicles of LM and LP, and of proliferating cells in cortex and medulla of thymus. In GrF compared with GrC there were higher (P<0.05) numbers of proliferating cells in follicles, interfollicular areas and domains of PP, but lower (P<0.05) numbers of apoptotic cells in follicles, interfollicular areas and domains of PP, and lower numbers of T-lymphocytes in follicles and interfollicular areas of PP and within villus epithelia. In thymus cortex and medulla numbers of proliferating cells were higher (P<0.05) in GrC than in GrF. In conclusion, studied lymphoid sites differed with respect to ontogenetic changes. Apoptotic rates were generally smaller at all sites of PP in GrC than in GrF and proliferation rates increased from GrP to GrF and from GrF to GrC in all tissues. Numbers of T-lymphocytes in PP were higher in GrF than in GrP, but lower in PP in GrC than in GrF, except in the domes. Numbers of B-lymphocytes did not change in PP despite of high proliferation and low apoptotic rates, suggesting that they leave PP during the first days of life. Interestingly, C feeding decreased T-lymphocyte numbers and increased apoptotic rates in PP.

Key Words: Immunology, Lymphocytes, Neonatal calf

W61  Effects of dexamethasone (DEXA) and growth hormone (ST) on glucose production in calves. H. M. Hammon*, J. W. Blum2, and S. S. Donkin3, 1University of Berne, Berne, Switzerland, 2Purdue University, West Lafayette, IN.

The hypothesis was tested that DEXA and ST increase glucose production in calves by stimulating hepatic gluconeogenesis and glycogenolysis. Calves (n=24) were randomly divided in 4 groups and were treated from d 3 to d 42 of life. CNTL received saline, DX was daily treated with DEXA (30 µg/kg body weight; Azium, Schering-Plough, Terre Haute, IN), GH was treated with 500 µg recombinant bovine ST (rhST; Posilac, Monsanto, St. Louis, MO) every 14 d, and DXGH was treated with DEXA and rhST; dosages were as in DX and GH. Blood samples (d 3, 7, 14, 28, 42) and liver samples (d 7, 14, 28, 42) were analyzed for glucose and insulin in blood plasma and mRNA and activities of phosphoenolpyruvate carboxykinase (PEPCK; EC 4.1.1.32) and pyruvate carboxylase (PC; EC 6.4.1.1) as well as glycogen content in liver. Glucose concentrations in DXGH were highest (P < 0.01) on d 14 and were higher (P < 0.05) in DXGH than in DX on d 42. Insulin concentrations in DXGH were higher (P < 0.05) than in CNTL on d 7 and were higher (P < 0.05) than in all other groups from d 14 to d 42. Insulin concentrations in DX were higher (P < 0.05) than in CNTL from d 7 to d 28 and were higher (P < 0.05) in DX than in GH on d 28. Expression of PEPCK was lower (P < 0.05) on d 7 and 28 in DX and DXGH than in CNTL and GH and on d 14 and 22 was lower than in DX (P < 0.05) and DXGH (P < 0.1). Expression of PC was lower (P < 0.05) on d 7 in DX and DXGH than in CNTL and GH and on d 14 tended to be lower in DXGH than in DX (P < 0.05) on d 28. Activities of PEPCK were higher (P < 0.05) on d 7 and tended to be higher on d 28 (P < 0.1) in DXGH than in CNTL and DX. PC activities on d 14 and 22 were lower (P < 0.05) in DX and DXGH than in CNTL and GH. Glycogen content in liver was reduced by DEXA and ST alone and in combination. The data indicate age-dependent expression of mRNA and activity of gluconeogenic enzymes and an age-dependent response to DEXA and the combination of DEXA and ST, but no response to ST alone.

Key Words: Glucocorticoids, Gluconeogenesis, Growth hormone

W62  The response of the somatotropic axis to growth hormone (ST) and dexamethasone (DEXA) in calves. H. M. Hammon*, H. Sauerwein2, J. W. Blum3, and S. S. Donkin3, 1University of Berne, Berne, Switzerland, 2Bonn University, Germany, 3Purdue University, West Lafayette, IN.

Glucocorticoids inhibit postnatal growth, but stimulate the somatotropic axis around birth. We have studied effects of DEXA treatment on the somatotropic axis and on the response of the somatotropic axis to ST. Calves (n=24) were randomly divided in 4 groups and were treated from d 3 to d 42 of life. CNTL received saline, DX was daily treated with DEXA (30 µg/kg body weight [BW]; Azium, Schering-Plough, Terre Haute, IN), GH was treated with 500 µg recombinant bovine ST (rhST; Posilac, Monsanto, St. Louis, MO) every 14 d, and DXGH was treated with DEXA and rhST; dosages were as in DX and GH. Blood samples (d 3, 7, 14, 28, and 42) and liver biopsy samples (d 7, 14, 28, and 42) were analyzed for ST, insulin-like growth factor (IGF)-I, and IGF binding protein (IGFBP)-3 in blood (by RIA or EIA) and ST receptor (STR) and IGF-I mRNA in liver (by Northern blot). BW increased (P < 0.05) in CNTL and GH up to d 42 and in DX and DXGH up to d 28, but then decreased (P < 0.05) up to d 42. Plasma ST concentrations were highest (P < 0.01) in GH on d 7 and 14 and were higher (P < 0.05) in DXGH than in CNTL and DX on d 7. Plasma IGF-I concentrations in DXGH were higher (P < 0.05) on d 7 and 14 than in CNTL and DX and were higher (P < 0.05) on d 28 than in all other groups. IGF-I concentrations on d 42 were lower (P < 0.05) in DX. Plasma IGF-BP-3 concentrations were higher (P < 0.05) on d 7 in DXGH than in CNTL and on d 14 and 28 in DXGH than in all other groups. IGF-BP-3 concentrations were higher (P < 0.05) on d 7 in DXGH than in CNTL and on d 14 and 28 in DXGH than in all other groups. IGF-BP-3 concentrations were higher (P < 0.05) on d 28 in GH than in DX and DXGH on d 14. DEXA and ST increased (P < 0.05) in response of the somatotropic axis to ST, but DEXA greatly enhanced the response of the somatotropic axis to ST.

Key Words: Glucocorticoids, Gluconeogenesis, Growth hormone


**W63** Small intestinal and colon morphometry, epithelial cell proliferation, and absorptive capacity in neonatal calves fed milk-derived insulin-like growth factor-I (IGF-I) on a colostrum extract. B. Flößer1, A. F. Speck1, H. M. Sauter1, H. M. Hammon1, P. Galmann2, G. Brem3, and J. W. Blum41. 1University of Berne, Berne, Switzerland, 2Swiss Federal Dairy Research Station, Liebefeld, Switzerland, 3University of Vienna, Vienna, Austria.

Concentrations of non-nutritional factors, such as insulin-like growth factor-I (IGF-I), in bovine colostrum (C) are high and can modulate neonatal intestinal development and function. In neonatal calves we have investigated effects on intestinal epithelial cell morphology, proliferation, apoptosis, and absorption of feeding milk-born human IGF-I (hIGF-I) or a bovine C extract. Calves were fed a milk-based formula containing amounts of nutrients comparable as in C for the first 3 d and a milk replacer from d 4 on. Formula and milk replacer contained only traces of non-nutritional factors such as IGF-I and insulin. In experiment 1, supraphysiologically high amounts of hIGF-I (3.8 mg/mL formula; secreted by transgenic rabbits with their milk) were added to the formula. Xylose appearance in blood (after feeding xylose on d 4) did not differ between groups. In experiment 2, an extract of first-milked bovine C that provided physiological amounts of IGF-I (0.05, 0.15 and 0.09 mg IGF-I/L formula on d 1, 2, and 3, respectively and 0.09 mg IGF-I/L milk replacer on d 4) was added to formula or milk replacer. Plasma xylose concentration in the control group was transiently higher than in calves fed the C extract. On d 5 (after euthanasia) villus circumferences and heights in small intestine and epithelial cell proliferation rate in intestine were higher in calves fed the C extract than in controls. In conclusion, orally administered hIGF-I from transgenic rabbits had no effect on the intestinal tract. However, feeding a bovine C extract enhanced intestinal villus size, although it appeared to transiently decrease the absorptive capacity.

**Key Words:** Growth factors, Intestine, Neonatal calves


We have shown that oral IGF-I increases lactase (LPH) activity in piglets compared to non-IGF-I treated pigs. Differences in LPH activity were greatest when piglets were killed in a post-absorptive state. Further, stable isotope tracer studies suggest that IGF-I up-regulates LPH activity by suppressing proteolytic degradation of LPH and its precursor (proLPHh). The current study was conducted using transgenic sows that over-express IGF-I in milk. We hypothesized that LPH activity would be maintained at a higher level in piglets suckling IGF-I transgenic sows (IGF-I) than piglets suckling non-transgenic sows (CON) following a short-term fast. Following farrowing, litter sizes were normalized to 10 piglets. On d 6, 30 piglets suckling IGF-I and 30 piglets CON were randomly assigned to 3 treatments: fed piglets (0h) remained with the sow until euthanasia; fasted piglets were removed from the sow 6 (6h) or 12 hours (12h) prior to euthanasia on d 7. Serum IGF-I and IGF-I binding proteins (IGFBP) were measured. Intestinal weight, length, protein and DNA content, disaccharidase activity and villus morphology were assessed. Serum IGF-I did not differ between CON and IGF-I, but was lower at 12h compared to 0h (p<0.05). Serum IGFBP-4 was lower at 12h compared to 0h and IGFBP-1 was higher at 12h vs. 0h or 6h (p<0.02). No effects of IGF-I or fasting were noted for jejunal protein or DNA content. Jejunal villus height and width were greater at 6h and 12h compared to 0h (p<0.05). Crypt depth differed between all groups and increased over time (p<0.05). Disaccharidase activity was unaffected by fed state, however IGF-I piglets had greater jejunal LPH (p<0.01) and succrase (p=0.025) activities. In summary, short-term fasting reduced serum IGF-I, but increased villus surface area. Piglets suckling IGF-I sows exhibited increased disaccharidase activity regardless of fed state. (Funded by the USDA CSREES under project NRICGP 90-35206).

**Key Words:** IGF-I, Fasting, Disaccharidase

**W65** Temporal and spatial expression of MUC1 mRNA along the gastrointestinal tract. C. Liu1, A. K. Erickson, and D. R. Henning, South Dakota State University, Brookings SD/USA.

MUC1, a heavily glycosylated membrane-associated mucin, is a major component of milk fat globule membranes (MFGM). The role that MUC1 from MFGM plays in the milieu between mother and offspring is not well understood. One possible role for milk MUC1 may be to mimic intestinal MUC1 on the surface of the epithelial cells lining the gastrointestinal (GI) tract in order to block the binding of bacteria to host epithelial cells. To begin to evaluate this possibility, we needed to know the MUC1 expression pattern along the GI tract, especially its distribution in the neonatal GI tract. Consequently, the current study was designed to evaluate temporal and spatial expression of MUC1 mRNA along the porcine GI tract. We used a reverse-transcription polymerase chain reaction (RT-PCR) approach with primers based on conserved sequences between human and mouse MUC1 to obtain the sequence of a 603 bp segment of porcine MUC1 cDNA from porcine lactating mammary gland. Using these same primers, we developed a quantitative RT-PCR procedure, with normalized beta-actin mRNA expression as an internal control, to assess the level of expression of MUC1 mRNA in different sections of the GI tract (stomach, duodenum, jejunum, ileum, cecum, and colon) from pigs of different ages (1-day, 3-weeks, 6-weeks, and 6-months). Our results indicate that MUC1 mRNA was expressed in a tissue-specific manner in porcine GI tracts with high expression in the stomach, moderate expression in the duodenum and colon, and virtually undetectable expression in the jejunum and ileum. No obvious age-related difference in MUC1 mRNA expression was detected.

**Key Words:** Porcine MUC1, mRNA expression, Gastrointestinal tract

**W66** Cloning and characterization of the bovine class 1 and class 2 insulin-like growth factor-I (IGF-I) mRNA. Y. Wang1, S. E. Price, D. E. Eversole, and H. Jiang, Virginia Polytechnic Institute & State University.

Insulin-like growth factor-I (IGF-I) is an important regulator of growth, development, and metabolism, and is the primary mediator of the growth-promoting activity of growth hormone (GH). The IGF-I polypeptide has been indicated to be generated from two classes of IGF-I mRNA containing either exon 1 (class IIGF-I mRNA) or exon 2 (class 2 IIGF-I mRNA) as the leader exon in several species. The objective of this study was to identify class 1 and class 2 IGF-I mRNA variants, and compare their expression in different tissues, at different developmental stages, and in response to GH, as well as their translatability. Three class 1 IGF-I complementary DNA (cDNA) corresponding to three different transcription start sites in exon 1 and one class 2 IGF-I cDNA were identified from adult cattle liver using 5′ rapid amplification of cDNA ends (5′ RACE). The expression of these four IGF-I mRNA variants were further confirmed by ribonuclease protection assays (RPAs). The RPAs also revealed the presence of two additional class 1 and one additional class 2 IGF-I mRNA variants in bovine tissues. Both classes of IGF-I mRNA were expressed in all tissues examined, including adipose, brain, adrenal gland, heart, kidney, liver, lung, skeletal muscle, rumen, small intestine, pituitary, and spleen, with the highest level in liver and with class 1 being more abundant than class 2 IGF-I mRNA. The levels of both class 1 and class 2 IGF-I mRNA were higher in adult liver than in fetal liver (P < 0.05) and were coordinately increased in the liver of steers in response to GH administration (P < 0.05). In vitro translation analyses indicated that the luciferase reporter mRNA fused to a class 1 IGF-I 5′-untranslated region (5′-UTR) was translated approximately four times efficiently as the luciferase reporter mRNA fused to a class 2 IGF-I 5′-UTR. These results together suggest that as in several other species, IGF-I gene is also expressed as class 1 and class 2 transcripts in cattle, with class 1 IGF-I mRNA contributing more to the IGF-I polypeptide than class 2 IGF-I mRNA and that the expression of both classes of IGF-I mRNA is sensitive to developmental and hormonal (i.e. GH) factors.

**Key Words:** Cattle, Insulin like growth factor, 5′ Untranslated region

Nutritional deprivation decreases blood insulin-like growth factor I (IGF-I) concentrations in a variety of species. In this study we tried to understand the underlying mechanism by determining the effects of fasting on the levels of total IGF-I and total GHR mRNA, as well as the levels of individual IGF-I and GHR mRNA variants in the liver of young steers. Fasting for nearly three days decreased the levels of serum IGF-I by 63% (P < 0.01) and this decrease was associated with a 75% decrease (P < 0.01) in total IGF-I mRNA in the liver. Fasting-induced decrease in liver IGF-I mRNA was further found to be caused by an equal decrease in the levels of both class 1 and class 2 IGF-I mRNA. In addition to IGF-I mRNA, fasting also decreased the levels of total GHR mRNA in the liver (P < 0.05) and this decrease was associated with a decrease in the levels of GHR mRNA variants 1C3 (P < 0.05) and 1A (P = 0.08). Fasting did not affect the levels of two other major GHR mRNA variants, 1B and 1C2. These results together suggest the following mechanism for fasting-induced decrease in blood IGF-I: fasting decreases the levels of GHR mRNA variants 1C3 and 1A in the liver, thereby decreasing GHR number, thereby decreasing GH-induced expression of IGF-I mRNA, thereby decreasing IGF-I secretion from the liver, and thereby decreasing blood IGF-I.

Key Words: Cattle, Insulin like growth factor, Liver

W68 The bovine growth hormone receptor promoter 1 is positively regulated by hepatocyte nuclear factor 4γ via the same element for hepatocyte nuclear factor 4α. H. Jiang*1, M. C. Lucy2, and Q. Xu1, 1Virginia Polytechnic Institute & State University, 2University of Missouri.

Transcription of growth hormone receptor (GHR) gene is directed by multiple promoters. One promoter, named GHR P1, is responsible for liver- and postnatal stage-specific expression of the GHR mRNA variant 1A. We previously found that the region between nucleotide -218 and nucleotide -151 (relative to the transcription start site) of GHR P1 plays a role in regulating the promoter activity, through interactions with a transcription factor named hepatocyte nuclear factor 4α (HNF-4α). Dezoxycorticosterone A footprint analyses and electrophoretic mobility shift assays indicated that the -218/-151 region might bind additional transcription factors in the liver. The objective of this study was to identify these additional transcription factors. Using the yeast-one hybrid system with the -218/-151 region as bait, we have isolated dozens of putative clones from a bovine liver cDNA library. Nucleotide sequencing identified several of the clones as hepatocyte nuclear factor 4γ (HNF-4γ) in addition to HNF-4α. Sequences analyses indicated that HNF-4γ and HNF-4α were encoded by different genes. Electrophoretic mobility shift assays revealed that HNF-4γ bound to the same element consisting of direct repeats of GGCTCA between nucleotide -196 and nucleotide -178, to which HNF-4α had been found to bind. Ribonuclease protection assays indicated that like HNF-4α, HNF-4γ mRNA was highly expressed in liver, absent in most tissues, and more abundant in adult liver than in fetal liver. Co-transfection analyses demonstrated that HNF-4γ was able to enhance the GHR P1 activity in the presence or absence of HNF-4α and that this enhancement was dependent on the GGCTCA repeats in the -196/-178 region. These results together suggest that HNF-4γ is another transcription factor for the liver- and postnatal stage-specific GHR P1, which positively regulate the GHR P1 activity via the same element for HNF-4α.

Key Words: Transcription factor, Growth hormone receptor, Liver


The somatotrophic axis is important in the regulation of growth. Increased concentrations of IGF-I and IGF binding protein (BP)-3 and decreased concentrations of IGFBP-2 are associated with increased growth rates in cattle and swine, however limited experiments have been done to examine the somatotropic axis in exotic species. The overall objective of this experiment was to determine serum concentrations of IGF-I, IGFBP-2 and IGFBP-3 in eight different exotic species. Serum samples were collected from male (M) and female (F) Java Banteng (5M; 3F), Bongo (5F; 3M), Addra Gazelle (4M; 4F), Giant Eland (6M; 2F), Nile Lechwe (5M; 3F), Roan Antelope (4M; 4F) and White Rhinoceros (4M; 4F). Blood samples were collected at two different time points, from each animal. At each time point, on average, F were older than M for all species except Nile Lechwe and White Rhinoceros. In addition, one sample was collected from eight (5M; 3F) Asian Elephants. Concentrations of IGF-I were determined by RIA and concentrations of IGFBP-3 and -2 were determined by Western Ligand Blot. Concentrations of IGF-I, IGFBP-3 and IGFBP-2 were detectable in all species. Average concentrations of IGF-I, IGFBP-3 and IGFBP-2, for all species, range from 17 to 442 ng/mL, 17 to 178 arbitrary units (AU) and 10 to 61 AU, respectively. In general, average concentrations of IGF-I and IGFBP-3 were greater in M and concentrations of IGFBP-2 were greater in F. Concentrations of IGF-I were greater in M than F (P < 0.05) in Java Banteng and in Nile Lechwe. There was a trend for greater concentrations in M than F (P < 0.10) in Bongo, Roan Antelope and White Rhinoceros. Concentrations of IGF-I increased with age in Java Banteng (P = 0.08) and in M Nile Lechwe (P < 0.05) and decreased in White Rhinoceros (P = 0.07) and F Nile Lechwe (P < 0.05). Concentrations of IGFBP-3 in Java Banteng were greater in M than F (P < 0.01) and increased with age (P < 0.01). Concentrations of IGFBP-2 were greater in F than M in Elephants (P < 0.05) and in Roan Antelope (P = 0.08). Although relatively few samples were collected, gender and age differences were observed, in some of the species, which parallel differences observed in domestic species.

Key Words: Insulin-like growth factor binding proteins, Insulin-like growth factor-I, Exotic species

Meat Science & Muscle Biology: Manipulation of Meat Quality

W70 Antioxidant effects of rosemary extract and whey powder on the oxidative stability of wiener sausages during 10 months frozen storage. S. A. Coronado1, F. R. Dunshea2, and N. P. Shah1. 1Victoria University, Melbourne, Australia, 2Victorian Institute of Animal Science, Werribee, Australia.

Lipid oxidation is a major problem encountered in meat processing. Fishmeal is added directly to pig feed in order to provide protein or energy and to increase dietary vitamin A and D. However, high levels of fish oil render the animal fat more prone to oxidation while introducing fishy odors into the meat product. The aim of this study was to investigate the stability of wiener sausages prepared from pork obtained from pigs fed diets containing vitamin E (10 or 200 mg α-tocopherol acetate per kg feed) and fish-meal (0 or 5%) and manufactured with or without an antioxidant (0.03% rosemary extract or 2.5% sweet whey). Twelve (Large White x Landrace) gilts were randomly allotted to four dietary treatments containing two levels of vitamin E (10 or 200 mg/kg) and two levels of fish meal (0 or 5%) using a 2 x 2 factorial design. Wiener sausages were manufactured from meat obtained from animals after slaughter and stored for 5 days at 4°C with or without antioxidants. The oxidative stability of the wiener was examined over ten months of frozen storage. Lipid oxidation in the product was measured by means of thiobarbituric acid reactive substances (TBARS) and fluorescence shift. Sensory evaluation of the product to detect oxidative changes was also carried out. No lipid oxidation as measured by TBARS, fluorescence shift and sensory analysis was observed in wiener stored at -20°C for ten months. The oxidative stability of wiener was unaffected (P > 0.05) by dietary treatments or by the addition of antioxidants. Dietary vitamin E lowered TBARS values and helped retard lipid oxidation.

Key Words: Antioxidant, Oxidation, Wiener
W71 Chemical composition and meat quality of pale, soft and exudative, and red, firm and non-exudative pork meat. F. Figueroa1, C. Perez1, A. D. Alarcon2, F. J. Solis2, J. A. Jimenez2, and G. Erosa1. 1Universidad Autonoma de Baja California, 2Universidad Autonoma de Chihuahua.

The objective of this study was to evaluate the chemical composition and meat quality of pale, soft and exudative (PSE) and red, firm and non-exudative (RFN) pork meat in twenty samples of Semimembranosus muscle from each type of meat. The carcass measurements included length of hot carcass with head (HCW), meat pH at 45 min (pH45) and at 24 h post mortem (pH24), the color coordinates L* (luminosity), a* (redness), and b* (yellowness) determined at 24 h post mortem. Measurements in meat included ash, organic matter (OM), water, dry matter (DM), crude protein (CP), water holding capacity (WHC), and free water (FW). The color differences were calculated using the equation ΔE=√(ΔL*² + Δa*² + Δb*²). The pH45 and pH24 were significantly (P<0.05) higher in RFN carcasses than PSE. There were no differences (P>0.05) in redness of meat. Water, DM, and CP contents were similar in both types of meat but PSE meat had higher ash and lower OM percentage. Both types of meat showed a negative correlation between water content and pH45, and between WHC and water content. WHC, L*, a*, and b* of PSE meat showed a negative correlation with pH45 while WHC of the same meat had a positive correlation with L*, a*, and b*. A positive association between FW and pH45 of RFN meat was observed, as well as between WHC and a*. It was concluded that PSE and RFN meat had similar chemical composition and meat quality except for ash content and meat yellowness which were higher in PSE meat.

Key Words: Meat quality, PSE pork meat, RFN pork meat

W72 SDS-PAGE profile of sarcoplasmic and myofibrillar proteins of pale, soft and exudative and red, firm and non exudative pork meat. F. Figueroa1, C. Perez1, A. D. Alarcon2, F. J. Solis2, J. A. Jimenez2, and G. Erosa1. 1Universidad Autonoma de Baja California, 2Universidad Autonoma de Chihuahua.

The objective of the study was to characterize the sarcoplasmic protein profile and myofibrillar components of pale, soft and exudative (PSE) and red, firm and non-exudative (RFN) pork meat. Three samples of Semimembrinosus muscle from each type of meat were taken 24 h post mortem and analyzed by SDS-PAGE. Sarcoplasmic proteins recognized in both types of meat were phosphorylase, creatine kinase, enolase, α-glycerophosphate dehydrogenase, phosphoglucomutase, pyruvate kinase, phosphoglycerate kinase, and a polypeptide of phosphofructokinase, and one of aldolase. The 84 and 27 kDa bands were observed only in RFN meat and attributed to phosphorylase-β kinase and triosephosphate isomerase respectively. The myofibrillar proteins identified in both types of meat were a polypeptide of myosin, β-actinin, actin, and the ε-actinin. The proteins observed only in RFN meat were a polypeptide of α-actinin, a 58 kDa, and troponin I as well as two high molecular weight (MW) bands and four low MW components, whereas those found only in PSE meat were four low MW and two high MW non identify proteins. It was concluded that the main difference between PSE and normal or RFN meat are the 58 kDa myofibrillar component, as well as the 54 and 27 kDa sarcoplasmic protein found only in RFN meat, and the 73 and 33 kDa protein of PSE meat.

Key Words: PSE and RFN pork meat, Sarcoplasmic protein, Myofibrillar protein

W73 Structure and ultrastructure of pale, soft and exudative and red, firm and non-exudative pork meat. F. Figueroa1, C. Perez1, A. D. Alarcon2, F. J. Solis2, J. A. Jimenez2, and G. Erosa1. 1Universidad Autonoma de Baja California, 2Universidad Autonoma de Chihuahua.

Twelve samples of Semimembranous muscle from pork were used to characterize the structure and ultrastructure of pale, soft and exudative (PSE) and red, firm, and non-exudative (RFN) pork meat. Observations from a scanning electron microscope showed that RFN fibers had a polygonal and straight shape with a lower interfibrillar and myofibrillar space than PSE fibers which showed an angular and flat shape with higher interfibrillar and myofibrillar space, and the absence of nuclei. Vast degradation of connective tissue was also observed in PSE meat. Differences between both types of meat were not clear when samples were examined under the optic Axiomat and the transmission electron microscopes. It was concluded that PSE meat has higher degradation of fibers, myofibrils and connective tissue than RFN muscle.

Key Words: PSE and RFN pork, Electron microscopy, Structure and ultrastructure

W74 Oxidative stability, shear force, and color of stored pork from pigs heterozygous for Rendement Napole and/or Halothane genes and consuming magnesium through drinking water. B. R. Frederikx1, E. van Heugten, and M. T. See. North Carolina State University, Raleigh, NC.

Sixty-four pigs (117±0.7 kg BW) representing 1 non-carriers (NN/rn-rn), 2 Rendement Napole carriers (NN/RN-rn-rn), 3 Halothane carriers (NN/rn-RN-rn-rn), and 4 carriers of both mutations (NN/rn-RN-rn-rn) in a factorial arrangement were individually penned and provided ad libitum access to feed (0.12% Mg) and water. Pigs were randomly allotted to receive 900 mg of Mg/L of drinking water from MgSO4 for 0 or 2 d before harvest. Longissimus dorsi (LD) and Semimembranosus (SM) chops were placed on trays, wrapped, and stored at 4°C to simulate retail display for 8 d. The posterior LD was split, vacuum packed, and stored at 4°C for 25 or 45 d. The RN carriers, regardless of the Halothane gene (Nn/RN-rn-rn), had higher (P<0.05) initial lipid content of SM (117 vs 99 g fat/Mg of tissue), oxidation of LD and SM after 8 d of displayed storage (322 vs 159:14 and 399 vs 151.16 µg MDA/kg of tissue, respectively), LD Minolta L* (lightness) after 25 and 45 d of vacuum packed storage (61.6 vs 56.3±0.8 and 62.3 vs 56.7±0.7, respectively), LD Minolta a* (redness) after 25 d of vacuum packed storage (11.28 vs 10.06±0.15) and lower (P<0.05) LD shear force (3.05 vs 3.94±0.01 kg) than normal carriers. Halothane carriers, regardless of the RN gene (Nn/rn-rn-rn), had higher (P<0.05) LD Minolta L* after 25 d of vacuum packed storage (60.6 vs 57.3±0.8), cooking loss (29.3 vs 25.9±0.8%), and LD shear force (3.71 vs 3.28±0.10 kg) than Halothane normal (NN/rn-rn-rn) pigs. A genotype interaction was present for LD Minolta a* after 45 d of vacuum packed storage (9.81, 10.88, 9.64, and 12.95±0.3 for genotypes 1, 2, 3, and 4, respectively). Magnesium did not affect quality characteristics reported. However, the Napole mutation increased lipid oxidation of loin and ham muscles, tenderness of displayed loins and paleness and redness of vacuum packed loins. The Halothane mutation increased cooking loss and toughness of displayed and paleness of vacuum packed loins.

Key Words: Rendement Napole, Halothane, Magnesium

W75 The influence of dietary protein on market barrows and gilts supplemented creatine monohydrate in conjunction with a high glycemic carbohydrate. C. A. Stahl1, B. R. Wiegand2, M. S. Carlson3, D. L. McNamara4, T. B. Schmidt2, and E. P. Berg3. 1University of Missouri, Columbia, MO, 2Illinois State University, Normal, IL.

Forty-eight Q-Max X Premier T-100 barrows and gilts (91 kg) were blocked by both weight and sex and assigned to one of 12 pens (four pigs/pen, 16 pigs/treatment) using a completely randomized design. Treatments 1 (basal diet consisting of a ground corn-soybean base) and 2 (basal diet supplemented with 0.92% creatine monohydrate (CMH) and 2.75% dextrose) were formulated to meet or exceed all NRC recommendations, while treatment 3 (basal diet supplemented with 0.92% CMH and 2.75% dextrose) was formulated to contain a minimum of 16% CP. All test diets were isocaloric and the CP ratio between barrows and gilts remained constant so that the synthetic levels of lysine were consistent within each diet treatment. Animal weight and feed disappearance was recorded at 7d intervals throughout the 28d testing duration to determine ADG and feed efficiency. In addition, real-time ultrasound was used to determine fat accretion and lean tissue development at the tenth rib. Upon completion of the growth study (d1-28), animals remained on experimental diets for an additional 5d to reach market weight. Treatment 3 barrows gained the least tenth rib fat (0.69; 0.43; 0.15; +/- 0.05cm; P<0.001) and expressed the highest percentage fat free carcass lean (50.58; 52.22; 54.09; +/- 0.66%; P<0.001) after 28d on test. In addition, dietary treatment decreased the first (1.6; 1.7; 1.45 +/- 0.15%; P=0.02) tenth (2.25; 2.03; 1.66 +/- 0.16%; P=0.03) and last (2.50; 2.36; 1.75 +/- 0.20cm; P=0.02) rib fat depth of treatment 3 barrows after 28d. The absence of a significant treatment difference were noted in the fat and lean tissue accretion of gilts. Moreover, diet did not significantly affect the meat quality parameters of barrow.
and gilt carcasses measured at one and 21d postmortem. In conclusion, the data suggest that an increase in dietary CP significantly affects the body composition of barrows fed a combination of 0.92% CMH and 2.75% dextrose.

Key Words: Creatine, Lysine, Pigs

W76 Improving pork tenderness using hydrodynamic pressure. M. B. Solomon* and V. Purcell, USDA-ARS, Beltsville, MD USA.

Pork producers have implemented management strategies that have resulted in today’s pork having less fat and more lean tissue which in turn have negatively influenced meat tenderness. The objective of this study was to determine whether hydrodynamic pressure processing (HDP) could improve pork tenderness. The longissimus (LM) muscles (left side) from 17 pork carcasses were excised within 1 h post-slaughter, vacuum packaged and aged (4 C) for 5 d then frozen (-10 C) for 3 months. A 15 cm frozen section (sirloin end) was removed from each LM and thawed (4 C) for 24 h. These sections were in turn divided in half and designated as anterior and posterior halves and randomly assigned to either HDP or control (C) treatment. HDP treatment consisted of a 1.3 cm thick flat steel plate fitted to the bottom of a 115-L plastic container filled with water. A 100 g of binary explosive was suspended 38 cm above the steel plate. Eight pork samples designated for HDP were vacuum packaged in one bag and placed on the steel plate and HDP treated. The remaining nine samples designated for HDP were vacuum packaged in one bag and placed on the steel plate and HDP treated. Two chops (2.5 cm thick each) were cut after HDP treatment from both the HDP treated and C sections for shear force evaluation. The HDP treatment consisted of eight pulses each 25 ms in duration with mean HDP 5.76 kg/cm². Percent improvement ranged from a low of -5.9% to a high of 35.3%. The HDP treatment consisting of six pulses improved 26.4% in shear force (C=7.51 kg/cm² vs HDP=5.50 kg/cm²). Percent improvement ranged from a low of 4.6% to a high of 46.1%. The combined average shear force improvement for HDP treatments was 22.6%. Results indicate that HDP enhances pork tenderness, however, a variability in meat sample response to HDP treatment exists.

Key Words: Pork, Tenderness, Hydrodynamic pressure

W77 Densitometric analysis of myofibrillar proteins in muscle samples from Angus bulls with high or low blood serum IGF-I concentration. A. Yilmaz1, M. E. Davis1, R. C. M. Simmen2, and M. Yamaguchi3. 1Department of Animal Sciences, The Ohio State University, 2Department of Animal Science, University of Florida, 3Department of Veterinary Biosciences, The Ohio State University.

The objective of this study was to determine possible changes in expression of myofibrillar proteins in muscle samples from bulls with high or low blood serum insulin-like growth factor I (IGF-I) concentration. Data were obtained from an experiment involving Angus beef cattle divergently selected on the basis of blood serum IGF-I concentration at the Eastern Ohio Resource Development Center. Selection was based on the mean IGF-I concentration of three blood samples taken at d 28, 42, and 56 of the 140-d postweaning test. Muscle samples were collected from carcasses of 43 bulls (21 high and 22 low line). Age at slaughter ranged from 374 to 443 d. Myofibrils were prepared using differential centrifugation and loaded on SDS-PAGE gels. Densities of each of the myofibrillar protein bands were determined using a laser scanning densitometer. Data were analyzed using SAS. All models used in this study included the fixed effect of year-line-season and the random effect of sire nested within year-line-season. Contrast analysis showed that a 35.2 32.1 ng/mL difference (P < 0.28) in mean IGF-I concentration of the high and low IGF-I line bulls did not result in line differences in density of the myofibrillar proteins, except that myosin light chain 2 was higher in low line than in high line bulls (P < 0.05) and troponin C density was higher in high line than in low line bulls (P < 0.05). Previous research, however, has shown that increasing amounts of troponin C loaded on a gel did not result in linear increases in the density of this molecule. A significant residual correlation between density of troponin T and IGF-I concentration measured at d 28 of the postweaning test was found (r = -0.44; P = 0.05). Significant cubic relationships of 32 kDa protein, myosin heavy chain, and alpha-actinin with mean IGF-I concentration of three blood samples taken at d 28 of the postweaning test resulted in today’s pork having less fat and more lean tissue which in turn have negatively influenced meat tenderness. The objective of this study was to determine whether hydrodynamic pressure processing (HDP) could improve pork tenderness. The longissimus (LM) muscles (left side) from 17 pork carcasses were excised within 1 h post-slaughter, vacuum packaged and aged (4 C) for 5 d then frozen (-10 C) for 3 months. A 15 cm frozen section (sirloin end) was removed from each LM and thawed (4 C) for 24 h. These sections were in turn divided in half and designated as anterior and posterior halves and randomly assigned to either HDP or control (C) treatment. HDP treatment consisted of a 1.3 cm thick flat steel plate fitted to the bottom of a 115-L plastic container filled with water. A 100 g of binary explosive was suspended 38 cm above the steel plate. Eight pork samples designated for HDP were vacuum packaged in one bag and placed on the steel plate and HDP treated. The remaining nine samples designated for HDP were vacuum packaged in one bag and placed on the steel plate and HDP treated. Two chops (2.5 cm thick each) were cut after HDP treatment from both the HDP treated and C sections for shear force evaluation. The HDP treatment consisted of eight pulses each 25 ms in duration with mean IGF-I HDP 5.76 kg/cm². Percent improvement ranged from a low of -5.9% to a high of 35.3%. The HDP treatment consisting of six pulses improved 26.4% in shear force (C=7.51 kg/cm² vs HDP=5.50 kg/cm²). Percent improvement ranged from a low of 4.6% to a high of 46.1%. The combined average shear force improvement for HDP treatments was 22.6%. Results indicate that HDP enhances pork tenderness, however, a variability in meat sample response to HDP treatment exists.

Key Words: Pork, Tenderness, Hydrodynamic pressure


Twenty-four Angus x Hereford steers (387 kg) were used to determine the effect of fish oil and/or canola oil supplementation in a finishing diet on animal performance, meat quality and tissue fatty acid composition. Steers were randomly allotted to one of three diets: 1) basal high concentrate diet (NONE; 88% concentrate, 12% grass hay), 2) basal diet plus 4% canola oil (CA), or 3) basal diet plus 3% canola oil and 1% crude fish oil (FISHCA). All steers were implanted with Synovex-S at the initiation of the study and fed the basal diet (NONE) for the first 41 d. After 41 d on feed, animals were gradually switched to treatment diets over a two-week period. From d 56 to harvest (d 106), all steers received their appropriate treatment rations. At 24 h postmortem, carcass data was collected, and samples were removed from each carcass for subsequent fatty acid, sensory, shear force and lipid oxidation analyses. Data were analyzed with dietary treatment in the model. Average daily gain tended (P = 0.07) to be greater for FISHCA than NONE or CA during the final 50 d on feed when treatment diets were fed. Hot carcass weight, dressing percentage, fat thickness, ribeye area or yield grade did not differ (P > 0.05) between treatments. Marbling score and quality grade were higher (P < 0.05) for CA and FISHCA than NONE. Lipid oxidation (TBARS, mg malonaldehyde/kg sample) was greater (P < 0.05) for FISHCA than CA or NONE, and TRABS values increased (P < 0.05) over storage time in all treatments. Warner-Bratzler shear force (WBS) values tended (P = 0.06) to be higher for CA than FISHCA, with NONE being intermediate. Sensory panelist off-flavor scores were greater (P < 0.05) for FISHCA ground beef compared to NONE or CA, which did not differ (P > 0.05). Ground beef samples from steers fed NONE or FISHCA received higher (P < 0.05) juiciness and tenderness scores from sensory panelists compared to CA. Concentration of the cis-9, trans-11 CLA isomer was higher (P < 0.05) in ground beef from FISHCA than NONE or CA, which were similar (P > 0.05). Feeding supplemental oils increased marbling score and quality grades. Addition of fish oil with canola oil increased CLA concentration, lipid oxidation, and off-flavors of ground beef.

Key Words: Beef, Fish oil, CLA
breed on development of novel beef cattle production systems especially on roughtage based diets seems to be justified.

Key Words: Feeding intensity, Breed difference, Carcass quality

**W80** Evaluation of marbling by US scoring system and video image analysis. J. Tószér¹, I. Holló², G. Holló², E. Szics³, R. Zándok³, J. Serej³, and I. Repa², ¹Szent István University, Gödöllő, H-2103, ²University of Kaposvár, Kaposvár H-7401.

The visible proportion and distribution of intramuscular fat in M. longissimus dorsi, called marbling, is the most important factor influencing quality grade in the United States and Canada (Boggs et al., 1995). In Europe carcass value is determined by conformation and fatness traits, in spite of it, marbling is often demanded as a primary quality trait of beef by consumers or in labeled products (Chambaz et al., 2002). There have been several methods developed to evaluate intramuscular fat content (Baker, 1986; Hekaya et al., 1999; Hassen et al., 1999; Chambaz et al., 2002). The aim of this research was to determine the correlation between results received by subjective scoring (USA, 1-6) and by video image analysis (VIA). Native Hungarian Grey (HG), and Holstein-Friesian growing-finning bulls were housed in confinement on deep litter and fed on corn silage, hay and concentrate (6 kg/day) based diets for 210 days in two groups with 10 head of each. Average age and weight at slaughter for HG and HF were 552 and 474 days, and 545 and 578 kg, respectively. Pictures of longissimus muscle cross section were taken by video camera and analyzed by software Terlet V 7.0 developed by Mosoni (2000). Marbling is evaluated using brightness of picture taken. Surfaces with more than 200 brightness units were measured in two replications. Data processing was made with SPSS10 statistical program package. Marbling score for HG bulls was 1.5 when evaluated by subjective scoring and 1.29% determined by VIA. For HF bulls, the values were 1.1 scores and 0.43%, respectively. In terms of marbling significant differences (P<0.01) were established between breeds using VIA, while no significant differences were recorded by subjective scoring (P<0.1). Correlations between the two marbling evaluation procedures for both breeds (HG: VIA=-0.7556+1.0778*USA, r=0.86) suggested the appropriateness of both methods in the evaluation of marbling in beef.

Key Words: Marbling, VIA, Cattle breeds

**W81** Evaluation of ultrasonic estimates of fat thickness and longissimus muscle area in de-haired hanging beef carcasses at chain speed. T. Perkins¹ and A. Rimal, Southwest Missouri State University.

The objective of this study was to evaluate the accuracy of real-time ultrasonic measurements of longissimus muscle area (REAU) and 12th rib fat thickness (FTU) in hanging de-haired beef carcasses at regular plant chain speed. A certified ultrasound technician took measurements on 387 head of slaughter cattle using an ALOKA 500V ultrasound unit. Carcasses were ultrasounded immediately after de-hairing at a pace of one carcass every 12-15 seconds in a hanging position on the rail. Carcass ribeye area (REAC), carcass fat thickness (FTC) and calculated muscle area (REAU) and CYG, FTC and CYG, and FTU and CYG were 368.5 ± 32.9 kg, 83.4 ± 9.96 cm², 1.03 ± 0.36 cm, 83.79 ± 10.5 cm², 1.08 ± 0.46 cm and 0.86 ± 0.39 cm, respectively. Pearson correlations for REAU and FTC, REAU and CYG, REAU and FTC, FTC and CYG, FTC and FTU, and FTU and CYG were 0.53, 0.72, -0.77, -0.39, 0.86 and 0.65, respectively. These data suggest that ultrasound can accurately assess carcass compositional differences in hanging beef at chain speed. However, the removal of hair prior to scanning is a must to keep up with the speed of the carcass movement every twelve to fifteen seconds.

Key Words: Ultrasound, De-haired, Beef

**W82** Effect of breed, sex, and slaughter weight on meat quality of lambs. J. Peinado¹, P. De Miguel², D. García³, M. Cordero¹, and M.I. Gracia¹, ¹Inasde Agropecuaria, S.L., Spain, ²GRUPO CARNICO MAGNUS, S.A., Spain, ³Estacion Tecnologica de la Carne de Guijuelo, Spain.

A total of 480 lambs was used to study the influence of breed, sex, and slaughter weight (SW) on meat quality. There were eight treatments arranged factorially with two breeds (Castellana vs Merino), two sexes (female vs male), and two SW (26 vs 31 kg). Each treatment was replicated six times and ten lambs penned together formed the experimental unit. All the lambs received a common pelleted diet based on barley, wheat, and soybean meal. Wheat straw was offered ad libitum. Following slaughter, carcasses were stored for 24 h at 2 ± 1°C. Then, samples from the longissimus muscle from the left side of two lambs per replicate were obtained and divided into two portions. Water holding capacity, chemical composition, and color were measured in the first portion (L1, 6th to 10th dorsal rib) and shear force was measured in the second portion (L2, 11th to 13th dorsal rib). Samples from L1 were stored at -20°C, whereas samples from L2 were previously stored for three d at 4°C and then frozen. Loin from Castellana lambs had more fat content than loins from Merino lambs (4.8 ± 4.2%; P < 0.05), and loins from females had more fat content than loins from males (4.8 ± 4.0%; P < 0.05). Loins from females had lower a* and higher L* values (P < 0.05), and had less cooking losses (21.3 ± 19%; P < 0.05) than loins from males. An increase in slaughter weight increased fat content of the loin (5.30 ± 3.49%; P < 0.05). Loins from lambs slaughtered at 31 kg had greater cooking losses (21.4 ± 18.9%; P < 0.05), and higher a* but lower L* values (P < 0.05) than loins from lambs slaughtered at 26 kg. Also, SW tended to increase shear force (Warner-Bratzler values of 7.67 and 6.74 kg; P < 0.10). It is concluded that meat quality of lambs can be adapted to different markets by manipulating breed, sex, and weight at slaughter.

Key Words: Lambs, Slaughter weight, Meat quality

**W83** Cholesterol level and sensory evaluation of lambs of various hair x wool sheep crosses. S. Wang¹, T. D. Bunch, R. C. Evans, C. P. Brenand, D. R. Whittier, and B. J. Taylor, Utah State University, Logan, Utah, USA.

The cholesterol level and sensory evaluation were compared in six lambs from each of the following genotypes: 1) St. Croix hair sheep, 2) St. Croix x wool sheep, 3) Callipyge wool x St. Croix, 4) Dorper hair sheep x St. Croix, 5) Dorper x wool, Callipyge wool x wool, and 6) wool x wool. Meat cholesterol was extracted by chloroform-methanol mixture and the cholesterol levels were determined by spectrophotometric measurement of the color generated by the reaction of cholesterol with glacial acetic acid-FeSO₄-H₂SO₄. A 9-point hedonic ballot ranging from 9 (like extremely) to 1 (dislike extremely) was used for the sensory evaluation based on the following index: flavor, tenderness, juiciness and overall quality. The general linear model (GLM) ANOVA procedures and Fisher’s LSD multiple-comparison test were used to determine the difference among genotypes. Cholesterol levels (mg/100g fresh meat) were 249.6, 170.1, 73.2, 149.2, 50.4 and 116.5, respectively. The cholesterol level in the hair sheep (St. Croix) is significantly higher (P < 0.05) than all the other genotypes and the lowest is in the Callipyge crosses. Significant differences (P < 0.05) existed between genotypes for every sensory characteristic measured. St. Croix had the highest overall sensory acceptance rating (6.8) and the lowest in the Callipyge wool x wool. As cholesterol correlates to fat composition of the tissue these differences may account for the differences found between crosses in the sensory evaluation data.

Key Words: Cholesterol, Sensory evaluation, Sheep

**W84** Estimation of correlations of reproductive traits with blood serum IGF-I concentration in Angus beef cattle. A. Yilmaz¹, M. E. Davis¹, R. C. M. Simmen², and H. C. Hines³, ¹Department of Animal Sciences, The Ohio State University, ²Department of Animal Science, University of Florida.

The objectives of this study were to obtain estimates of heritabilities and genetic (rA1A2), environmental (rE1E2), and phenotypic (rP1P2) correlations of insulin-like growth factor I (IGF-I) concentration with scrotal circumference (SCR), percentage of motile (MOT) and morpho-
logically normal (NORMAL) sperm cells, calving rate (CR), and age of heifers at first calving (AFC). Data were obtained from an ongoing experiment that involves Angus beef cattle divergently selected on the basis of blood serum IGF-I concentration at the Eastern Ohio Resource Development Center. Selection was based on the mean IGF-I concentration of three blood samples taken at d 28, 42, and 56 of the 140-d postweaning test. Data were analyzed using SAS and MTDFREML. Fixed effects, which included birth year, IGF-I line effect, season of birth, age of dam, sex, mating number and on-test age, were tested for significance and only significant effects were included in the subsequent analyses. (Co)variance estimates were obtained using an animal model that did not include maternal genetic or permanent environmental effects. Calving rate was coded as either 1 (conceived) or 100 (did not conceive) and was treated as a repeated measure. Environmental correlations of calving rate with mean IGF-I concentration for matings other than the first were ignored, because including IGF-I measurements for each mating resulted in non-permissible heritability estimates for IGF-I measurements. Correlations with mean IGF-I concentration were small, except that genetic correlations of mean IGF-I with SCR, MOT, and CR were moderate to high. These results suggest that selection for blood serum IGF-I concentration should result in a decrease in age at first calving and increases in all remaining variables.

### Mean IGF-I

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</table>

**Key Words:** Inulin-Like Growth Factor I, (Co)variance Component Estimation, Reproduction

### W85 Molecular characterisation of myostatin gene in mexican Beefmaster cattle

M. Sifuentes-Rincon1, X. F. De la Rosa-Reyna1, A. Del Bosque 2, and H. A. Barrera-Saldana1
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The production of animals with superior muscle structure is of great importance to food animal agriculture. Dysfunction of myostatin gene has been reported in mammals. In bovine the loss of this gene activity has been associated to double-muscled phenotype present in some european breeds. Beefmaster is one of the main breeds in Tamaulipas, Mexico. Due to the role of myostatin gene in muscle development, the objective of this study was to analyze a coding region containing mutations which potentially altering the myostatin gene expression. Eighty-seven individuals of Beefmaster cattle were blood-sampled and the DNA extracted was used to amplify a 548-bp from exon II. Mutation analysis of this region was achieved using both Basic Exon-Sequence Scanning and nucleotide sequencing. We detected some sequence variations in our tested population: nt 374-51 (T-C Transition); nt 374-50 (Transition G->A); nt 414 (Transition C-T); nt 374-16 (Deletion 1). The nucleotide changes found were grouped in three haplotypes A, B and C. The first one does not contain mutations, whereas B and C present the 3 transitions and the deletion changes, respectively. The data from this study indicate that mutations founded in Beefmaster were identical to those previously reported in other non-double-muscled breeds. Therefore exon II from myostatin gene does not make a useful molecular marker to selection those individuals with superior muscle mass in Beefmaster cattle.

**Key Words:** Myostatin, Beefmaster cattle, Mutation

### W86 Association between promoter region insulin-like growth factor-I polymorphism and genetic merit for production traits in Holstein sires

G. W. Kazmer1, A. M. Sifuentes-Rincon
1University of Connecticut.

DNA was extracted from blood samples from dairy sires at the time of enrollment into a progeny test program. Of these animals, genetic merit information based on at least 40 daughters eventually became available on 309 sires, from which population means and standard deviations (SD) were calculated. 204 bulls were found to be either one SD greater than or one SD less than the mean for either one or more of the following traits: milk yield (MY), fat yield (FY), fat percent (FP), protein yield (PY) and protein percent (PP) and were included in subsequent analysis. A 264bp fragment spanning a polymorphic site 512 bp upstream from initiation site of insulin-like growth factor-I (IGF-I) was amplified using 5' - ATTA CAAAGCTGCTGCC - 3' as forward and 5' - CATATCTGAT CATACGTTACCCG - 3' as reverse primers. Bulls were genotyped using single strand conformation polymorphism techniques. Two distinct alleles were found in this population and designated in accordance with previous reports. Genotypic frequencies were compared between +1 and -1SD groups for each trait using the Frequency procedure of SAS. Further, trait means for AA, AB and BB genotypes were compared using GLM procedure. Genotypic distribution was different between -1SD and +1SD groups of F% and P% (p<0.05 and p<0.02, respectively), as more BB genotypes were present in -1SD than in +1SD groups for both traits. Comparing trait means among -1SDF% and +1SDF% indicated that BB genotypes had less P% than AA or BB genotypes (0.13% vs 0.14%, P<0.04). Data indicate that BB genotype may be associated with increased milk yield and decreased fat and protein percentage in dairy animals.

**Key Words:** IGF-I, Polymorphism, Yield Traits

### W87 Genetic polymorphism at the kappa casein loci in Holstein and Iranian native cattle Sarabi by use of PCR-SSCP

A. G Tahvildarzadeh1, J. Shoja1, M. Torchi2, A. M. Tahmashi3, and S. Alijanii2
1Dept. of Animal Sci. Tabriz University, 2Dept of Plant Breeding and Genetic, Tabriz University, Iran.

Methods have been devised for detecting polymorphism in the bovine k-casein genes using the polymerase chain reaction (PCR) followed rather by restriction enzyme digestion (to reveal a RFLP) or by single strand conformation polymorphism and to demonstrate CSN3 polymorphism in blood sample of Iranian native cattle (Sarabi n=66) and Holstein-Frisian (n =102). The PCR products (453 bp) were heat-denatured, loaded onto non-denaturing polyacrylamide gels, and Etidium Bromide stained. Each variant yielded patterns clearly distinguishable from the others. Reference DNA sample from cows and bulls, which were previously genotyped at DNA level with PCR-RFLP, were used to develop the optimal conditions of PCR-SSCP. The optimal condition for SSCP were 8% polyacrylamide gels (49:1 acrylamid: bis-acrylamid ratio), with 5% glycerol and constant running temperature of 40°C. Estimated gene frequencies of Holstein and Sarabi were 0.8284 ± 0.0265, 0.1716 ± 0.0265 and 0.7652 ± 0.0361, 0.2348 ± 0.0361 for A and B alleles respectively. The observed heterozygosity for Sarabi and Holstein were 0.3484 ± 0.052 and 0.2843 ± 0.052 respectively. The estimated gene diversity from sum of squares of allele frequency represented by Bruce, for Sarabi and Holstein were 0.3593 ± 0.0265, 0.1716 ± 0.0265 and 0.7652 ± 0.0361, 0.2348 ± 0.0361 for A and B alleles respectively. The obtained heterozygosity for Sarabi and Holstein were 0.3484 ± 0.052 and 0.2843 ± 0.052. The estimated gene diversity from sum of squares of allele frequency represented by Bruce, for Sarabi and Holstein were 0.3593 ± 0.053 and 0.2843 ± 0.053 respectively. Based on information at this locus and based on chi-square test statistic, no evidence was found of disequilibrium in two populations. Comparison of allele frequencies in this study with other cattle breeds indicates that there was no significant difference between observed and expected frequencies in both Sarabi and Holstein populations. The only significant differences observed are those between the two breeds of this study with Jersey and Brown Swiss from other study.

**Key Words:** Single strand conformation polymorphism, PCR-RFLP, Sarabi cattle

### W88 Type trait evaluations and heritabilities of Holstein dairy cattle in northeastern Iran

M. Jafarika1, F.E. Shahryari1, and A.A. Naserian, Ferdowsi University of Mashhad, Mashhad, Iran.

This study was conducted to evaluate measures of type traits and their relationships and heritabilities for Holstein dairy cows by using data from 520 dairy cows of Kenebist Farm (Astan Ghods Razavy, Mashhad, Northeastern Iran). Type traits were divided into two categories. First, the traits that classifiers measure were stature, pin set, rump length, pin width, rear udder height, rear udder


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the same as from the univariate model. Heritabilities increased for some measures when using the multivariate model and ranged from 0.067 to 0.132, 0.076 to 0.098, and 0.048 to 0.095 for milk, fat, and protein, respectively. Genetic correlations between measures of persistency and 305-d yield were 0.038 to 0.764, 0.100 to 0.450, and 0.127 to 0.461 for milk, fat, and protein, respectively. Phenotypic correlations had similar trend to genetic correlations.

Key Words: Lactation persistency, Iran, Dairy cattle

W91 Genetic correlations between boar semen traits. S.-H Oh1, M. T. See1, T. E. Long2, and J. M. Galvin2. 1North Carolina State University, Raleigh, NC, 2NPD USA, Roanoke Rapids.

Currently boars selected for commercial use as AI sires are evaluated on grow-finish performance and carcass characteristics. If AI sires were also evaluated and selected on semen production, it may be possible to reduce the number of boars required to service sows thereby improving the productivity and profitability of the boar stud. The objective of this study was to estimate genetic correlations between boar semen traits; total sperm counts (TSC), volume collected (SV), number of extended doses (ND), and acceptance rate of ejaculates (AR). Semen collection records for 842 selected boars and two generations of pedigree data were provided by NPD USA. Genetic parameters were estimated using animal models and MTDFREML software. Breed, farm and contemporary group were included as fixed effects, and were significant (P < .0001) in all four traits. Heritability estimates were .44 for TSC, .44 for SV, .46 for ND and .16 for AR. The genetic correlations between TSC and SV, TSC and ND, and TSC and AR were .75, .98 and -.06, respectively. Genetic correlations between SV and ND, SV and AR, and ND and AR were .70, -.04 and -.02, respectively. Boar producing ejaculates with greater volume had more total sperm cells and produced more extend doses. The acceptance rate of ejaculates was not genetically correlated with the other recorded semen traits.

Key Words: Heritability, Semen, Pig

W92 Effect of selection for testosterone production on testicular morphology and daily sperm production in pigs. S. Walker*, O. W. Robison, C. S. Whisnant, and J. P. Cassady, North Carolina State University, Raleigh, NC.

The objective of this study was to measure indirect responses in morphological testicular characteristics and daily sperm production to divergent selection for testosterone. Duroc boars from lines divergently selected 10 generations for testosterone production in response to GnRH challenge followed by random selection were used. In generation 21 endogenous testosterone in the high (H, n=54) and low (L, n=44) testosterone lines averaged 490 ng/ml and 276 ng/ml (P<0.01), respectively. Plasma FSH concentrations did not differ significantly between the lines. Boars from generation 20 were castrated at 211 d of age and 97 kg. After adjustment for body weight, average paired testicular weights for H (n=46) and L (n=13) were 417 g and 457 g (P<0.01), respectively. Testicular tissue samples were used to determine volume density of Sertoli cells, sperm per gram of testis, total daily sperm production, and total testicular sperm. No significant differences were detected between lines for volume density of Sertoli cells, sperm per gram of testis, total daily sperm production, or total testicular sperm adjusted for age. Selection for testosterone concentration in response to a GnRH challenge is an effective method of changing testosterone concentration. However, indicators of male fertility did not differ significantly between lines. Thus, selection for testosterone is not recommended as a method of improving sperm production in pigs.

Key Words: Selection, Reproduction, Pigs
males HL with females LL (HL); and 4) Reciprocal crosses of males LL and females HH (LH). The quails were allocated in groups of batteries with five levels and four cages by level and were fed with a diet containing 21% CP and 2,900 kcal of ME/kg. During 10 weeks, egg production, egg weight, feed intake, and feed efficiency were measured daily. During weeks 3, 6, and 9, the hatchability and fertility were measured. Preplanned contrasts of HH vs. LL, pure vs. crosses, and HL vs. LH were performed. During weeks 1 to 2, the crosses had higher (P<0.03) hatchability than pure breeds improved (P<0.05) feed efficiency. During weeks 3 to 7, eggs production of crosses was lower (P>0.01) than pure breeds. Crosses increased (P<0.01) egg weight, and decreased weight, and feed intake, and improved (P<0.04) feed efficiency. Hatchability of HH pure breed quails was lower (P<0.01) than other treatments. In week 8 to 10, the crosses increased (P<0.01) egg weight over pure breed quails. Fertility of the cross LH was higher (P<0.01) than other treatments. It is concluded that the crosses between Japanese quails selected for high fertility of the cross LH was higher (P<0.05) due to weight, Japanese quail, Egg quality.

Selection by weight, Japanese quail, Egg quality

To determine the effect of selection for high or low mature weight and its reciprocal crossing on egg quality characteristics in Japanese quail, J. J. Portillo1, F. G. Rios, I. V. Ferrer, and R. Barajas1, 1FMVZ-Universidad Autónoma de Sinaloa (Mexico).

Our objectives were to determine the influence of inbreeding on post-thaw semen characteristics measured by computer assisted sperm analyzer (CASA) and determine if post-thaw semen characteristics are heritable. Frozen semen samples were obtained from two inbred (Line1, n=11 and Prospector, n=7) and a non-inbred line (n=9) of Hereford bulls. Average inbreeding level of each group was 0.27, 0.45, and 0.0 respectively. Semen samples were collected from 1978 to 2000. For CASA analysis four straws (0.5 ml) from each bull were evaluated. Cells were analyzed by mixed model analysis using a model that contained line and age at collection as fixed effects and individual bull as a random effect. The genetic correlation between BF and MS was small, therefore selection for marbling can be implemented without increasing fatness. The genetic correlation between REA and MS was moderate negative. Further work is required to determine the impact on variance component estimates of including ultrasound data along with carcass and growth data.

Key Words: Crosses, Japanese quail, Hatchability

W96 Effect of selection of high or low mature weight and its reciprocal crossing on egg quality characteristics in Japanese quail. J. J. Portillo1, F. G. Rios, I. V. Ferrer, and R. Barajas1, 1FMVZ-Universidad Autónoma de Sinaloa (Mexico).

The current genetic evaluation of carcass traits for the North American Limousin Foundation (NALF) utilizes bivariate analyses. This study used NALF field records to estimate variance components to develop a multivariate evaluation. Weaning weight (WW), carcass weight (CW), ribeye area (REA), back fat (BF) and marbling score (MS) were analyzed with MTDF-REML (derivative free restricted maximum likelihood) using bivariate and trivariate linear models. Contemporary group and AOD (age of dam) were fit as fixed effects and age at slaughter and at weaning as covariates. Six analyses were performed (CW-WW; REA-M; MS-BF; CW-REA and WW-CW-REA, WW-BF-M). Random maternal and permanent environment effects were included for WW. A total of 31,063 pedigree records and 18,368 performance records were used. Heritability estimate for CW in the bivariate analysis of CW and WW were 0.41. The genetic correlations between CW and WW were 0.77. Heritabilities estimates for BF and MS were 0.37 and 0.31, with genetic correlation of -0.07. For CW and REA, the heritabilities were 0.30 and 0.34, with genetic correlation of 0.45. The REA and MS heritabilities were 0.35 and 0.33 and genetic correlation of -0.37. For trivariate analysis, the genetic correlation between CW and REA was 0.50. For WW-BF-MS analysis heritability for BF was 0.38 and 0.30 for MS, with genetic correlation of -0.13 between BF and MS. The heritability for CW increased when estimated in a model that included WW. The genetic correlation between BF and MS was small, therefore selection for marbling can be implemented without increasing fatness. The genetic correlation between REA and MS was moderately negative. Further work is required to determine the impact on variance component estimates of including ultrasound data along with carcass and growth data.

Key Words: Carnass traits, Maternal effects, Heritabilities estimates

W97 Colorado State University Center for Genetic Evaluation of Livestock: Current approaches to performing large scale beef cattle genetic evaluations. S. E. Speidel* , R. M. Enns, D. J. Garrison, C. S. Welsh, and B. L. Golden, Colorado State University, Fort Collins, CO.

The purpose of this paper is to review methodology for conducting beef cattle genetic evaluations performed by the Colorado State University Center for Genetic Evaluation of Livestock (CSU-CGEL). This methodology includes the specification of the type of model used, components that make up the model and solutions reported for each analysis. The CSU-CGEL performs contract genetic evaluations worldwide for 15 different clients including breed associations, private ranches, and composite and pure-bred mating system cooperatives. These evaluations consist of the traits birth weight, weaning weight, yearling weight, docility, stayability, heifer pregnancy rate, calving ease, mature cow maintenance energy requirements, pulmonary arterial pressure, fat thickness, marbling score, rib eye area, carcass weight and quality grade that can be placed in the categories of growth, reproduction, carcass, longevity and behavior. The approach used to determine criteria for inclusion in the statistical model is the same for all analyses, even though the

Key Words: Selection by weight, Japanese quail, Egg quality

W95 Heritability estimates for semen charateristics of inbred and non-inbred Hereford bull. B. Tseveenjav*1, H. D. Blackburn2, and R. M. Enns, 1Department of Animal Sciences Colorado State University, 2National Animal Germplasm Program ARS-USDA.

Our objectives were to determine the influence of inbreeding on post-thaw semen characteristics measured by computer assisted sperm analyzer (CASA) and determine if post-thaw semen characteristics are heritable. Frozen semen samples were obtained from two inbred (Line1, n= 11 and Prospector, n=7) and a non-inbred line (n=9) of Hereford bulls. Average inbreeding level of each group was 0.27, 0.45, and 0.0 respectively. Semen samples were collected from 1978 to 2000. For CASA analysis four straws (0.5 ml) from each bull were evaluated. Cells were analyzed by mixed model analysis using a model that contained line and age at collection as fixed effects and individual bull as a random effect. No significant differences between groups of bulls were found for motility or progressive motility (Table 1). For average path velocity (VAP), cell elongation (ELON), and cell area (AREA) significant differences were between bull groups. Mean separation (Table 1) indicated that Line1 had larger cell area and were not as elongated as the Prospector and non-inbred group cells. The higher VAP for Linel bulls is an indicator that Line1 cells are faster moving and perhaps more robust. Method R for a single trait was used to estimate heritability for semen characteristics. The heritability estimates would indicate relatively large amount of additive genetic variation present across bull groups, which could be utilized in a selection program. The lack of significant differences for motility and progressive motility across bull groups was surprising and indicates no inbreeding depression was exhibited for post-thaw semen characteristics. One explanation for this could be that indirect selection pressure was placed on these characteristics as inbreeding was increased.

Table 1. LS means and heritabilities of semen characteristics

<table>
<thead>
<tr>
<th>Trait</th>
<th>Line1 Prospector</th>
<th>Heritability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motile (%)</td>
<td>0.90±0.03</td>
<td>0.91±0.02</td>
</tr>
<tr>
<td>Progressive (%)</td>
<td>0.31±0.04</td>
<td>0.29±0.03</td>
</tr>
<tr>
<td>VAP (mm/sec)</td>
<td>91.23±12.57</td>
<td>69.17±6.46</td>
</tr>
<tr>
<td>ELON (%)</td>
<td>43.02±3.11</td>
<td>45.15±1.00</td>
</tr>
<tr>
<td>AREA (mm)</td>
<td>7.08±0.33</td>
<td>6.44±0.25</td>
</tr>
</tbody>
</table>

Within a row, different superscripts differs at the p<0.01 level.

Key Words: Semen characteristics, Heritability, Inbreeding
actual model for a given analysis differs for each category. For example, the growth traits birth weight and weaning weight are analyzed in a bivariate model as well as weaning weight and yearling weight, but weaning weight EPD reported are from the birth weight/weaning weight analysis. These traits are run together because they are genetically correlated and the increased amount of information adds accuracy to the prediction. Weaning weight is included in the carcass analysis, but for a different reason than it was included in with the growth traits. Weaning weight is analyzed with carcass traits to account for selection bias seen when calves are either selected as replacements or as slaughter animals. The production of EPD is its own unique puzzle, but if done properly provides producers with the most advanced tools currently available to help them increase the profitability of their operation.

**Key Words:** Beef cattle, Genetic evaluation, Expected progeny differences

**W98** Identification and characterization of an AFLP marker for protein yield in Canadian Holsteins. B. S. Sharma1, Z. Jiang2, and G. B. Jansen3, 1Department of Animal and Poultry Science, University of Guelph, Canada, 2Department of Animal Science, Washington State University, USA.

A total of 200 cows, including 100 high and 100 low EBV for protein yield were used for genome-wide screening of QTL (quantitative trait loci) linked markers for protein yield in Canadian Holsteins using selective DNA pooling and amplified fragment length polymorphism (AFLP) approaches. These cows were selected from an experimental population of 5445 animals and used to form 5 high and 5 low performance pools with 20 animals per pool. AFLP analysis was performed on these pools using 80 selective primer combinations. The PCR products of selective amplifications were electrophoresed and electropherogram readings were standardized by dividing the sum of peak heights of standard length fragments. Standardized peak heights of AFLP fragments were log transformed and compared between high and low pools. A 288 bp fragment, generated using the E-ACG/T-CAT primer combination, was found to differ most significantly (P<0.001). The difference was also confirmed by AFLP genotyping of individual cows. The AFLP fragment was then extracted from the gel and sequencing analysis revealed a C/T substitution responsible for this AFLP polymorphism. This marker was genotyped on all high and low performance animals using a Bi-PASA (bi-directional PCR amplification of specific allele) technique along with approximately equal addition of new animals into each pool from both tail of EBV distribution. Allele C was twice as frequent in low than in high performance animals (0.28 vs. 0.14, P<0.01). A BLAST search against GenBank databases showed evidence that this AFLP marker is orthologous to an intron region of the human TCF7L2 gene. Based on comparative maps between human and bovine genomes, we genotyped two additional markers in this AFLP marker region on a bovine/hamster RH panel. RHMAP analysis assigned this AFLP marker and the bovine TCF7L2 gene on bovine chromosome 26 (BTA 26).

**Key Words:** AFLP, Selective DNA pooling, Dairy cattle

**W99** Enzyme addition as a tool to improve early postweaning piglet performance. E. Gómez1, M. Cortés2, J. Sánchez3, F. J. Guzmin4, and P. Medel5, 1Centro de pruebas de porcino, Hontalbilla, Spain, 2Imasde Agropecuaria, S.L., Spain.

A total of 192 crossbred piglets (Pietrain*Large white x Large white*Landrace), 50 % male and 50 % female, weaned at 21 days and weighting 6.5 kg were used to determine the effect of addition of an enzymatic complex (CE n 34) containing 275 U/kg of endo-1,3(4)-β-glucanase (E.C. 3.2.1.6), 400 U/kg of endo-1,4-β-xylanase (E.C. 3.2.1.8) and 3,100 U/kg of α-amylase (E.C. 3.2.1.1) to diets on performance. There were two experimental treatments based on enzyme supplementation (500 mg/kg) to a basal diet. The experimental design was applied in both the prestarter (21 to 40 d of age) and the starter diet (40 to 60 d of age). Nutritive value of the diets was 10.08 MJ NE/kg and 14.7 g/kg lysine for Prestarter and 10.03 MJ NE/kg and 13 g/kg lysine for Starter. Data were analyzed as a completely randomized block design. The GLM procedure of SAS. For the prestarter period, piglets fed on T3 (500 mg/kg of enzyme complex) gained more weight than piglets fed on either T1 or T4, with the piglets fed on T2 having an intermediate value (17.51, 18.09, 18.49, 17.55 kg for T1 to T4, respectively, P<0.05). Feed intake was not affected by dietary treatment, but piglets fed on T3 had better feed conversion ratios than those fed on T4, with pigs fed on both T1 or T2 having intermediate values (1.601, 1.584, 1.536, 1.614 g feed/g gain for T1 to T4, respectively, P<0.05). Neither mortality nor piglet uniformity was affected by dietary treatment. It was concluded that i) the addition of the enzyme complex to a diet for piglets improved their growth, and ii) the dietary concentration of the enzyme complex resulting in the optimal performance was 500 mg/kg.

**Key Words:** Enzymes, Piglets

**W100** Xylanase, glucanase and amylase supplementation to piglet diets. A. Morillo1, D. Villalba2, E. McCartney3, M. I. Gracia4, and P. Medel4, 1Test & Trials, Spain, 2U de Lleida, Spain, 3Pen & Tec Consulting, Spain, 4Imasde Agropecuaria, S.L.

A study was designed to assess the efficacy of an enzyme complex (CE n 34) containing 275 U/kg of endo-1,3(4)-β-glucanase (E.C. 3.2.1.6), 400 U/kg of endo-1,4-β-xylanase (E.C. 3.2.1.8) and 3,100 U/kg of α-amylase (E.C. 3.2.1.1), when added at 2 concentrations (T2, 500 and T3, 600 mg/kg) to a pelleted diet based on cereals (wheat, maize, barley) on the performance of newly-weaned piglets, in comparison with a negative Control group (T1, 0 mg/kg). The experimental diets were fed in two phases: as prestarter pellets from weaning (21 d) to 42 d and as starter pellets from 42 to 63 d of age, to 16 replicates of 10 piglets per treatment. The prestarter and starter diets, respectively, were formulated to contain 12.5 MJ ME/kg and 15 g/kg lysine and 12.6 MJ ME/kg and 13.5 g/kg lysine. Data were analyzed as a completely randomized block design using the GLM procedure of SAS. For the prestarter period, piglets fed on T3 (500 mg/kg of enzyme complex) gained more weight than piglets fed on either T1 or T4, with the piglets fed on T2 having an intermediate value (17.51, 18.09, 18.49, 17.55 kg for T1 to T4, respectively, P<0.05). Feed intake was not affected by dietary treatment, but piglets fed on T3 had better feed conversion ratios than those fed on T4, with pigs fed on both T1 or T2 having intermediate values (1.601, 1.584, 1.536, 1.614 g feed/g gain for T1 to T4, respectively, P<0.05). Neither mortality nor piglet uniformity was affected by dietary treatment. It was concluded that i) the addition of the enzyme complex to a diet for piglets improved their growth, and ii) the dietary concentration of the enzyme complex resulting in the optimal performance was 500 mg/kg.

**Key Words:** Enzymes, Piglets

**W101** Enzyme supplementation to piglet diets. A. Morillo1, D. Villalba2, E. McCartney3, M. I. Gracia4, and P. Medel4, 1Test & Trials, Spain, 2U de Lleida, Spain, 3Pen & Tec Consulting, Spain, 4Imasde Agropecuaria, S.L.

A study was designed to assess the efficacy of an enzyme complex (CE n 34) containing 275 U/kg of endo-1,3(4)-β-glucanase (E.C. 3.2.1.6), 400 U/kg of endo-1,4-β-xylanase (E.C. 3.2.1.8) and 3,100 U/kg of α-amylase (E.C. 3.2.1.1), when added at 2 concentrations (T2, 500 and T3, 600 mg/kg) to a pelleted diet based on cereals (wheat, maize, barley) on the performance of newly-weaned piglets, in comparison with a negative Control group (T1, 0 mg/kg). Diets were fed in 2 phases: Prestarter from weaning (21 d) to 35 d and Starter from 35 to 57 d of age, to 15 replicates of 10 piglets per treatment. The prestarter and starter diets, respectively, were formulated to contain 12.5 MJ ME/kg and 15 g/kg lysine and 12.6 MJ ME/kg and 13.5 g/kg lysine. Data were analyzed as a completely randomized block design using the GLM procedure of SAS. For the prestarter period, piglets fed on T3 (500 mg/kg of enzyme complex) gained more weight than piglets fed on either T1 or T4, with the piglets fed on T2 having an intermediate value (17.51, 18.09, 18.49, 17.55 kg for T1 to T4, respectively, P<0.05). Feed intake was not affected by dietary treatment, but piglets fed on T3 had better feed conversion ratios than those fed on T4, with pigs fed on both T1 or T2 having intermediate values (1.601, 1.584, 1.536, 1.614 g feed/g gain for T1 to T4, respectively, P<0.05). Neither mortality nor piglet uniformity was affected by dietary treatment. It was concluded that i) the addition of the enzyme complex to a diet for piglets improved their growth, and ii) the dietary concentration of the enzyme complex resulting in the optimal performance was 500 mg/kg.

**Key Words:** Enzymes, Piglets
477 and 487 g/d for T1, T2 and T3 respectively, P<.01). Finally, enzyme complex reduced feed conversion ratio by 4% from 21 to 35 d of age (1.23, 1.20 and 1.17 g/g for T1, T2 and T3 respectively, P=.01). No significant differences were found between 500 mg/kg and 600 mg/kg. There were no significant differences among treatments in piglet body weight uniformity, cleanliness, incidence/severity of diarrhea, veterinary treatments or mortality. In conclusion, the addition of 500 or 600 mg/kg of an enzyme complex containing glucanase, xylanase and amylose to a barley wheat and maize-based diet of weaned piglets improved growth performance.

Key Words: Feed enzymes, Piglets

W102 Activity of disaccharidase in small intestinal membranes of piglets as influenced by age. Q. M. Yang1,2, D. F. Li1, and S. Y. Qiao1, 1College of Animal Science and Technology, CAU, Beijing, P. R. China, 2Southern Research and Outreach Center, University of Minnesota.

The objective of this study was to determine the activities of disaccharidase in the small intestinal membrane of pigs. Thirty-nine pigs from eight litters were creel fed from d 28 and weaned on d 35. On d 0 (day of farrowing), d 7, 14, 21 and 28, three pigs were selected and d 35, 42, 49 and 56, six pigs were selected and prepared for membrane collection of jejuno-ileal segment. Age of cold piglets was used to determine the activity of disaccharidase in the membranes. The results indicated that the activities of lactase, sucrase and maltase were 1.91±0.65, 0.14±0.11 and 0.32±0.14 U/g membrane of the middle jejunum, respectively, on d 0 before suckling. The average activity of lactase was 4.16±1.54 U/g membrane during 1 to 4 weeks, however, it decreased (P<0.05) to 2.23±1.20 U/g membrane of 5 to 6 weeks of age (0.94±0.54 U/g membrane). The activity of lactase was higher in ileum in the first week and in the proximal region of the jejunum. The average activity of sucrase in the membrane of small intestine was, respectively, 1.63±0.65, 2.09±0.66, 2.91±1.09, 5.71±2.2, 7.05±3.43, 2.04±1.00, 3.72±1.90 and 3.34±1.91 U/g membrane from week 1 to week 8. The activity of sucrase decreased after weaning (P<0.01). The average activity of maltase in the membrane of small intestine was only 1.25±1.88 U/g during week 1 to week 3 and increased (P<0.01) to 9.43±2.09 U/g membrane at 4 weeks old. However, it decreased (P<0.01) to 1.37±1.33 U/g membrane on week 6 of weaning, and then increased to 4.39±4.55 U/g membrane at week 7 and week 8. The activity of lactase coincided with the ability to digest lactose from milk before week 4, and then the decrease on week 5 when the pigs increased solid feed intake, and dropped to a very low level after weaning. The activity of sucrase was developed continuously, and reached its peak on week 5, but decreased at weaning. The activity of maltase developed on week 4, but was dramatically affected by weaning. In conclusion, the activity of lactase was due to the presence of milk, and the activities of sucrase and maltase were developed when pigs were growing, but decreased due to weaning.

Key Words: Piglets, Small intestinal membrane, Diasaccharidase

W103 Effects of feeding flaxseeds on the production traits of sows. S. K. Baidoo1,2, G. Azunaya1, and A. Fallah-Rad1, 1Department of Animal Science, University of Manitoba, 2Southern Research and Outreach Center, University of Minnesota.

The objective of this study was to determine the effects of flaxseed and vitamin E on serum progesterone concentrations (PGC) of sows and vitamin E levels of sows and piglets. Forty-eight Cotswold gilts were allotted to six dietary treatments for both gestation and lactation periods with 8 gilts per dietary treatment. The experimental design was a split-plot design with repeated measurements. Three levels of flaxseed (FS) (0%, 5% and 10% FS) and two levels of vitamin E (40 IU/kg and 80 IU/kg) were 2 factors in the factorial arrangements and were applied to the main plots. Individual sow or piglet was an experiment unit. Measurements in different gestation and lactation phases were treated as repeated measurements applied to the subplots. Serum were from blood samples collected from vena cava puncture for all the sows and three piglets per litter. The progesterone concentrations (PGC) in the serum of gestation gilts on d 30 (20.4 ng/ml) and 60 (19.6 ng/ml) of gestation were higher than in the serum of gilts on d 90 (16.4 ng/ml), 109 (15.0 ng/ml) of gestation and d 1 (0.83 ng/ml) of farrowing (SEM=0.62; P<0.05). The PGC on d 90 and d 109 of gestation were also higher (P<0.05) than those on d 1 of gestation and all the days post parturition. The diets with 0 and 5% FS increased (P<0.05) PGC in the serum of gestation sows compared to the 10% FS diet (9.9 ± 5.5 vs. 8.4 ng/ml, SEM=0.38). Vitamin E had no effect (P>0.05) on serum PGC in both gestation and lactation. The serum PGC of sows at farrowing (0.83 ng/ml) was higher (P<0.01) than on d 8 (0.24 ng/ml) and d 16 (0.37 ng/ml). The vitamin E concentration (VEC) in the milk of sows on d 1 was higher (P<0.01) than on d 8 and d 16. The serum VEC (IU/ml) of pigs was 0.8 on d 1, 6.7 on d 8 and 5.3 on d 16 (P<0.05, respectively). The diet with vitamin E at 80 IU/kg increased (P<0.05) VEC in sera of pregnant and lactating sows, pigs, and in body tissue of pigs compared to diets with vitamin E at 40 IU/kg. In conclusion, the progesterone concentration (PGC) in the serum of sows influence was by phase of pregnancy. High levels of VE and 10% FS in the diet increased VE in milk and body tissue of pigs.

Key Words: Sows, Flaxseed, Vitamin E

W104 Dietary effects of flaxseeds and vitamin E on lipid profiles of sows. S. K. Baidoo1,2, A. Pallad-Rad1, and Q. M. Yang2, 1Department of Animal Science, University of Manitoba, 2Southern Research and Outreach Center, University of Minnesota.

The objective of this study was to determine the effects of flaxseed and vitamin E on serum lipid profile of sows. Forty-eight Cotswold gilts were allotted to six dietary treatments for both gestation and lactation periods with 8 gilts per dietary treatment. The experimental design was a split-plot design with repeated measurements. Flaxseed (FS) with three levels (0%, 5% and 10% FS) and vitamin E with two levels (40 IU/kg and 80 IU/kg) were 2 factors in the factorial arrangements and were applied to the main plots. Individual sow or piglet was an experimental unit. Measurements in different gestation and lactation phases were treated as repeated measurements applied to the subplots. Serum from blood samples were collected via vena cava puncture from all the sows and three piglets per litter. All the saturated free fatty acids (SFFA) and unsaturated free fatty acids (UFFA) in the serum of sows and pigs were not different (P>0.05) among dietary treatments. The total n3 FFA in serum of piglets from sows fed diets with 10% FS were higher (P<0.05) than the piglets from sows fed control diets (14.1% vs. 8.7%; SEM=1.5). The amount of SFFA, UFFA, SFFA: UFFA, n3 FFA and n6 FFA in milk were different (P<0.01) among phases of gestation and lactation, but not different (P>0.05) between the dietary vitamin E contents. There were interactions (P<0.01) between diets and phases of gestation for n3 FFA and n6

Key Words: Sows, Flaxseed, Production traits
**W106** Carry over effect of dietary protein supplied to pregnant sows on protein utilization during lactation. P. K. Theil*, H. Jorgensen, and K. Jakobsen, Danish Institute of Agricultural Sciences, Denmark.

Lowering the supply of dietary protein in swine diets has been in focus the last decade in order to minimize nitrogen (N) excretion to the environment. This experiment was conducted to quantify the protein metabolism in 8 sows fed low (LP) or standard (SP) dietary protein during pregnancy and either low (LF) or high (HF) dietary fat during lactation. The experimental setup was a crossover design between pregnancy diets (LP, SP) and lactation diets (LF, HF). The dietary change occurred at the day of farrowing. Diet formulation and feeding level were in accordance with Danish recommendations. This implied an elevated feeding level during the last month of pregnancy, while lactating sows were fed according to litter size. The LP and SP diets supplied 7.39 and 10.29 g fcat digestible protein/MJ ME, respectively, while LF and HF diets supplied 10.18 and 10.04 g fcat digestible protein/MJ ME. Nitrogen balance was quantified in three balance periods during lactation by total collection of feces and urine on days 9–12, 16–19, and 23–26. Milk production, determined during the balance trials by N\_\text{Dilution}, increased from 831 g/piglet/d (d 10) to 1151 g/piglet/d (d 24) (P < 0.001), with no effect of pregnancy diets (P = 0.73). Milk contained 17.7% of DM and milk protein content (N x 6.38) was 28.1 % of DM, with no effect of stage of lactation (P = 0.89). As the milk production increased, milk protein yield increased (P < 0.01) as lactation progressed, whereby the protein retention (N x 6.25) decreased concomitantly (P < 0.05). The LP and SP sows were supplied with comparable amounts of metabolized protein during lactation. The data show that sows fed the LP diet during pregnancy retained considerable amounts of protein during lactation at the expense of milk protein yield.

<table>
<thead>
<tr>
<th>Item</th>
<th>Fat</th>
<th>Protein</th>
<th>BW</th>
<th>P2</th>
<th>Fat</th>
<th>Protein</th>
<th>BW</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N balance of lactating sows (g/d)</td>
<td>141 ±0.59</td>
<td>151 ±0.59</td>
<td>11.8 ±0.59</td>
<td>24 ±0.45</td>
<td>27 ±0.45</td>
<td>2.4 ±0.45</td>
<td>38 ±0.16</td>
<td>46 ±0.16</td>
</tr>
<tr>
<td>Milk</td>
<td>66 ±0.27</td>
<td>78 ±0.27</td>
<td>6.9 ±0.27</td>
<td>13 ±0.01</td>
<td>20 ±0.01</td>
<td>2.9 ±0.01</td>
<td>9.02 ±0.72</td>
<td>9.54 ±0.72</td>
</tr>
<tr>
<td>Litter size</td>
<td>9.0 ±0.64</td>
<td>9.5 ±0.64</td>
<td>0.73 ±0.64</td>
<td>1.86 ±0.35</td>
<td>2.03 ±0.35</td>
<td>0.12 ±0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIP(days)</td>
<td>5</td>
<td>9</td>
<td>29.16 ±0.02</td>
<td>43.58 ±0.02</td>
<td>190.30 ±0.02</td>
<td>20.98 ±0.02</td>
<td>28.99 ±0.02</td>
<td>44.42 ±0.02</td>
</tr>
</tbody>
</table>

A dynamic computer-model to estimate the changes of body composition during lactation in sows. J. Kim* and K. Y. Whang, Korea University, Seoul, Korea.

A lactating sow model was developed to estimate body composition changes and nutrient flow based on body weight (BW), P2 back fat depth (P2), and litter size (LS) and to propose the nutrient requirements to support ideal body condition. Input variables were BW, P2 at farrowing, feed intake (FI) during lactation, number of suckling piglets, piglets weights at farrowing and weaning. The BW and P2 were used to determine body composition. Difference of piglet weight between farrowing and weaning (PWC) was employed to determine average daily gain and daily milk requirement for piglets. General feed intake pattern (PFI) was also modeled to reach maximum feed intake at 7 days post-farrowing. The model showed body composition of sow (fat, protein, water, and ash), BW, and P2. An example of model (BW:200 kg; P2: 20 mm; LS: 9; PWC: 5.5 kg; FI: 120 kg; FIP: 7 days) showed that fat and protein contents and BW of sow decreased until 5 d post-farrowing and increased after on. A reversed pattern showed in P2. Estimated values of this model indicated that piglet body weight change was main factor that affected body composition and BW of sow. Feed intake was also important factor on body composition and BW of sow. But effects of feed intake pattern of sows were relatively less important than weight change of piglets.

**W108** Analysis of the effect of gestation housing systems on fertility and piglet death. L. Anil*, S. Baidoo, J. Deen, R. Walker, S. Anil, and R. Morrison, University of Minnesota.

Records of 1426 litters from 664 sows of parity 1–4 were analyzed to compare the production performance in terms of farrowing rate and piglet deaths/litter among sows housed in individual stalls and pens with electronic sow feeder during gestation and farrowing in crates. A major cause of piglet death, death due to laid-on, which is related to housing systems was also compared. The means in each group were compared using Independent-samples T test. Farrowing rate was significantly (P < 0.001) higher among sows housed in individual stalls during gestation compared to sows housed in pens with electronic sow feeder during gestation (72.22 and 79.49 respectively). There was no significant difference in mean percentage of pig death/born alive (7.94 ± 0.46 and 7.60 ± 0.42 per litter in stalls and pens respectively), average number of mimes/litter (0.22 ± 0.02 in both) and average number of stillborn/litter (0.56 ± 0.04 and 0.53 ± 0.04 in stalls and pens respectively) among sows housed in the two systems. Piglet death per litter due to laid-on was also similar in the two housing systems (0.20 ± 0.020 in both), indicating that factors such as previous experience in stalls or muscle weakness due to stall-housing are not critical in determining piglet death due to laid-on. The results indicate that in terms of the production parameters studied, neither system is superior to the other.

**Key Words:** Housing, Gestation, Fertility
Multi-50 Holstein cows were blocked by body condition score and assigned to one of two treatments 60 d prior to their anticipated calving date in two consecutive summers (24 cows in year 1: 11 cows in year 2). Treatments for both years were: (1) no cooling system and, (2) with a cooling system based on fans with water spray. The cooling system operated from 10:00 to 18:00 h during the entire dry period of the cows, which consisted of the hot summer months (extreme low and high temperatures of 18°C and 48°C) in both years. Cows were fed a totally mixed ration ad libitum twice daily at 7:00 and 14:00 h consisting of alfalfa hay (60% of dry matter), wheat straw (18%), wheat grain (15%), wheat bran (5%), and a vitamin/mineral premix (2%). Rectal temperatures and respiration rates were recorded twice daily at 9:30 and 14:30 h on Tuesday and Friday each week. There was a third measurement of both variables at 18:00 h during year 2 only. Body condition was scored weekly and calf birth weights were recorded. After calving, all cows were moved to the same pen, which was provided with shades, but had no fans or misters, and fed a ration appropriate for cows in early lactation. Cows were milked twice daily at 5:00 and 17:00 h and milk yield was recorded weekly through week eight. Data were analyzed by linear models with the fixed effects of year, treatment and year x treatment interaction. During the dry period, interaction year x treatment was not significant (P > 0.05) on rectal temperatures or respiration rates at 9:30 h. However, cooled cows in year 2 had lower (P < 0.05) respiration rate (66.5 ± 2.2 breaths/min) and rectal temperatures (38.9 ± 0.06°C) at 14:30 h. Body condition score was higher (P < 0.05) for cooled cows in year 1 (4.03 ± 0.02), but the interaction was not significant (P > 0.05) for calf birth weight and milk production.

Cooling dry cows using fans with water spray reduced heat stress and increased cow comfort under these very hot conditions, as indicated by afternoon respiration rates and rectal temperatures, but had little impact on subsequent parturition productivity.

Key Words: Hot weather, Respiration rate, Rectal temperature

W110 Use of digital infrared thermography to assess thermal temperature gradients and pathologies of the bovine claw. S. J. Scherm*1, S. D. Bowers1, K. B. Graves1, R. Carroll2, J. White1, and S. T. Willard1. 1Mississippi State University, Mississippi State, MS, 2Carroll Trimming, Palastine, TX.

Lameness is a major problem in dairy cattle, and alternative methods for assessing claw health are needed. In this study, digital infrared thermal imaging (DITI) of regions of the bovine claw (Holstein cows; n = 21) were acquired following routine claw trimming procedures to determine whether thermal gradients of the claw exist that might be related to lameness. Using WinTES software, rectangular transects were drawn through thermal images of the claws and temperatures quantified (MAX, AVG, MIN and standard deviation, (SD); °C) relative to the bulbar, pre-bulbar, subapical and apical regions. The medial and distal digits of the claw were analyzed separately for each fore- and hind-limb. A lameness data capture form was used to document any detectable pathologies of each claw (e.g., laminitis, abscesses, infections), and a severity score assigned (1 = mild/slight; 3 = severe). Data were analyzed comparing thermal gradients among respective claw regions. Across all claws examined, a temperature gradient was observed with AVG bulbar, prebulbar, subapical and apical temperatures as follows: 29.4 ± 0.21, 29.8 ± 0.19, 30.7 ± 0.21 and 30.02 ± 0.21 °C, respectively. AVG center claw medial and distal digit temperatures were higher (31.08 ± 0.23; P < 0.05) than outer claw laminar surface temperatures (28.42 ± 0.15 °C). The highest temperatures of the claw were observed in the subapical region (32.63 ± 0.24 °C), while the lowest temperatures were observed in the prebulbar region (27.59 ± 0.15 °C). All regions of the claw were highly correlated with one another (r = 0.71 to 0.94; P < 0.0001), as were center and laminar surface temperatures (r = 0.77; P < 0.0001); suggesting that while temperatures differed by region they changed proportionately to one another. The greatest amount of variability in temperatures was observed (as determined by SD values) in the subapical region (1.21 ± 0.04 °C), and the least variability observed in the region of the bulb (0.69 ± 0.03 °C). Where case studies (pathologies) were identified, an association between lameness score and anomalies in claw temperature were evident. These data indicate that thermography may be a useful tool for assessing claw abnormalities, pathologies, and other predisposing factors to bovine lameness.

Key Words: Bovine, Lameness, Digital infrared thermography

W111 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: Immune measures. Leslie Dabovich1, Julie Morrow2, Anthony Rudine3, Lindsey Hulbert1, Barbara Smith1, and John McGlone1. 1Texas Tech University, 2 USDA-ARS, West Lafayette, USA.

Lameness is a major problem in dairy cattle, and alternative methods for assessing claw health are needed. In this study, digital infrared thermal imaging (DITI) of regions of the bovine claw (Holstein cows; n = 21) were acquired following routine claw trimming procedures to determine whether thermal gradients of the claw exist that might be related to lameness. Using WinTES software, rectangular transects were drawn through thermal images of the claws and temperatures quantified (MAX, AVG, MIN and standard deviation, (SD); °C) relative to the bulbar, pre-bulbar, subapical and apical regions. The medial and distal digits of the claw were analyzed separately for each fore- and hind-limb. A lameness data capture form was used to document any detectable pathologies of each claw (e.g., laminitis, abscesses, infections), and a severity score assigned (1 = mild/slight; 3 = severe). Data were analyzed comparing thermal gradients among respective claw regions. Across all claws examined, a temperature gradient was observed with AVG bulbar, prebulbar, subapical and apical temperatures as follows: 29.4 ± 0.21, 29.8 ± 0.19, 30.7 ± 0.21 and 30.02 ± 0.21 °C, respectively. AVG center claw medial and distal digit temperatures were higher (31.08 ± 0.23; P < 0.05) than outer claw laminar surface temperatures (28.42 ± 0.15 °C). The highest temperatures of the claw were observed in the subapical region (32.63 ± 0.24 °C), while the lowest temperatures were observed in the prebulbar region (27.59 ± 0.15 °C). All regions of the claw were highly correlated with one another (r = 0.71 to 0.94; P < 0.0001), as were center and laminar surface temperatures (r = 0.77; P < 0.0001); suggesting that while temperatures differed by region they changed proportionately to one another. The greatest amount of variability in temperatures was observed (as determined by SD values) in the subapical region (1.21 ± 0.04 °C), and the least variability observed in the region of the bulb (0.69 ± 0.03 °C). Where case studies (pathologies) were identified, an association between lameness score and anomalies in claw temperature were evident. These data indicate that thermography may be a useful tool for assessing claw abnormalities, pathologies, and other predisposing factors to bovine lameness.

Key Words: Bovine, Lameness, Digital infrared thermography

W112 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: Immune measures. Leslie Dabovich1, Julie Morrow2, Anthony Rudine3, Lindsey Hulbert1, Barbara Smith1, and John McGlone1. 1Texas Tech University, 2 USDA-ARS, West Lafayette, USA.

Seventy nine Camborough-22 (PIC USA) gilts with known estrous dates were used to determine the effects of two feeding systems (5 crates vs. pens of 5) and two feeding systems (drop fed vs. trickle fed) on immunity. The four treatments were arranged in 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop. trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period. Immune measures were collected five to six weeks before expected farrowing. Data were analyzed as a randomized complete block design with a 2 X 2 factorial arrangement of treatments. Immune measures were collected including total number of white blood cells (WBC), differential counts, red blood cell numbers, hemoglobin, hematocrit, lymphocyte proliferation under phytohemagglutinin and lipopolysaccaride mitogens, neutrophil chemotaxis, and neutrophil phagocytosis. The interaction between penning and feeding systems was statistically significant for percent phagocytosis (77.97, 97.06, 91.04, and 74.16, SEp = 5.01, P < 0.05 for DROP-Crate, DROP-Pen, TRICKLE-Crate, and TRICKLE-Pen, respectively) and average number of beads phagocytized (5.38, 6.51, 5.55, and 5.11, SEp = 0.07, P < 0.05, respectively). In general, the efficiency of neutrophil phagocytosis (measured by both % of neutrophils that phagocytized and the numbers of beads phagocytized) was higher among Crated gilts that were Trickle-fed than Drop-fed; however, among penned gilts, the neutrophil efficiency was reduced among

in the Polar data it cannot be used interchangeably with the ECG data. However, if there are no anomalies present or if anomalies are classified and corrected then the 2 systems can be used interchangeably.

Key Words: Swine, Heart rate variability, Well-being
Trickle-fed gilts compared with Drop-fed gilts. Generally, all other immune measures were not influenced by the penning or feeding systems evaluated. However, neutrophil phagocytosis efficiency may be improved for crated gilts that are trickle rather than drop fed. Among penned gilts, trickle feeding reduced neutrophil efficiency compared with neutrophils from gilts that were drop fed.

Key Words: Pig, Welfare, Immunity

W113 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: behavioral measures.

L. Hulbert1, J. Morrow2, J. Dailey3, and J. McGonne1, 1Texas Tech University, 2USDA-ARS.

Seventy-eight Camborough-22 (PIC USA) gilts in mid gestation were used to determine the effects of two penning systems (crates vs. pens of 5) and feeding system (drop fed vs. trickle fed) on gilt behavior. The four treatments were arranged in a 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop at 0730 h. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period at 0730 h. Gilts with a known estrus date and a predicted next estrus date were randomly selected and moved from their acclimation group pens to their assigned treatment. Behavioral measures were collected from time lapse video recordings made over a 24-h period from d 50 to 70 of gestation. Measures of reproductive performance and physiology will be reported elsewhere. Behaviors recorded and summarized included standing, lying, sitting, drinking, feeding, social interactions and oral/nasal/facial (ONF) behaviors. The statistical model was a randomized complete block design with a 2 X 2 factorial arrangement of treatments, four complete blocks and a split plot over time (4 h time periods over a 24-h day). Overall activity levels of gilts were statistically similar (P > 0.10) among treatments. However, gilts in some treatments expressed different durations of behaviors at certain times of day. Gilts in Pen-DROP showed more (P < 0.05) ONF around 1200 h than gilts in the other treatment groups. Overall the entire 24-h period, ONF duration was not different among treatments. Crated gilts showed more (P < 0.01) standing but more (P < 0.05) sitting than penned gilts (for Crated and Pensed gilts, respectively; standing: 0.25 vs. 0.06 ± 0.024 h and sitting: 0.10 vs. 0.04 ± 0.17 h). Crated gilts spent more (P = 0.05) time feeding than penned gilts (0.09 vs. 0.07 ± 0.007 h) while the time to feed was not significantly different between Drop- and Trickle-fed gilts. Agonistic and non-agonistic social interactions did not differ (P > 0.10) among treatments during this mid gestation sample period. In conclusion, while overall behavioral activity levels were statistically similar among treatments, pregnant gilts expressed different forms of activity depending on the available space.

Key Words: Pig, Welfare, Behavior


When apparently healthy swine are transported, it is not uncommon for a small portion of them to be shedding Salmonella. It is theorized that some ‘non-shedders’ start to shed. Our goal was to identify characteristics of those individuals that shed Salmonella and those that do not shed Salmonella. Thus, we experimentally created transportation stress in order to induce recrudescence of Salmonella in pigs. Two experiments were conducted using 30 pigs in each experiment. Experiment 1 (Exp. 1) differed from Experiment 2 in that Exp. 1 established catheters in the pigs while catheters were not established in Exp. 2. Salmonella-free pigs were inoculated intranasally with 5 x 10^6 or 1 x 10^6 cfu of Salmonella choleraesuis/pig 3 weeks prior to mixing and transport. Fe cal samples were collected at 5 h post mixing and transport, at 1, 2, and 4 d after mixing. Blood samples were collected at 0, 3, 5, 7, 24, 48 and 72 h for cortisol analysis. Upon necropsy the body condition was given a score to indicate degree of wounds due to fighting. Data were analyzed in relation to the expression of Salmonella infection. Pigs were classified as positive for Salmonella in the feces, lymph nodes, or combinations there of. In both Exp. 1 and 2 we found no differences in the numbers of fights, degree of wounds on body due to fighting, or plasma cortisol concentrations in relation to the Salmonella status of the pigs (P > .10). In each experiment, we had only one pig that was considered a persistent shedder. Interestingly, both of these had plasma cortisol concentrations that were below the mean and median for the group. It was thought that shedders would be more stressed, thus this observation is interesting and warrants further investigation.

Key Words: Stress, Swine, Salmonella

W115 Effects of an environmental enrichment on the behavior, physiology and growth of beef cattle. T. Ishiwata1, K. Uetake1, N. Abe2, and T. Tanaka1, 1School of Veterinary Medicine, Azabu University, 2Faculty of Agriculture, Tamagawa University.

To determine the effects of an environmental enrichment on behavior, physiology and growth, 35 9-mo-old Japanese Black X Holstein steers were allocated to 3 pens (6 X 9.5 m in each): Pen C consisted of a feeding alley, a trough and a water bowl (control, n=11); Pen D included a drum (58 X 90 cm) containing hay (n=12); Pen GD included a drum with a plastic carpet (30 X 120 cm) for grooming (n=12). Behavioral observations were made for 2 h at 10 min intervals after morning and evening feedings for 3 d in 5 successive mo. Agonistic behavior was observed for 1 h after both feedings to assess the dominance order (DO). Jugular vein blood samples were collected and body weight recorded every 2 mo. ANOVA and post-hoc test, and correlation analysis were performed. The effect of the pen was significant in the evening observations, but that of the plastic carpet was not significant. The steers continued frequent access to the drum for 3 mo after its installation (in both Pen D and GD, 0-3 mo: 4 mo after installation, P<0.05). The installation of a drum increased the frequencies of active behaviors especially eating, and reduced those of self-grooming, licking bar, and inactive behaviors (resting and rumination) for 5 mo (for all behaviors, Pen D, GD: C, P<0.05). The average daily gain (ADG) was not different between pens, but it was correlated with eating hay at the drum in Pen D from 2 to 4 mo after installation (r=0.63, P<0.05). In Pen C, ADG was correlated with eating hay at the trough from 2 to 4 mo after installation (r=0.76; P<0.05). DO was correlated with access to the drum in Pen GD (r=0.73; P<0.05). Plasma dopamine concentrations were higher in Pen D than in Pen C (P<0.05). Serum triglyceride concentrations were higher in Pen C than in Pen GD (P<0.05). Although social factor affected the steers’ access to the drum with a plastic carpet, the drum kept the steers attracted, and promoted their growth by encouraging their eating and activity for several months.

Key Words: Beef cattle, Environmental enrichment, Behavior

W116 Age and castration stress influence the thermal nociceptive response of calves. S. T. L. Ting1,2, B. Earley1, I. Veissier3, S. Gupta1,2, and M. A. Crowe1, 1Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland, 2Faculty of Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland, 3INRA, Centre Clermont-Ferrand-Theix, F-63122 Saint Genes Champanelle, France.

To determine the effect of age and castration stress on the thermal nociceptive (or pain) threshold (TPT) of calves, and the presence of stress-induced hypoalgesia (i.e., increased thermal pain threshold) following castration, 60 Friesian calves were allocated to one of six treatments (n=10/treatment): Sham controls at 21 wk of age (C), bupivacaine castration at 6 (6-wk), 10 (10-wk), 14 (14-wk), 19 (19-wk) and 22 (22-wk) wk of age. The TPT of each calf was assessed 72 h before treatment, and at 12, 24 and 48 h after treatment using a far infrared (10600 nm) CO2 laser device (MPB Lamson Inc., Dorval, QC, Canada). The CO2 laser beam (5.5 watt) was applied to a shaved area of the skin on the caudal aspect of the metatarsal. The latency of each calf to react by moving the leg at which the CO2 beam was aimed was recorded. Two alternative measurements were taken from each of the legs, with at least 30 s between the two measurements. Mean latencies for the four measurements were calculated. At -72 h before treatment, there were no
differences (P > 0.20) in the TPT between C calves and the 10- to 22-wk-old calves. However, 6-wk-old calves had higher TPT than C at -72 h (P = 0.001), and at 24 h (P = 0.004) and 48 h (P = 0.0004) after treatment, but the values were not different at 12 h (P = 0.06). While the overall TPT (mean of 12 to 48 h data) after treatment were higher in 10-wk (P = 0.004), 14-wk (P = 0.0001), 19-wk (P = 0.0001) and 22-wk-old (P = 0.03) calves than their respective values at -72 h, the TPT values did not change with time in C (P = 0.07) and 6-wk-old calves (P = 0.94). In conclusion, calves at 6 wk of age are less sensitive to thermal pain than older calves (10- to 22-wk), and their sensitivity to pain is not modified by castration. The TPT of the older calves (10- to 22-wk) increased following castration, indicating the presence of stress-induced hyperalgesia.

Key Words: Cattle, Castration, Hyperalgesia

W117 Effects of age at transport on development of neonatal dairy calves. T. A. Johnson1, S. D. Eicher2, J. N. Marchant-Forde2, and A. G. Fahey1. 1Purdue University, West Lafayette, IN, 2USDA-ARS, West Lafayette, IN.

Transportation stress at an early age can influence performance and the developing immune system. The purpose of this study was to evaluate the effects of age at transport on growth and health of neonatal calves. Holstein calves (n=47) were randomly assigned to treatments that were by age at transport; 2-3 d (A), 4-5 d (B), or 6-8 d (C) within a completely randomized design. Colostrum was given for the first 24 h after birth and followed by 2 daily feedings of milk replacer (4 L/d) and ad libitum grain-based dry feed. Calves were transported (6 h) and then placed in outdoor individual hutches. Weights were collected pre- and post-transport then on d 7, 14, 21, 28, 35, and 42. Clinical and fecal scores, and nasal and ocular discharge were evaluated five times a wk for each calf. Repeated procedures in Mixed Models of SAS were used to analyze the data. Calf weights decreased from d 0 through post-transport for all treatments, then increased throughout the rest of the study (P < 0.05). Intake also increased over time (P < 0.05). Fecal scores were affected by treatment and time (P < 0.05), with group C having lower fecal scores throughout the 5 wk and all group scores decreasing over time. Additionally, the B group had greater (worsened) fecal scores at wk 2 than group C (P < 0.05) and tended to have greater scores than group A (P = 0.10). Eye lacrimation increased over time (P < 0.05), but was not different among treatments. Nasal discharges were different over time (P < 0.05), and tended to be different by treatment (P = 0.06). The A group had greater nasal discharge scores compared to the C group at wk 1 to 5, and than group B at wk 5 (P < 0.05) and tended to be greater (P = 0.07) than group B at wk 1 and 2. Clinical scores were different over time (P < 0.05), and at wk 5 the A clinical score was less than that of the C group (P < 0.05) and tended to be less than that of the B group (P = 0.06). These data suggest that calves may have increased susceptibility to intestinal disease when transported at 4 to 5 d of-age and respiratory disease when transported at 2 to 3 d of-age. 

Key Words: Dairy calves, Transport, Stress

W118 Goat kid preference forage. T. W. White*, H. G. Bateman, C. C. Williams, and S. Alford, Louisiana State University Agricultural Center, Baton Rouge, LA.

Six Boer x Spanish wether kids (mean BW = 18.7 ± 0.68 kg) were used in a preference experiment comparing alfalfa hay (AH), Coastal Bermudagrass hay (CBH), fresh cut wheat (W), oat (O), white clover (WC), crimson clover (CC), rape (R), mustard (M), or turnip (T) forage. Fresh forages were cut daily, and all forages were sampled prior to feeding at 0800. Samples of each forage were composited weekly for analysis. Kids were exposed to each forage for 2 d prior to beginning the experiment. During the experiment, each kid was randomly offered known weights of two forages simultaneously in every combination for 2 d. After 3 h, remaining forages were removed and weighed and DMI calculated for each forage. Kids had access to grass hay until the next day. Data were analyzed by ANOVA with preplanned contrasts. Average DM consumption of the respective forages was 235, 195, 97, 113, 9, and 18.7 ± 1.9 kg per day. As fed consumption was 260, 213, 560, 589, 48, 88, 569, 265, and 259 g per day. Average consumption as fed was higher (P < 0.01) for fresh forage than hay; however, on DM basis this was reversed (P < 0.01). Kids preferred AH (P < 0.01) to CBH on DM basis. Preference for fresh forages was similar when expressed on fresh and dry basis. Consumption of O and W was higher (P < 0.01) than for M, R and T or CC and WC. Kids preferred R (P < 0.01) to M or T. Kids consume relatively high amounts of O, W, and R but will ingest more DM in a given time when fed hay.

Key Words: Goats, Forage, Preference


Foliage from shrubs and trees is an important source of protein, vitamins and minerals in arid regions specially during the dry season when other sources of food are scarce. Therefore, a study was undertaken to evaluate the effect of supplementing Quercus grisea, Quercus eduardii, Acacia shaffneri, and Opuntia spp. leaves to an oat straw-based diet on performance and carcass traits in male kids. Twenty intact male kids (14.9 ± 0.7 kg BW) were blocked by weight and randomly assigned to one of five treatments, four supplements and one control. The leaves were included in a proportion of 15% of the diet (isonitrogenous, CP = 14.2%). The kids were fed in individual stalls for an average of 120 days before they were humanely slaughtered. Analysis of variance (SAS) was conducted for a completely randomized design using live weight as covariate. Slaughter weights were similar for all treatments (P > 0.05). Hot carcass weights were similar in kids supplemented with Q. eduardii, Q. grisea and A. shaffneri but were heavier than for kids fed Opuntia or control diets (P < 0.05). Kids supplemented with Q. eduardii had the heaviest empty body weight (P < 0.05). Kids fed Q. grisea and A. shaffneri had similar empty body weight (P > 0.05) but values were greater than for kids fed Opuntia or control diets (P < 0.05). A similar tendency was noted for rib eye area. Dressing percentages were similar among treatments (P > 0.05). It is concluded that feeding leaves from shrubs and trees commonly consumed by range animals might improve goat production via enhanced carcass characteristics.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quercus eduardii</th>
<th>Quercus grisea</th>
<th>Acacia shaffneri</th>
<th>Opuntia spp.</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight (kg)</td>
<td>15.7 ± 2.4</td>
<td>15.2 ± 1.9</td>
<td>15.1 ± 1.3</td>
<td>14.6 ± 1.1</td>
<td>14.1 ± 0.7</td>
</tr>
<tr>
<td>Slaughter weight (kg)</td>
<td>25.2 ± 3.6</td>
<td>23.2 ± 1.8</td>
<td>24.5 ± 2.7</td>
<td>20.7 ± 2.0</td>
<td>20.7 ± 3.3</td>
</tr>
<tr>
<td>Hot carcass weight (kg)</td>
<td>11.3 ± 1.9n</td>
<td>11.0 ± 1.8a</td>
<td>10.9 ± 1.2a</td>
<td>8.9 ± 1.0b</td>
<td>9.0 ± 1.8b</td>
</tr>
<tr>
<td>Dressing (%)</td>
<td>46.8 ± 1.9</td>
<td>44.4 ± 1.4</td>
<td>43.5 ± 0.7</td>
<td>43.0 ± 1.2</td>
<td>41.0 ± 1.6</td>
</tr>
<tr>
<td>Empty body weight (kg)</td>
<td>21.0 ± 3.3</td>
<td>18.7 ± 2.2</td>
<td>19.5 ± 3.3</td>
<td>17.1 ± 2.0</td>
<td>16.4 ± 2.7c</td>
</tr>
<tr>
<td>Rib eye area (cm²)</td>
<td>13.5 ± 2.4a</td>
<td>12.2 ± 2.3ab</td>
<td>11.0 ± 1.3abc</td>
<td>7.5 ± 0.6b</td>
<td>10.0 ± 1.2abc</td>
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</tbody>
</table>

Key Words: Goat kids, Shrubs, Trees

W120 Effects of method of exposure of crossbred Boer wether goats to Eastern red cedar foliage on cedar consumption. G. Animalt1,2, A. L. Gotthich3, R. C. Merek1, G. Detwiler1, L. J. Dawson3, R. Puchala1, T. Sahlul1, and R. E. Estill4. 1E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK, 2Animal Science Department, Oklahoma State University, Stillwater, OK, 3School of Veterinary Medicine, Oklahoma State University, Stillwater, OK, 4USDA ARS Jornada Experimental Range, Las Cruces, NM.

This study was conducted to determine effects on present and future consumption of Eastern red cedar (Juniperus virginiana) foliage (CF) by goats of stepwise increases in dietary level of CF compared with a constant relatively high level and subsequent availability of low-quality forage. Twenty-four yearling wethers (23.5 ± 3.1 kg initial BW) were penned individually in Phases 1 and 3. In Phase 1 (8 wk), a concentrate-based diet (12.6% CP and 35.5% NDF) was offered at approximately

85% of the maintenance energy requirement alone (Control) or with weekly stepwise (Step) increases in substitution of CF for concentrate (0, 1.25, 2.5, 5, 10, 15, 20, and 25% in wk 1-8, respectively; DM basis) or substitution of 25% CF in wk 2-8 (Set). Weights grazed grass pastures in Phase 2 (6 wk). In Phase 3 (2 wk), all wethers were offered the 75% concentrate on 25% CF diet, without or with separate choice offering of prairie hay. CF was harvested weekly from male trees and refrigerated; CF and concentrate were hand-mixed prior to feeding. In Phase 1, average total DM was similar among treatments. Intake of CF as a percentage of that offered was greater (P < 0.05) for Step vs Set in wk 3-8 (wk 3: 86 and 48; wk 4: 89 and 56; wk 5: 94 and 71; wk 6: 96 and 81; wk 7: 93 and 63; wk 8: 96 and 84), although CF intake as g/d was greater (P < 0.05) for Set vs Step in all but wk 7 and 8. In Phase 3, concentrate intake was similar among treatments, and hay intake when offered averaged 149, 134, and 124 g/d for Step, Set, and Control, respectively. For wethers not receiving hay, CF intake as g/d for Step was greater among treatments (P < 0.05) but was not different from treatments offered hay (67, 37, 30, 53, 56, and 56 g/d for Step, Set, Control, Step-hay, Set-hay, and Control-hay, respectively: SE = 7.1). Similarly, CF intake as a percentage of offered CF ranked (P < 0.05) Step > Set > Control without hay, but was not different between Step without hay and treatments with hay (78, 41, 34, 61, 57, and 60 for Step, Set, Control, Step-hay, Set-hay, and Control-hay, respectively; SE = 7.6). In conclusion, gradual increases in dietary level of CF deserve further research as a potential means of elevating present and future CF consumption, with attention also directed to type and level of other feedstuffs offered.

Key Words: Eastern Red Cedar, Goats, Adaptation

W121 Evaluation of tropical legume forages (Medicago sativa, Dolichos lablab, Leucaena leucocephala, and Desmanthus virgatus) for growing goats. J. Kanani1, S. D. Lukefahr1, and R. L. Stanko1, 1Texas A&M University-Kingsville.

A feeding trial of 56 d was conducted to evaluate the effect of supplementing with legume forages (Medicago sativa, Dolichos lablab, Leucaena leucocephala, and Desmanthus virgatus) on growth and feed performance. Castrated kids (n=24) with an average initial age of 135 d and live-weight of 18.72 kg were used in the study. Kids were of predominantly Boer or Spanish crossbreeds, which were randomized across diet groups. Four diets were composed of Sorghum bicolor (sudangrass hay) supplemented by one of four legume hay forages, calculated on a DM basis, and corn (200 g/d per goat). On the basis of 100 g/d gains, each animal was limited fed 0.4 and 0.6 kg of legume to sudangrass each day. A split-plot design was employed, with diets as main plots, and pens as subplots (consisting of 3 pens as replicates per diet). Each pen contained two goats. In addition, for growth traits, data were blocked for the effects of breed-type, litter size, parity of dam, and initial age as a linear covariate. Interactions between main effects were never significant (P>0.05). Also, Boer compared to Spanish crossbred kids had similar weight gains (4.26 and 4.52 kg; P=0.719), although Boer crossbred kids tended to be heavier (P<0.10) than Spanish crossbred kids (23.8 and 21.4 kg) at the end of the study. Total body weight gains over the 56-d trial were not significantly influenced by diet (4.61, 4.28, and 4.02 kg for alfalfa, lablab, leucaena, and desmanthus, respectively). Intake of alfalfa decreased further as a potential means of elevating present and future CF consumption, with attention also directed to type and level of other feedstuffs offered.

Key Words: Goats, Cell wall degradability, Grazing


The degradation characteristics of a feed, particular rate of degradability and effective degradability provide an estimate of its rumen digestibility, which to a large extent influences intake and productivity of livestock. However, there is very little information available on degradability characteristics of forage consumed by grazing goats. The aim of this study was to determine the in situ degradability of the cell wall content of the diet consumed by grazing goats in a thorn scrubland in North Mexico. Three ruminal and esophageal cannulated goats were used to obtain samples during the 1999 dry season (February-June) and a month (July) of the rainy season. The extrusa samples collected from the previous month were incubated in the rumen of the same animals for 0, 3, 7, 12, 24, 48, 72 and 96 h. The degradation of the cell wall content of the samples was described by using the equation p = a + b (1−e−ct). The values obtained for the fractions: (a), soluble fraction, (b) insoluble but fermentable fraction, (a+b) potential degradability, (c) constant rate of degradation, and (ED) effective degradability were analyzed according to a randomized block experimental design using Proc GLM (SAS). The fractions (a), (b), (c), (a+b) and (ED) differed among months (P<0.05). July had higher values for (a), (c), (a+b) and (ED), except for (b) (P<0.05), for which March had the highest value (53.6%), indicating shrub regrowth. Results indicated that variations in quality and availability of the forage consumed by grazing goats may be detected by measuring both the rate (c) and the effective degradability (ED).

Key Words: Goats, Cell wall degradability, Grazing


Spanish wether and doeling kids (n=38; 4.5 mo of age; 13.4 kg initial BW) were used to determine influences of different quality diets consumed continuously or after a lower quality diet on characteristics of growth. The experiment consisted of two 9-wk periods. Diets were low quality forage (L; prairie hay supplemented with soybean meal), high quality forage (H; dehydrated alfalfa pellets), and 70% concentrate (C). Kids on two treatments consumed L in Period 1, with half switched to C and half to H in Period 2 (LC and LH, respectively). The CC treatment entailed C consumption in both periods, and HH kids were fed H in both periods. For HC, H was fed in Period 1 followed by C in Period 2. Dry matter intake ranked (P<0.05) LC and LH < CC < HC and HH in Period 1 (502, 352, 386, 610, and 636 g/d) and CC and LC < LH, HC, and HH in Period 2 (652, 621, 833, 808, and 836 g/day) for CC, LC, LH, HC, and HH, respectively). Average daily gain was lowest among treatments (P<0.05) for LC and LH in Period 1 (78, 1, -1, 84, and 80 g) and was 53, 82, 112, 92, and 73 g in Period 2 for CC, LC, LH, HC, and HH, respectively (SE = 11). Empty body fat concentration at the end of Period 1 was greatest for the C diet and lowest for L (P<0.05; 12.2, 6.4, and 9.0% for C, L, and H, respectively). At the end of Period 2, empty body fat concentration was 22.0, 15.9, 14.4, 20.1, and 15.2% (SE = 1.94), and protein concentration was 16.8, 16.9, 17.9, 16.5, and 17.6%.

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<th>a+b</th>
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SEM 1.7 3.6 2.6 0.0098 2.4

Means with the same superscript do not significantly differ (P<0.05).

Key Words: Goats, Cell wall degradability, Grazing
Thirty-six meat goat wethers (3/4 Spanish and 1/4 Boer), born in the previous Spring (initial age and BW of 8.5 mo and 17 ± 0.6 kg) or Fall (initial age of 2.5 mo and 13 ± 0.8 kg), were used to determine effects of ad libitum consumption of different quality diets and age on early subsequent growth while grazing wheat forage. The experiment was 14 wk long, with 9 wk in the winter consuming prairie hay (5% CP and 71% NDF) supplemented with 0.125% BW of soybean meal (PH), alfalfa pellets (AP), or a 70% concentrate diet (CD), and 5 wk in the spring grazing wheat forage. Average daily gain in Period 1 (28, 54, and 49 and 23 g; wk 5: 249 and 215 g for Spring and Fall, respectively). In accordance, in fat mass on d 98 (4.60 and 3.31 kg) was considerably greater than on d 42 (2.39 and 1.96 kg for Spring and Fall, respectively). In accordance, protein accretion from d 42 to 98 was similar between ages (14.3 and 12.6 g/d for Spring and Fall, respectively; SE = 0.86), whereas rate of fat accretion was greater (P < 0.05) during day (22.5 ± 2.07, 18.3 ± 1.67 and 21.7 ± 2.85 m, respectively). Within pasture, A-B goat distance (19.9 ± 3.91 m) was not different from the B-B distance (12.7 ± 6.79 m). During day, distance among ages was 21.5 ± 3.55 m and 16.6 ± 3.54 m at night. Distances of D with goats in W were greatest (P < 0.01) during day (100.7 ± 2.17 m) and least at night (75.1 ± 2.98 m) and distances of D with goats in E were greatest (P < 0.05) during day (40.4 ± 1.98 m) and least at night (35.2 ± 1.82 m). Genotype of goat did not affect spatial relationships; however, time of day did, with distance traveled and distance between animals greater during day than at night.

Key Words: Goats, Sheep, GPS

Physiology

A database of treatment mean observations from the literature was constructed for Angora goats to estimate metabolizable protein (MP) requirements for maintenance, gain, and mohair fiber growth by Angora goats. J. Luo*, A. L. Goetsch, and T. Sahlu, E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.

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> 0.05) between growing and mature goats in intercepts or regression coefficients of equations derived from data sets 1 or 2, observations were pooled. Data set 1 was then split into subsets for equation development (n = 73) and evaluation (n = 51). The initial equation for the regression with the development subset was $M = 4.52$ (SE = 0.349) + (0.336 (SE = 0.056) x ADG) $\pm R^2 = 0.41$ after removing five observations with residuals greater than 1.5 times the residual SD was $M = 4.30$ (SE = 0.286) + (0.318 (SE = 0.0471) x ADG) [n = 68; $R^2 = 0.41$]. Regressing observed against predicted values with the evaluation subset resulted in an intercept and slope not different (P > 0.05) from 0 and 1, respectively. The equation with data set 2 was $M = 4.61$ (SE = 0.475) + (0.292 (SE = 0.0583) x ADG) + 1.49 (SE = 0.430) x CFGR) [n = 88; $R^2 = 0.41$]. Similarly, after removing observations with residuals greater than 1.5 times the residual SD, the final equation was $M = 3.35$ (SE = 0.440) + (0.281 (SE = 0.0486) x ADG) + (1.65 (SE = 0.394) x CFGR) [n = 83; $R^2 = 0.46$]. In conclusion, predicted MP$^m$ for Angora goats was 4.30 and 3.35 g/kg BW$^{0.75}$ with 0 ADG and 0 TG and CFGR, respectively, and MP requirements for ADG, TG, and CFGR were 0.318, 0.281, and 1.65 g/kg, respectively.

Key Words: Metabolizable protein, Angora goats, Mohair

W128 Adrenal and metabolic response to exogenous ACTH stimulation in pregnant and non-pregnant Angora and Spanish wether goats consuming different quality diets. I. Tovar-Luna*, A. L. Goetsch, R. Puchala, and T. Sahu, E (Kika) de la Garza American Institute for Goat Research, Langston, OK.

Angora goats are suspected of aborting under nutritional and(or) cold stress due to an impaired ability to mobilize body reserves to maintain blood glucose levels. We used non-pregnant (NP; n=6/breed) and pregnant (PREG; n=7/breed) Angora goats at 1.5 yr-old wether goats regardless of diet quality. Supported by USDA project No. 0003835.

Key Words: Stress, Gestation, ACTH


Six Alpine (AL; 38.4 ± 3.0 kg), Angora (AN; 23.1 ± 2.7 kg), Boer (BO; 40.75 ± 4.5 kg), and Spanish (SP; 33.6 ± 2.16 kg) wethers (1.5 yr of age) were used to determine effects of genotype and diet quality on heat production (HP) when fed near maintenance or fasting. The experiment consisted of four simultaneous crossovers, with 21 d for adaptation before measures. Diets were 60% concentrate (CON; 14% CP and 12.4 MJ ME/kg DM) or ground alfalfa hay (HAY; 18% CP and 10.17 MJ ME/kg DM). Heat production was determined from O$_2$ consumption and production of CO$_2$ and CH$_4$ with a head-box respiration calorimetry system (Sable Systems, Las Vegas, NV), along with fasting states (2-4 d fast periods in fed and fasting states (4-d fast). Heat production was expressed on the basis of average BW during HP measurement periods.

There were no interactions between genotype and diet. Intake of ME was similar among genotypes and between diets. Neither diet (358 and 354 kJ/kg BW$^{0.75}$ for CON and HAY, respectively; SE = 5.7) nor genotype (359, 361, 346, and 358 kJ/kg BW$^{0.75}$ for AL, AN, BO, and SP, respectively; SE = 8.8) influenced fed HP (P > 0.10). Fasting HP was similar between diets but was greatest among genotypes (P < 0.05) for AL (253, 227, 219, and 226 kJ/kg BW$^{0.75}$ for AL, AN, BO, and SP, respectively; SE = 7.25), which may have been due to a greater level of activity exhibited by AL than other genotypes during fasting. Efficiency of utilization of ME for maintenance was similar (P > 0.10) between diets (0.68 and 0.67 for CON and HAY, respectively; SE = 0.01). The ME requirement for maintenance, estimated by regressing HP against ME intake, was similar (P > 0.10) between diets (341 and 346 kJ/kg BW$^{0.75}$ for CON and HAY, respectively; SE = 10.5) and among genotypes (352, 354, 321, and 346 kJ/kg BW$^{0.75}$ for AL, AN, BO, and SP, respectively; SE = 14.8). In summary, with a level of intake near maintenance, the energy need for maintenance appears similar for AL, AN, BO, and SP 1.5 yr-old wethers regardless of diet quality. Supported by USDA Project No. 0003835.

W130 Effects of genotype, diet, and feed intake on the relationship between energy expenditure and heart rate in goats. I. Tovar-Luna*, C. A. Meza-H.*, Z. B. Johnson$^{1}$, I. Tovar-Luna$^{1}$, E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK. $^{1}$Department of Animal Science, University of Arkansas, Fayetteville, AR.

Heart rate (HR) holds promise as an indirect means of estimating energy expenditure (EE). Therefore, an experiment was conducted to determine effects of genotype, diet, and feed intake on the ratio of EEE:HR. Six Alpine (41 ± 6.3 kg), Angora (23 ± 4.0 kg), 7/8 Boer (39 ± 4.4 kg), and Spanish (36 ± 1.3 kg) wethers (1.5 yr of age) were fed chopped alfalfa hay (18% CP and 10.2 MJ ME/kg DM) or a 60% concentrate diet (14% CP and 12.0 MJ ME/kg DM) at a level of intake near maintenance followed by a 4-d fast, in a cross-over design. HR was recorded using an ECG monitor (Polar Electro, Woodbury, NY) based on O$_2$ consumption and production of CO$_2$ and CH$_4$ with the Brouwer equation in 2-d periods while being fed and at the end of fasting. To monitor HR, stick-on ECG electrodes were attached to the chest just behind and slightly below the left elbow and at the base of the jugular groove on the right side of the neck. The human S610 HR monitor (Poly Australia, Woodbury, NY) was used to record HR at 1- min intervals. Heart rate per minute was affected by level of intake (60.7 and 38.9 for maintenance and fasting, respectively; SE = 0.9; P < 0.05) and a genotype × feed intake interaction (maintenance: 60.8, 63.6, 59.0, and 59.2; fasting: 42.1, 39.6, 38.3, and 35.6 for Alpine, Angora, Boer, and Spanish, respectively; P < 0.05). There was no difference in the ratio of daily EE (kJ/kg BW$^{0.75}$) to average HR per minute was not affected by genotype (6.01, 5.72, 5.87, and 6.24 for Alpine, Angora, Boer, and Spanish, respectively; SE = 0.22), diet (5.96 and 5.96 for hay and concentrate, respectively; SE = 0.13), level of intake (5.90 and 6.01 for maintenance or fasting, respectively; SE = 0.13), or their interactions. The absence of these effects on EE:HR suggest potential use of HR to estimate EE by goats. Supported by USDA project No. 0003835.

Key Words: Goats, Energy, Maintenance

W131 Interactions among body condition, protein supplementation, serum insulin levels and ovarian activity in goats. C. A. Meza H.*$^{1,2}$, J. M. Sanchez S.$^{1,2}$, J. G. Chavez-Perches$^{2}$, H. Salinas$^{3}$, J. Urrutia M.$^{3}$, and M. Mellado$^{4}$.$^{1}$Universidad Autonoma Chapingo-URUZA, $^{2}$Radiodiagnostico y Ultrasonografia, $^{3}$INIFAP, $^{4}$UAAAN.

A reduction in either nutrient intake or body condition may compromise ovarian activity (OA). Previous results showed that protein supplementation and a high body condition increased OA without differences in serum LH and GH between treatments. This study evaluated the effect of by-pass protein supplementation level upon OA and serum insulin (INS) concentrations in Criollo x Alpine-Sannen goats, 19 months old, with divergent body condition (BC). Goats with low BC (LBC; n=16; BW=28.71 kg, BC(0.210.2) g) or high BC (HBC; n=16; 38.461.0 kg, BC; 30.80.2 g) received one of two levels of by-pass protein (PROT; blood meal): Non-PROT (NP, 0 g hd d$^{-1}$) or PROT (HP, 125 g hd d$^{-1}$).
during 40 d prior to ovulation. Goats had access to water, shade, mineral salts, and a basal diet of alfalfa hay (2.0% BW, 14.8% CP). Once synchronized (PGF2α, 2 injections 11 d apart), blood samples were collected 36 h later at 15-min intervals during a 6-h period to evaluate serum INS levels. On d 15 post-ovulation, OA was evaluated by transrectal ultrasonographic scanning. Overall means for total follicles (TF), corpus luteum (CL), and total ovarian activity (TOA; TF+CL) were 2.31, 2.34 and 4.65, respectively. While TF was not affected (P>0.05) by BC, both CL (P=0.03) and TOA (P=0.01) favored HBC-goats. Similarly, HP goats showed higher values for TF (P<0.04), CL (P<0.06) and TOA (P<0.01). While HBC-goats had greater serum INS than LBC goats (1.92 vs. 0.81 ng mL-1), HP-goats had greater INS values than NP goats (1.04 vs. 1.69 ng mL-1), and INS and CL were positively correlated (r=0.46; P<0.01). Results suggest that high serum INS levels may have prevented atresia and enhanced ovarian activity in both the high body condition and the protein supplemented goats.

Key Words: Goats, Insulin, Ovarian activity

Management

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1SE, most conservative standard error is presented. 2Observed significance level. 3Significance between primiparous and multiparous goats.

Key Words: Recombinant bovine somatotropin, Milk, Goats

W134 Growth performance by Alpine, Angora, Boer, and Spanish wether goats consuming 50 or 75% concentrate diets. M. Urge1,2, R. C. Merkel2, T. Sahlu2, G. Animit1,2, and A. L. Goetsch2, 1Animal Science Department, Alemaya University, Dire Dawa, Ethiopia, 2E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.

Forty-six weaned wether goats (12 Alpine, 12 Angora, 10 Boer [87.5%], and 12 Spanish) were used to determine differences in growth performance with consumption of a 75% concentrate diet for 24 wk (75C) or for 12 wk subsequent to 12 wk of feeding a 50% concentrate diet (50C). Initial BW was 20.2, 12.2, 20.7, and 19.2 kg (SE = 0.73) for Alpine, Angora, Boer, and Spanish, respectively. There were no interactions between genotype and dietary treatment in DM intake, ADG, or gain efficiency in wk 1-12 or 13-24. Dry matter intake in wk 1-12 ranked (P < 0.05) Alpine and Boer > Spanish > Angora (703, 436, 689, and 567 g/d) and in wk 13-24 was greater (P < 0.05) for Alpine and Boer vs Angora and Spanish (712, 515, 702, and 456 g/d for Alpine, Angora, Boer, and Spanish, respectively). Dry matter intake as g/d was similar between dietary treatments. Average daily gain in wk 1-12 was greatest among genotypes (P < 0.05) for Boer (59, 59, 90, and 49 g); in wk 13-24 ADG was lowest among genotypes (P < 0.05) for Spanish and tended to be greater (P < 0.10) for Boer vs Alpine (58, 63, 82, and 25 g for Alpine, Angora, Boer, and Spanish, respectively). Gain efficiency (ADG:DM intake) was greater (P < 0.05) for Angora and Boer than for Alpine and Spanish in wk 1-12 (85, 132, 127, and 85 g/kg), and in wk 13-24 was lower (P < 0.05) for Spanish than for Angora and Boer (80, 121, 104, and 51 g/kg for Alpine, Angora, Boer, and Spanish, respectively). Average daily gain and gain efficiency were greater (P < 0.05) for 75 vs 50% dietary concentrate in wk 1-12 (ADG: 73 and 55 g; gain efficiency: 122 and 92 g/kg), and tended to be greater (P < 0.11) for 50C than for 75C in wk 13-24 (ADG: 49 and 65 g; gain efficiency: 77 and 101 g/kg for 75C and 50C, respectively). In conclusion, a moderate vs high dietary concentrate level did not impact differences among Alpine, Angora, Boer, and Spanish wether goats in growth performance.

Key Words: Goats, Growth performance, Dietary concentrate level

W135 Economical feedstuffs for on-farm meat goat diets. S. Schoenian1, N. C. Whitney2, and E. Johnson1, 1Maryland Cooperative Extension, Keedysville, MD, 2University of Maryland Eastern Shore, Princess Anne, MD.

Eighteen intact male crossbred Boer meat goats were utilized to demonstrate the use of barley (an inexpensive, alternative local grain) as the primary feedstuff in an economical on-farm meat goat diet. At approximately 161.0 ± 1.3 days of age and 28.4 ± 0.5 kg body weight, goats were placed into two groups for a 14-day adjustment period and fed 17%
CP diets consisting of a pelleted commercial goat feed (COM; 17% Goat Feed, Southern States, Inc.; n = 9) or a barley-based feed mixed on-farm (BAR; n = 9) with ad libitum grass hay and water. The BAR diet was 76.2% barley, 20% protein supplement pellet (40% CP) and 3.8% medicated mixing pellet (Decox). At the end of the adjustment period, 3 diets were placed in 4.6 x 1.5 m pens with 3 pens per treatment. Animals were hand-fed pre-weighed diets (twice daily) and grass hay (once daily) at levels adjusted to provide approximately 110% of the amount previously fed. Body weights were measured and recorded weekly for 42 days. There was no effect of diet on body weight, with average weights increasing (P < 0.01) from 29.7 ± 0.86 kg (week 1; day 0) to 35.7 ± 0.95 kg at the end of the study (week 6; day 42). Hay consumption was not influenced by treatment and averaged 0.54 ± 0.02 kg/d. Average daily gain was also similar between diets, averaging approximately 0.16 ± 0.06 kg/d. Feed intake (measured as feed offered) was influenced by week only (P < 0.01), increasing (P < 0.01) from 1.0 ± 0.09 kg/d to 1.5 ± 0.09 kg/d per goat from the first to the last 2-week period, respectively. Cost of feeding hay was not influenced by treatment but overall grain cost per goat per day was influenced by a treatment by week interaction (P < 0.01) in which cost was higher (P < 0.01) for all 2-week periods for the COM compared to BAR diets. Average cost per goat per day was $0.17 ± 0.03, $0.26 ± 0.03 and $0.23 ± 0.03 for BAR and $0.30 ± 0.03, $0.43 ± 0.03 and $0.50 ± 0.03 for the COM for the first, second and third 2-week periods, respectively. In this study, the barley-based diet provided similar gains for meat goats but was more economical than the commercial diet tested.

Key Words: Barley, Goat, Feed Costs

W136 Effect of breed type and feed level on production efficiency in meat goats. S. E. Kom*, N. C. Beckford, and J. M. Dzakuma, Prairie View A&M University, Prairie View, TX.

Feed intake was measured in goats, fed at an ad libitum level of intake (100%) or at restricted levels of 85% and 70% of ad libitum intake, from weaning to 13 mo of age. There were a total of 72 kids of three breeds: 24 Boer (BR), 24 Spanish (SP) and 24 Tennessee Stiff-legged (TS). Goats were classified as large (BR), intermediate (SP) or small (TS) in size. Weights were taken biweekly. Cost of feed supplied over the period (calculated at $0.22 per kg), change in weight from weaning until slaughter, and sale price per kg of live weight (based on the San Angelo livestock auction prices, estimated at $1.98 per kg live weight), were used in evaluating revenue. The objective was to perform cost analysis of feed intake when three breeds of goats were raised at three different levels of a formulated ration. Average weaning ages for BR, SP and TS breeds, respectively, were 81, 77 and 88 days. Significant differences (P < 0.01) existed in 13 mo cumulative feed intake between BR (198.87 kg), SP (121.85 kg) and TS (146.39 kg). Goats fed at the 100%, 85% and 70% levels consumed 189.98 kg, 148.86 kg, and 128.27 kg, respectively. Revenue was calculated as: (selling price per kg x change in weight) - feed cost. Revenue calculated for the BR breed at the 100%, 85% and 70% dietary levels, respectively, were: $28.42, $29.26 and $24.82; for the SP breed at the same levels, respectively, were: $30.07, $16.23 and $16.47; and for the TS at the same levels, respectively, were: $17.13, $21.05 and $16.36. ADG, from weaning to 13 mo slaughter, at 100%, 85% and 70% levels, respectively, for BR were: 0.120, 0.104, and 0.089 kg/d (P < 0.01), for SP at the same levels, respectively, were: 0.103, 0.068, and 0.064 kg/d (P < 0.01), and for TS at the same levels, respectively: were: 0.088, 0.080, and 0.066 kg/d (P < 0.05). Differences (P < 0.01) were also observed in ADG, averaged over all dietary levels over the 13 mo period, for BR (0.104 kg), SP (0.078 kg) and TS (0.078 kg). Significantly higher (P < 0.01) revenue could be generated in a production system using BR when compared to a system using SP or TS breeds. A production system using SP and TS breeds would generate about equal amounts of revenue.

Key Words: Boer Goats, Tennessee Stiff-legged, Goat Revenue


This study was conducted to evaluate the effect of feeding free-choice minerals containing 3 levels of dietary copper (Cu) on the Cu status of lactating does (halfblood and 3/4 Boer) and of their offsprings. Fifty-one pregnant does (BW: 56 kg) were separated into 6 equal groups of wk prior to kidding, assigned to 3 experimental treatments (free-choice minerals containing either 0, 1,000 or 3,000 mg Cu/kg DM) and pen-fed hay and a grain mix for 4 wk. Goats were then grazed on three separate perennial pastures starting 2 wk before the start of the kidding season (March 21 - April 17) until weaning (July 8). Intake of free-choice minerals by pregnant and lactating does was monitored weekly throughout the trial. Blood samples for the determination of plasma Cu were taken by jugular venipuncture from 24 pregnant does at the start of the trial, and from the same does and 15 kids at weaning. Kids were harvested at weaning and liver samples taken for the determination of liver Cu concentrations. From the start of the trial until the end of kidding, does consumed daily 22.1, 20.1, and 20.9 g free-choice minerals, corresponding to respective Cu intakes of 0.0, 20.1, and 62.6 mg/d. While grazed with nursing kids, does consumed daily 22.4, 23.4, and 21.9 g free-choice minerals, corresponding to Cu intakes of 0.0, 23.4, and 65.7 mg/d, respectively. Blood plasma Cu of does at the start of the trial (avg: 1.37 mg/L) and at weaning (avg: 1.27 mg/L), and of kids at weaning (avg: 1.15 mg/L) were not affected by treatment. Kid birth weight (avg: 3.6 kg), weaning weight (avg: 20.5 kg), daily gain from birth to weaning (avg: 160 g/d), live and carcass grade at weaning (avg 1.2; USDA scale), carcass weight (avg: 10.2 kg), and carcass yield (avg: 49.6%) were not affected by treatment. Liver Cu concentrations increased (P < 0.01) linearly with increasing dietary Cu (110, 182, 247 mg/kg DM, respectively), but liver lesions were minimal and not affected by addition of Cu. Feeding these levels of Cu for 6 mo were not detrimental to does or their lactating kids and did not affect kid performance.

Key Words: Goat, Performance, Copper

W138 Evaluation of goat eye mucous membrane scoring for determination of the need for anthelmintic treatment. S. P. Hart*, W. Pomroy, and T. A. Gibson1, 1E (Kika) de la Garza Institute for Goat Research, Langston University, OK, 2Massey University, Palmerston North, New Zealand.

The major gastrointestinal parasite of goats in the southern U.S. is Haemonchus contortus, which is hematophagus, causes anemia, and therefore affects eye mucous membrane color (EMMC). The objective of this study was to evaluate EMMC as an indicator of the need for anthelmintic treatment. EMMC on the inside of the lower eyelid was scored using a color chart with four gradations of color (1 = dark, 4 = pale). EMMC was also captured with a digital camera with the values for red, blue and green determined from a selected digital picture area. Goat (n = 167) on a variety of pasture studies were evaluated for packed cell volume (PCV; microhematocrit) and fecal egg count (FEC; eggs/gram [epg]; McMaster). Data were analyzed by X2 analysis and GLM procedures. Fecal egg counts averaged 212, 596, 816, and 2077 epg for the scores 1 through 4, respectively, and were greater (P < 0.01) for a score of 4 than for other scores. EMMC scores correctly identified 22 of 30 animals with FEC greater than 2,000 (sensitivity 73%) but included 47 animals with FEC less than 2,000 (specificity 70%). Goats with score of 4 had lower PCV than scores of 3 or less (P < 0.01; 23, 26, 29, and 29%, respectively). Eye scores of 4 correctly identified 19 of 25 animals with PCV < 20% (specificity 76%), but also included 50 animals with PCV > 20% (specificity of 75%). The red, blue, and green digital values from the image were poorly correlated to FEC or PCV (R2 < 0.11). In conclusion, scoring EMMC with a chart correctly identified most animals needing anthelmintic treatment, but included a significant proportion not requiring treatment.

Key Words: Internal parasites, Mucous membrane, Anemia
W139 WITHDRAWN . . .


A decline in sheep-wool prices has shown the establishment of alternative ovine production systems as hair sheep in arid environments. The purpose of present work was to evaluated the effect of transport stress on hair sheep (Black-belly X Pelibuey) exposed to a trip along 200 km during 3 h in a van vehicle, moving from a subtropical to a semiarid climate, with an altitude variation from 1,380 to 2,153 m passing into a maximum of 2,480 m above the sea level. The study included 6-months old hair ewes (n = 35), randomly allotted into 2 groups: 1) Control Group (i.e. without transportation, n = 18); 2) Transport Group (n = 17). Blood samples were obtained every hour just before and during transportation of the ewes included in both groups, to determine serum levels of cortisol, sodium (Na) and potassium (K). Once the ewes arrived to the semiarid environment, blood samples were taken every 3 h during 72 h. Transformed hair ewes had shown greater serum levels of cortisol than non-transported ewes (i.e., control ewes) (2.53 vs 0.96 mg/L; P < 0.001). A greater difference was immediately shown after the first hour of transportation (3.11 vs.1.10 mg/L) but a statistical difference remained during the 3 h trip (P < 0.001). Sodium (Na) levels, decreased in transported ewes (P = 0.06). A greater decrease of Na was shown during the first two hours of transportation. Serum potassium (K) levels showed no statistical difference within 3 h of transportation (P>0.10). In conclusion, hair ewes exposed to transport stress had shown greater serum levels of cortisol and lower levels of sodium, primarily during the first two hours of transportation, while no difference was found on serum levels of potassium (K).

Key Words: Hair sheep, Transport stress, Cortisol

W141 Effect of pre- and post-mating FGA-intravaginal sponges on estrous synchronization and embryo recovery in hair ewes. E. Ávila-Hernandez1, H. Rodríguez-Frausto2, R.M. Rincon1, J.J. Chavez1, R. Bañuelos1, and C. F. Arechiga*,1, UAMVZ-Universidad Autónoma de Zacatecas, Zacatecas, Mexico., 2FMVZ-Universidad Autónoma de Nayari, Nayari, Mexico.

Intravaginal sponges containing fluorogestone acetate (FGA) were used before and after mating in hair ewes. Pubertal hair ewes (n=20) with an age of 5.5 mo and average body-weight of 21.1 2.3, were randomly distributed in a 2x2 factorial design (n=5/group). First, duration of FGA treatment (12 vs 6 d) was evaluated for estrous synchronization, according to a established protocol reported by Rangel, 1999 (i.e., sponge FGA 0-12d; d 10, 500 IU eCG; d 12, 75 mg PGF2α, followed by natural breeding or insemination), and was compared to a shorter protocol (αFGA 0-12d; d 10, 500 IU eCG; d 12, 75 mg PGF2α). Secondly, after natural breeding with hair rams, it was determined the effect of a FGA sponge from d 1 to 7 post mating on embryo collection. The effect of FGA on reproductive tract for 12 d increases the number of ewes showing estrus (12 d=100% vs. 6 d=70%), as well as number of embryos collected from hair ewes using FGA for 12 d compared to 6 d (30 vs. 9 embryos) (P<0.05). However, hair ewes exposed to FGA for 12 d showed a greater number of embryos when no FGA sponge was used compared to the FGA treatment after mating (no FGA=18 vs. FGA=12 embryos).

Embryo collection efficiency (%) [(total number of embryos collected/total number of corpora lutea) x 100], was 20% greater when FGA was used after mating (i.e., 75 vs 55%; FGA12d/FGA post mating vs. FGA12d/No FGA post mating, respectively). In conclusion, a FGA-sponge treatment for 12 d increases estrous synchronization of hair ewes and FGA treatment post mating (d 1-7) tended to increase embryo-collection efficiency.

Key Words: Hair sheep, Estrous synchronization, Embryo recovery


The purpose of present study was to determine luteal function through 2 weekly measurements of serum progesterone in hair ewes (n=37), exposed to an estrous synchronization program by intravaginal sponges with fluorogestone acetate (FGA) from d 0-12, induction of multiple ovulation with 500 IU of eCG at d 10 and laparoscopic insemination, at their first autumn of life (i.e., reproductive season). 86.5% of hair sheep retained the intravaginal sponge (32/37), 28 ewes with retained sponge and 2 ewes without retention of the sponge showed estrus (i.e., 30/37, 87.5%). During the period of FGA exposure (12 d), 43.2% of hair ewes (16/37), had serum progesterone (P4) levels greater than 1 ng/ml. The rest, (56.8%; 21/37), had diminished luteal function or were in the follicular phase of the estrous cycle. By the end of the study, total average of serum progesterone was 5.46 ng/ml and serum-progesterone average after laparoscopic insemination was 7.96 ng/ml. 100% of hair sheep showed luteal function after laparoscopic AI. 91.9% (i.e., 34/37) showed estrous cyclicity evidence through an estrous-cyclical pattern of progesterone secretion. There was a conception rate of 10% (3 pregnancies out of 30 inseminations), and a pregnancy rate of 8.1% (3 pregnancies out of 37 ewes included in the study), even though hair ewes had a minimal average daily gain in body weight of 28.7 g/d during the last two months including the experimental protocol. Further research is required for the establishment and implementation of effective protocols for estrous synchronization and laparoscopic artificial insemination in pubertal hair ewes at semiarid climates.

Key Words: Hair sheep, Estrous synchronization, Laparoscopic insemination

W143 Assesment of different extenders for ovine semen cryopreservation. M. A. Lopez1, C. F. Arechiga*, M. A. Castillo-Pecina2, M. Perez2, and J. Gutierrez3, 1UAMVZ-Universidad Autonoma de Zacatecas, Zacatecas, Mexico., 2FZ-Universidad Autonoma de Chihuahua, Chihuahua, Mexico.

A first trial was carried out to assess the capacity of five extenders: CY (sodium citrate-egg yolk-fructose); M (skim-milk-fructose); BFS (bovine fetal serum-fructose); SOP (Artificial saliva-Opuntia ficus indica extract-fructose) and AV (avola vera gel-sodium citrate-fructose); and its combinations in 1:1 (v/v) proportion (better proportion in preliminary investigations), as mediums for ovine sperm subjected to chill-freezing process were similar in all senses than in the first trial, but also...
The purpose of present work was to evaluate the effect of three schemes to synchronize ovulation in hair ewes to be included in programmed breeding using natural mating with hair rams. The study included 30 puberty hair ewes of 5.5 mo of age and 20.7 kg, of average body weight randomly allotted in three groups. Ewes were sampled twice a week for serum progesterone determination by radioimmunoanalysis. Results have shown that an Ovsynch protocol complemented with a FGA sponge from d 0-7 and a ECP injection, had a greater proportion of ewes estrous (9/11 ewes; 82.1% estrus and mating). However, when ECP was not included in the protocol (i.e., Ovsynch + FGA), a lower number of hair ewes showed estrus and were mated (5/11 ewes; 45.5% estrus and mating), and even more when the Ovsynch protocol was used (i.e., no FGA sponge, nor ECP) (0/11 ewes; 0% estrus and mating). The number of corpora lutea was 8, 11 and 12 for groups 1, 2 and 3, respectively. In conclusion, a greater number of hair ewes are mated by hair rams when the Ovsynch protocol is complemented with a FGA sponge and a ECP injection. We imply that a regular Ovsynch protocol is not recommended to be used for natural breeding. Synchronized Ovulation Schemes

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
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<tbody>
<tr>
<td>0 22:00 GnRH</td>
<td>GnRH + FGA</td>
<td>Ovsynch + FGA + ECP</td>
</tr>
<tr>
<td>0 22:00 PGF2a</td>
<td>PGF2a (FGA release)</td>
<td>PGF2a (FGA release)</td>
</tr>
<tr>
<td>9-11 08:00 Mating</td>
<td>Mating</td>
<td>Mating</td>
</tr>
<tr>
<td>9 22:00 GnRH</td>
<td>GnRH</td>
<td>GnRH + 2 mg ECP</td>
</tr>
</tbody>
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GnRH: 0.1 mg Gonadorelin. Fertagyl (Intervet de Mexico, Edo. de Mexico, Mexico). Prostaglandin F2alpha: 37 mg Chlormadinone. Prosolv C (Intervet, Edo. de Mexico, Mexico). FGA: 40 mg Fluorogestone Acetate; Chronogest (Intervet, Edo. de Mexico, Mexico). ECP: 2 mg Estradiol Ciprionate. ECP (Pharmacia & Upjohn, Mexico, D.F.). Hormones were generously provided by Intervet de Mexico S.A. de C.V., through Drs. Garces-Yepez and Ramirez Martin del Campo.

Key Words: Hair sheep, Synchronized ovulation, Programmed breeding


Protein systems developed in the last decades permit allocate more precisely the nutrient supply. An accurate understanding of the quality of the forage consumed by grazing animals is necessary to alleviate nutritional constraints. The objective of this study was to determine the metabolizable protein content originated from the energy and protein of the diet using the French PDI protein system. Three criollo sheep (BW = 52±6.6 kg) fitted with rumen and esophageal cannulae belonging to a flock of 100 animals were used. The animals grazed on a zone with low grass covering and scattered semi succulent trees. Mean rainfall was 450 mm. Extrusa and rumen fluid samples were collected from August to December 2002. Data used to fit the PDI system were: dietary CP content, in situ degradability of CP (5g DM were placed in nylon bags and incubated in sheep fed alfalfa hay and a commercial concentrate (70:30) for 0, 3, 6, 12, 24, 48, 72 and 96 h), organic matter fermented in the rumen (estimated from the digestible organic matter) and the digestibility of the feed protein in the small intestine (from tables provided in the literature). Data was analyzed using a randomized block design (Proc GLM, SAS). Escape protein was different between months (P<0.05) with a mean of 53 g/kg DM. Data indicate that the potential production of microbial protein originated from dietary nitrogen is higher (mean = 89 g/kg DM) (P<0.05) than originated from dietary energy (mean = 29 g/kg DM) which leads to a mean of metabolizable protein (escape + microbial protein from dietary energy) content of 82 g/kg DM. It is concluded that the forage consumed by sheep require a supply of energy to alleviate the unbalance with protein during the rainy season.

Key Words: Hair sheep breeds, Energy source, Lamb performance

W147 Feed efficiency, growth rates, carcass evaluation and sensory evaluation of lambs of various hair x wool sheep crosses. T. D. Bunch*, R. C. Evans, S. Wang, C. P. Brenard, D. R. Whittier, and B. J. Taylor, Utah State University, Logan, Utah, USA.

Feed efficiency, growth rates, carcass evaluation and sensory evaluation were compared in six lambs from each of the following genotypes: St. Croix hair sheep, St. Croix x wool sheep, Callipyge wool x St. Croix, Dorper hair sheep x St. Croix, Dorper x wool, Callipyge wool x wool, and wool x wool. The general linear model (GLM) ANOVA procedures and
Fisher’s LSD multiple-comparison test was used to determine the differences among genotypes. Feeding efficient varied from 5.20 to 6.87, with the highest feed efficiency in St. Croix lambs. Standardized daily live weight gain ranged from 0.34 to 0.55 kg, with the highest rate of gain in the Callipyge wool x St. Croix lambs. Whole sale weight (kg) was the highest in the Callipyge wool x wool (19.26) and lowest in the St. Croix (15.38). Quality grade among the seven genotypes of lambs ranged from 5.5 to 7.6, with the St. Croix and St. Croix x wool lambs having the higher values. The highest value for the percent wholesale body weight was observed in the Callipyge wool x wool (64.1) while the value for St. Croix was the lowest (55.6). Percent loin eye of carcass weight was the highest in the Callipyge wool x wool (4.5) and the lowest is the St. Croix (3.0). The overall sensory acceptance rating was the highest in the St. Croix (6.8) and the lowest in the Callipyge wool x wool.

**Key Words:** Carcass evaluation, Feed efficiency, Sheep

**Ruminant Nutrition: Dairy and Beef**

**W150** Rumenal and intestinal protein digestion of tropical alfalfa and corn silage measured by mobile nylon bag technique in steer. A. Taghizadeh, M. Danesh Mesgaran*, R. Valizadeh, and F. Eftekhar Shahroodi, Ferdowsi university, Mashhad, Iran.

The ruminal and intestinal disappearance of dry matter (DM) and crude protein (CP) of tropical (Iranian) alfalfa and corn silage were measured in three steers (370 ± 16), with ruminal and intestinal canulae, using mobile nylon-bag technique. The experimental samples, 18 replicates, were placed in nylon bags (3 x 6 cm, pore size 47 µm), then incubated in the rumen of steers for 12 h prior to being inserted into the intestine. Dry matter and crude protein disappearances in the rumen, intestine and total tract were calculated as the difference between the each nutrient in the intact feeds and the remaining after incubation in the rumen and intestine. The disappearance of DM in the rumen, intestinal and total tract for alfalfa and corn silage was 410 and 380, 190 and 460, 540 and 810 g kg⁻¹, respectively. The disappearance of CP in the rumen, intestine and total tract for alfalfa and corn silage was 510 and 290, 730 and 890, 870 and 730 g kg⁻¹, respectively. The results of intestinal and total tract DM disappearance of alfalfa were significantly different from the control (P < 0.05). The alfalfa did not affect the diet digestibility in the rumen, intestine and total tract was significantly higher compared with corn silage (< 0.05). The disappearance results of DM and CP of alfalfa and corn silage may related to the growing condition, species and conservative processing.

**Key Words:** Dry matter, Nylon bag, Intestine

**W151** Influence of low-level protein supplementation on forage intake, diet digestion and selection by beef steers grazing tallgrass-prairie range during the fall. D. A. Llewellyn*, R. C. Cochran, T. T. Marston, C. G. Farmer, and T. A. Wickersham, Kansas State University, Manhattan.

An experiment was conducted to evaluate the effect on forage utilization of providing a limited quantity of a high-protein (45.5% CP, DM basis) supplement to beef cattle grazing tallgrass-prairie during the fall period. Sixteen ruminally fistulated Hereford x Angus steers (BW = 250 kg) were blocked by weight and randomly assigned to one of two treatments (i.e., fall supplementation or no fall supplementation) in a two-period study to evaluate the effect of low-level supplementation on forage intake and digestion during September and November. Within each treatment, four steers were used for measuring diet selection (by ruminal evacuation) and four were used for total fecal collection (via fecal bags). Each period consisted of a 15-d adaptation period, a 6-d period in which total feces production was measured. The diet to feces ratio of the internal marker acid detergent insoluble ash was used to calculate diet digestibility and this
value, in combination with measured fecal output, was used to calculate intake. Steers were individually fed the high-protein supplement at a rate of 0.14% of BW/d (as-fed basis) but prorated and delivered 3 d/wk. The effect of full supplementation on diet selection, intake, and digestion was not dependent on the period in which the character-istics were measured. The quality of the diet selected decreased as season progressed (CP decreased, P<0.01; NDF tended to increase, P = 0.08; ADF increased P<0.01) and as a result, digestible OM intake and total tract OM digestion were significantly lower (P = 0.04 and P = 0.02, re-
spectively) during November. Full supplementation did not significantly influence the quality of diet selected or forage intake but supplemented steers tended (P = 0.06) to digest their diet to a greater extent. In conclusion, seasonal effects on intake and digestion were evident, little impact of low-level full supplementation was observed.

Key Words: Beef cattle, Protein, Diet selection

W152 Ruminal digestibility of five forages estimated from the in situ degradation and rate of passage. M. Murillo-Ortiz1, F. O. Carrete-Carreon2, and O. Ruiz-Barrera3, 1Juarez University of Durango State, 2INIFAP-DGO, 3University of Chihuahua.

The objective was to estimate the ruminal dry matter digestibility (RDMd) of five forages from the potential degradability and the rate of passage. Forages evaluated are: alfalfa hay (AH), ryegrass hay (RGH), beans straw (BS), and Sudan grass hay (SGH). Dry matter degradability was estimated introducing polyester bags with 5g of ground sample in the rumens of four sheep for periods of 3, 6, 9, 15, 24, 48, and 72h. The rate of passage was obtained introducing forage marked with ytterbium in the rumens of four sheep and collecting feces samples of each animal at 0, 6, 12, 18, 24, 30, 36, 48, 60, 72, and 96 post-dose. The model Y= a + b(1-e-kdt) was fit to the degradation data; where: Y= degradation at time t; a= soluble fraction that is rapidly degraded; b= insoluble but potentially degradable fraction; and kd = degradation rate of b fraction (h^{-1}). Marker concentrations in feces were described by the model: Y= Ae^{-ktd} where: Y=marker concentration in the compartment at dosing time; A=marker concentration in the compartments at dosing time; k1= rate of passage of particles through the rumen (h^{-1}); k2= rate of passage through the cecum and colon (h^{-1}); TT= transit time. RMDd was obtained with the model: RMDd (%)= (1-a-b/k1) + (b/(kd+k1)). Statistical analysis of MRT consisted on analysis of variance using a completely randomized design. The largest MRT was observed in OS (23.4 h) which was different to CS (20.6 h) (P<0.05). MRT for OH, RGH, and AH were 14.8h, 13.6h, and 12.9h, respectively (P<0.05). MRT of OS and CS were different to MRT of the other forages (P<0.05). Different MRT among forages can be explained from the morphological and chemical composition of the forages. These results indicate that the combination of ruminal degra-
dability characteristics with the rate of passage are good estimators of the MRT of forages.

Key Words: Rumen, Models, Degradability

W154 Effect of urea treatment and Fibrozyme® addition on in situ dry-matter degradability of corn bran. J. I. Aguileram, M. A. Castillo-Pecinac, C. F. Arechiga1, C. Arzola2, and O. Ruiz-Barrera3, 1UAMVZ-Universidad Autonoma de Zacatecas, Zacatecas, Mexico, 2UAMVZ-Universidad Autonoma de Chihuahua, Chihuahua, Mexico.

Present work try to compare the effect of urea or hemicellulase (Fibrozyme®) on the in situ degradability of corn bran. Animals received a total-mixed ration based on oat hulls (33%), flaked corn (29%), alfalfa hay (20%), cotton-seed meal (16%), salt (1%), and a mineral premix (1%). A 4x4 latin-square design included 4 rumen-fistulated Holstein steers, under 4 different treatments: C) Control corn bran; CU) corn bran treated with 4% urea; CF) corn bran with Fibrozyme® (15 g/d); and CUF) corn bran treated with 4% urea and Fibrozyme®. Nylon bags containing 5 g (as dry matter basis) of each one of the treatments were immersed at 0, 6, 12, 24, 48, 72 and 96 h in the ventral rumen of the steers. Effective degradability was adjusted in the following model p=a + b (1 - e^{-kt}) considered in the Neway computer software. All treatments showed a 95% rumen degradability by 72 and 96 h. However, there were statistical differences in rumen degradability within treatments from 6 to 48 h of incubation. Specifically, at 12h, values were: C= 46.4%; CU= 50.52%; CF= 57.3%; and CUF= 38.78%. At 24 h C= 61.5%; CU= 62.2%; CF= 73.8%; and CUF= 46.0%. Effective degradability at 5% of outflow rate was 52.9, 50.1, 59.1 and 42.8% for C, CU, CP and CUF, respectively. Ruminal availability of corn bran was influenced by urea and/or Fibrozyme®. While Fibrozyme® addition enhanced effective degradability of corn bran, combination with urea or urea by itself tend to reduce it. Both, Fibrozyme® and urea treatments could provide a healthier ruminal environment feeding high levels of corn bran, by either accelerating or slowing down ruminal degradability, respecti-vely.

Key Words: Corn bran, Urea treatment, Exogenous enzyme

W155 Effect of urea treatment and Fibrozyme® addition on in situ dry-matter degradability of oat hulls. J. I. Aguileram, M. A. Castillo-Pecinac, C. F. Arechiga1, C. Arzola2, and O. Ruiz-Barrera3, 1UAMVZ-Universidad Autonoma de Zacatecas, Zacatecas, Mexico, 2UAMVZ-Universidad Autonoma de Chihuahua, Chihuahua, Mexico.

Present work try to compare the effect of urea or hemicellulase (Fibrozyme®) on the in situ degradability of corn bran. Animals received a total-mixed ration based on oat hulls (33%), flaked corn (29%), alfalfa hay (20%), cotton-seed meal (16%), salt (1%), and a mineral premix (1%). A 4x4 latin-square design included 4 rumen-fistulated Holstein steers, under 4 different in situ treatments: O) Control oat hulls; OF) oat hulls with Fibrozyme® (15 g/d); OU) oat hulls treated with 4% urea; and OF) oat hulls with Fibrozyme® and 4% urea. Nylon bags containing 5 g (as dry matter basis) of each one of the treatments were immersed at 0, 6, 12, 24, 48, 72 and 96 h in the ventral rumen of the steers. Effective degradability was adjusted in the following model p=a + b (1 - e^{-kt}) considered in the Neway computer software. Dry matter availability in rumen by 96 h was 42.6, 43.5, 62.5 and 60.4% for O, OF, OU and OFU, respectively. There was a statistical differences within treatments from 12 to 96 h of incubation, as well as for effective degradability at 5% of rumen outflow (38.7, 39.8, 47.5 and 46.6% for O, OF, OU and OFU, respectively). Urea treatment enhance the effective degradability of oat hulls. Whereas Fibrozyme® had no effect.

Key Words: Oat hulls, Urea treatment, Exogenous enzyme
Disposal of grass seed straw has become an environmental challenge, resulting in greater interest in enhancing its nutritive value for ruminants. Four ruminally cannulated primaparous beef heifers (mean BW 450 kg) were used in a 4 x 4 Latin square design experiment to determine the impact of an exogenous fibrolytic enzyme preparation on intake and digestibility of ammoniated and non-ammoniated bluegrass seed straw (2 x 2 factorial treatment arrangement). The ammoniated enzyme contained xylanase and cellulase activity and enzyme activity was 676 µmol reducing sugars/g CP/min (20.9% CP). Heifers allocated to enzyme diets received straw treated with enzyme by hand spraying freshly prepared enzyme solution onto straw at a rate of 0.22 g enzyme (4.4 IU xylanase)/kg. Ammoniation resulted in greater (P < 0.05) in situ DM degradability at 8, 16, 24, 36, 72, and 96 h of ruminal incubation. Similarly, in situ NDF degradability was greater (P < 0.05) for ammoniated compared with non-ammoniated straw diets at 48 and 96 h of ruminal incubation and tended (P < 0.10) to be greater at 16, 24, 36, and 96 h. Total tract NDF and ADF digestibility was greater (P < 0.01) for ammoniated than non-ammoniated straws. No treatment effects were detected for DMI; however, heifers fed ammoniated straws consumed greater (P < 0.05) amounts of NDF than those fed non-ammoniated straws. Ammoniation resulted in lower (P < 0.05) ruminal pH, ruminal butyrate and acetate:propionate, and greater propionate concentration at 0, 2, 8, 12, 16, and 18 h post-feeding. Addition of enzyme resulted in greater (P < 0.05) butyrate concentration at 0, 2, and 18 h post-feeding. No other enzyme effects (P > 0.10) were observed. For the diets evaluated in this experiment, optimum fiber digestibility appeared to have been achieved by the ruminal microorganisms without the complement of exogenous enzymes. Ammoniation improved digestibility of grass seed straw; however, exogenous enzyme was not effective for the conditions of this study.

Key Words: Forage, Xylanase, Rumen fermentation

W158 Effect of exogenous fibrolytic enzymes (Fibrozyme) on vitro digestibility of dry matter and cell wall of Brachiaria cultivars hays. J. H. Avellaneda-Cevallos1, S. S. Gonzalez2*, J. M. Pinos-Rodriguez2, R. Barcena1, M. Cobos1, D. Hernandez-Sanchez2, and M. Crosby-Galvan2, 1Universidad Tecnica Estatal de Quedeo, Ecuador, 2Colegio de Postgraduados, Mexico, 3Universidad Autonoma de San Luis Potosi, Mexico.

This study was done to evaluate the effect of exogenous fibrolytic enzymes (Fibrozyme) on in vitro digestibility of dry matter (DMIVD), neutral (NDFIVD) and acid (ADFIVD) of hays of five culti-vars of Brachiaria (brizantha var. Toledo (BT); ruziensensis x brizantha CIAT 46024 (RB); decumbens var. Seal (DS); ruziensensis x brizantha CIAT 36061 cv. Mulato (RBM); brizantha var. Insurgente (BI) cut 35 d after regrowth. The experimental design was completely randomized with a 5x2x6 factorial arrangement of treatments (cultivars, enzyme, dose, incubation time); means were compared using Tukey test. First phase of Tilley and Terry method (3, 6, 12, 24, 48 and 72 h) was used. Medium (40 mL McDougal saliva and 10 mL ruminal liquid) was placed in a 100 mL tube with 500 mg ground hay (1 mm mesh) dried at 60°C during 24 h, with or without 1.5 g enzyme/kg/DM hay. DMIVD at 48 and 72 h, with or without enzyme, was larger (P < 0.05) for BT (50.24 and 49.36 %; 58.22 and 56.18 %) and BI (47.14 and 45.61 %; 57.05 and 55.82 %) than for RB (42.71 and 41.04 %; 49.41 and 50.1 %), DS (37.45 and 36.63 %; 43.56 and 43.67 %) and RBM (37.15 and 39.15 %; 48.47 and 49.44 %). Enzyme did not change (P > 0.05) DMIVD for the five Brachiaria cultivars. NDFIVD, at 48 and 72 h, was larger (P < 0.05) for BT (45.68 and 45.10 %; 58.25 and 58.29 %) and BI (47.44 and 51.03 %; 54.73 and 58.49 %), than for RB (37.15 and 41.70 %; 42.41 and 49.26 %), DS (38.18 and 43.05 %; 42.80 and 44.64 %) and RBM (39.51 and 41.42 %; 49.57 and 50.94 %). Enzyme increased (P < 0.05) NDFIVD at 72 h for RB. Also, ADFIVD was increased (P < 0.05) by enzyme for BT (7.52 vs 14.73 %) at 12 h; BT (12.80 vs 21.35 %) and DS (11.42 vs 19.49 %) at 24 h; BT (32.43 vs 39.21 %), RB (21.07 vs 28.68 %) and BI (38.85 vs 45.62 %) at 48 h. Therefore, these exogenous fibrolytic enzymes increase in vitro degradation of cell wall fraction of Brachiaria cultivars hays.

Key Words: Cell wall fractions, Exogenous fibrolytic enzymes, Brachiaria cultivars

W155 Effect of Leucaena (Leucaena leucocephala (Echinochloa polystachya) supplementation on Aleman-grass (Echinochloa polystachya) ruminal degradability. J. Vergara-Lopez1*, A. Rodriguez-Petit2, A. Atencio2, and C. Navarro2, 1Instituto Nacional de Investigaciones Agrícolas (INIA), 2Universidad Experimental Sur del Lago (UNESUR).

In order to evaluate the supplementation effect of Leucaena on ruminal degradability, potential degradability of DM (PD), initial degradation (ID), maximum degradability (MD), degradate rate and ruminal pH of Aleman-grass an experiment was carried in a humid tropical forest in Venezuela. The evaluated treatments were: T1, Alemen-grass (pA) + 2 kg commercial concentrate (AC); T2, pA + 2 kg Leucaena once a day and T3 pA + 2 kg Leucaena twice a day (1 kg at 0800 h and 1 kg at 1500 h). Three Criollo Limonero steers fistulated with permanent rumen cannulas were exposed to treatments by a 14 days adaptation period before sampling (F1). Samples were taken during 5 days (F2). During F2, nylon bags were incubated 0, 6, 12, 24, 48, 72 and 96 h, while rumen contents pH were measured on 0, 3, 6, 9, 12 and 24 h post feeding. Ruminal degradability data was evaluated by non-linear model procedure and a switch-over design was used for statistical analysis. PD was higher (P < 0.05) in T3 (62.91%) than T1 (58.31%) or T2 (59.17%). ID not shown statistical differences between treatments. Ruminal pH on T3 (6.74) was higher (P < 0.05) than T1 (6.66) and T2 (6.65). We concluded that Leucaena supplied twice a day, increases DM degradability of Aleman-grass.

Key Words: Ruminal degradability, Leucaena leucocephala, Echinochloa polystachya
Barley harvested as hay is a significant source of winter forage for live- stock producers in Montana. Limited data is available using hay barley as a roughage source for backgrounding steers. Ninety-six Angus cross steers were allotted to pens in a random block design. The objectives of this study were to 1) determine the effects of four barley varieties on animal performance and diet digestibility, and 2) determine the effects of feeding awned vs. hooded head type barley. MT 981060, Westford, and Haybet are all hooded forage barley varieties while Valier is an awned feed barley variety. Steers were fed ad libitum access to their roughage source, 2.6 kg head^{-1} d^{-1} of cracked feed barley, and 0.45 kg head^{-1} d^{-1} of a commercial 32% CP supplement. All roughage was chopped to 5.1 cm. Pen was the experimental unit in the 60 d trial. Steers were weighed and diet, ort, and fecal samples were obtained on d 28 and upon completion (d 60) of the trial. Diet and fecal samples were composited by pen and analyzed for DM, OM, N, NDF, ADF, and AA. Acid insoluble ash was used to estimate fecal output. Steers fed MT981060 and Valier had 55% greater (P < 0.01) ADG when compared to steers fed Haybet and Westford barley (avg 3.29 vs. 2.75 kg/d, respectively). Dry matter intake was greatest (P < 0.01) for steers fed MT 981060 and Valier, intermediate for Haybet and least for Westford (avg 10.06 vs. 9.61 and 8.08 kg/d, respectively). 

**Key Words:** Backgrounding steers, Forage barley varieties, barley

### W161 Continuous culture fermentation of three forage varieties supplemented at four energy levels. R. E. Vibart*, S. P. Washburn, V. Felner, and J. T. Green, North Carolina State University, Raleigh.

Eight dual-flow continuous cultures (700 ml) were used to compare effects of endophyte-infected (E+), endophyte-free (E-), and nontoxic endophyte-infected (EN) (MaxQ) Jessup tall fescue (Festuca arundinacea L.) on rumen fermentation in a grazing simulation at four levels of concentrate supplementation (ground corn). For each of the fescue varieties (E+, E-, and EN), forage to concentrate ratios of 100:0, 85:15, 70:30, and 55:45 were used for a total of 12 experimental diets in a randomized incomplete block design with two replicates. Vegetative grasses were used with compositions as follows: E+ (12.3% CP, 59.9% NDF, 29.2% ADF), E- (13.4% CP, 60.7% NDF, 29.4% ADF), and EN (10.4% CP, 63.2% NDF, 31.4% ADF). Rumen cultures were adapted for 48 h before experimental diets were fed and then gradually adjusted to the final diets. Each culture vessel was offered a total of 15 g of DM per day including: four equal portions of grass (fed at 0300, 0900, 1500, and 2100 h); and two equal portions of corn (fed at 0900 and 2100 h). The fractional dilution rate was set at 6.25% per hour. Headspace gas and liquid samples were analyzed for methane, rumen culture pH, volatile fatty acids, and ammonia-N concentration to assess the rumen environment from the pasture-based diets. Methane concentrations were higher (P < 0.05) for E+ compared to E- or EN. Methane was also higher (P < 0.05) for E- than for EN but only when sampled after feeding corn. Ammonia-N concentrations also varied by grass: EN had lower (p < 0.05) values compared to E+ and E-. Rumen pH values, ammonia-N (mg/100 ml), acetate concentrations (mM), and the acetate: propionate ratio decreased linearly with increasing levels of energy supplementation, whereas propionate and butyrate increased linearly. Interactions of feeding time by grass and energy by grass were observed for concentrations of ammonia-N. Although some differences were observed among fescue varieties, fermentation responses were generally similar at similar levels of energy supplementation.

**Key Words:** Festuca arundinacea, Endophyte, Energy supplementation

### W162 Effects of field peas inclusion on in situ disappearance rate of grass hay, soybean hulls, and field peas in beef steers fed medium concentrate diets. S. A. Soto-Narvaez*, G. J. Williams, M. L. Bauer, G. P. Lardy, D. Landblom, and J. S. Caton, North Dakota State University, Fargo.

Four ruminally and duodenally cannulated steers (703.4 ± 41 kg initial BW) were used in a 4 x 4 Latin square to evaluate effects of field pea inclusion on in situ disappearance rate (%/h) of grass hay, soybean hulls, and field peas in beef steers fed 55% concentrate diets. Steers were fed ad libitum at 0700 and 1900 daily and were allowed free access to water. Diets consisted of 45% grass hay (6.8% CP) and 55% concentrate mixture. Treatments consisted of: 1) control, no peas; 2) 15% peas; 3) 30% peas; and 4) 45% peas in the total diet, with peas replacing wheat middlings, soybean hulls, and barley malt sprouts in the concentrate mixture. Steers were adapted to diets for 9 d. Grass hay was incubated in situ, beginning on d 10, for 0, 2, 5, 9, 14, 24, 36, 72, and 98 h; and field peas and soybean hulls for 0, 2, 5, 9, 14, 24, 36, 48, and 72 h. Linear, quadratic, and cubic contrasts were used to compare increasing field pea levels. In situ DM and NDF disappearance rates of grass hay and soybean hulls decrease linearly (P ≤ 0.05) with increasing field pea rates. Rate of grass hay in situ ADF disappearance also decrease linearly (P ≤ 0.05) with increasing field peas. In situ DM disappearance rate of field peas demonstrated a quadratic effect (P ≤ 0.01; 5.9, 8.4, 5.5, and 4.9 0.52 %/h, for 0, 15, 30, and 45% field peas in the diet, respectively) with increasing field pea level. Rate of in situ CP disappearance respond quadratically (P ≤ 0.09) for grass hay (4.2, 4.7, 2.7, and 2.2 ± 0.24 %/h), soybean hulls (7.0, 7.5, 7.6, and 5.7 ± 0.61 %/h), and field peas (6.7, 7.5, 7.5, and 5.8 ± 0.19 %/h for 0, 15, 30, and 45% of field pea inclusion, respectively). Inclusion of up to 45% field peas into medium concentrate diets consumed by beef steers reduces rates of in situ DM, NDF, and CP disappearance.

**Key Words:** Field Peas, Digestion Rate, Cattle

### W163 Effects of sun-curing, formic acid-treatment or microbial inoculation on ruminal kinetic parameters of timothy. R. Martineau*, H. Lapierre², D. R. Ouellet², D. Pellerin¹, and R. Berthiaume², ¹Université Laval, Quebec, Canada, ²Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lenoirville, Quebec, Canada.

Effects of three methods of conservation on ruminal kinetic parameters of timothy (Phleum pratense L.) were investigated. Treatments were: 1) sun-cured hay (H; 48 h wilting), 2) formic acid-treated silage (F; 6 L of 85% formic acid per ton of fresh forage; 24 h wilting), or 3) microbial inoculated silage with Lactobacillus plantarum LPH-1 and Pseudomonas aeruginosa PC1 (forage:concentrate ratio = 56:44, 125 X 10^{11} total CFU per ton of fresh forage; 20 h wilting). Percent DM were 84.9, 36.1 and 35.5 (SEM=1.34) for treatments F+I, F, and I, respectively. Six ruminally cannulated Holstein cows in mid lactation, consuming 15.9 kg DM per day (SEM=0.98; P=0.15), were randomly assigned to treatments. CP disappearance was estimated with the in situ nylon bag technique after a 9 day adaptation period (forage:concentration ratio = 56:44; incubation times = 0 to 72 h in triplicate; bag pore size = 41.6 x 52 µm). Soluble fraction (A), total potentially degradable fractions (A+B), degradation rate (Kd) and estimated rumen degradable protein (RDP) at Kp 4% were lower for treatment H than for treatments F+I (P=0.01). Fraction B was higher for treatment H than for treatments F+I (P<0.01). Treatment F decreased fractions A (P<0.01) and A+B (P=0.03) but increased fraction B (P=0.01) when compared to treatment I. Results suggest that formic acid-treatment limits protein breakdown in silage (lower fraction A and higher fraction B) when compared to microbial inoculation. However, formic acid-treatment is not as effective as sun-curing for limiting proteolysis.

**Key Words:** in situ Disappearance, Formic acid-Treatment, Microbial Inoculation
A study was conducted to evaluate the effect of Corn Distillers dried grains with solubles (D) vs. soybean meal (S) as a protein source in a creep feed. Thirty-six steer calves (avg. 160.7 kg ± 2.8; 2 groups / treatment) were used in a completely randomized design to compare the effects of D and S on growth performance and intake of drylot calves. (C) calves prior to (68 d) and after weaning (112 d). Steers were allotted by age (avg. 122.5 d ± 2.5) to 1 of 6 endophyte-free tall fescue pastures with dams. The dietary supplements consisted of a cracked corn / soyhull mix with the protein source and were formulated to contain 14.2% CP and 1.39 Mcal/kg of NEn. Calves were placed in open drylots and adjusted to a receiving diet of cracked corn, soyhulls, and fescue hay with D and S treatments continued, while the C treatment received S as the protein source. During phase 2, the cracked corn was replaced with shelled corn and increased in the diet. During phase 3, steers were placed on a common diet of shelled corn, soyhulls, and fescue hay. Diets for phase 1, 2, and 3 were formulated to provide 13.5, 13.2, and 12.0% CP and 1.08, 1.25, and 1.27 Mcal/kg of NEn, respectively. Weight and ultrasound measurements were taken intermittently throughout the feedlot phase. Treatments D and S had greater (P < .05) ADG than C (1.66, 1.00 vs. 0.72 kg, respectively). The feed / extra gain was similar among treatments, while cost / kg of extra gain for D was lower (P < .05) than S ($0.88 vs. $1.89, respectively). For phases 1 and 2, weight of all treatments increased in a linear (P < .01) fashion, but the quadratic response differed between C vs. D and S (P < .05). DMI was similar among treatments, but ADG between C vs. D and S differed (P < .01) during phase 1. Feed / gain among treatments was similar for phase 1; during phase 2, all treatments differed (P < .01) with D being the highest and C the lowest. For phases 1 and 2, backfat depth and ribeye area for all treatments increased in a linear (P < 0.01) fashion, while the backfat depth of C also increased in a quadratic (P < 0.05) fashion. Final performance and carcass data will be presented later. In conclusion, protein source had no effect on ADG, however DDGS reduced cost / kg extra gain.

Key Words: distillers dried grains with solubles, performance, creep

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Sulphates salts are present in many water sources found on rangeland and negatively affect water intake by cattle. The objective of this work was to determine water consumption by beef cattle when they were given access to water containing a range of concentrations of Na2SO4 and MgSO4. In Exp. 1, 5 beef heifers (300-400 kg) were offered either ad lib access to tapwater (8 ppm SO4) or water containing 3000 ppm SO4 for two wks and restricted access (twice daily) for two wks. Exp. 2 was conducted as a taste test for 2 d where 8 animals were given water twice daily containing tapwater (11 ppm SO4), Na2SO4 or MgSO4 at 1500, 3200, or 4700 ppm SO4. Each test was separated by 2 d of access to tapwater. Data was analyzed using paired t-tests in Exp. 1 and by Wilcoxon paired sample tests in Exp. 2. In Exp. 1 animals drank less (P < 0.05) water when it contained Na2SO4 (4.37 ± 0.90 kg/drink) compared to tapwater (9.00 ± 0.81 kg/drink) when given ad lib access. When access was restricted, average drink intake was 21.88 ± 2.15 kg for tapwater and 11.19 ± 2.89 kg for water containing Na2SO4 (P ≤ 0.01). Average daily intake of tapwater was less (P ≤ 0.05) when water access was restricted (44.26 ± 4.13 kg compared to ad lib access (55.42 ± 5.62 kg); however, average daily intake of the SO4 water was not different (P ≥ 0.05) for ad lib (25.52 ± 5.16 kg) and restricted access (21.53 ± 5.74 kg). In Exp. 2 there was no difference (P ≥ 0.05) between average water intake for MgSO4 (20.71 ± 0.50 kg/drink) and Na2SO4 (18.78 ± 1.74 kg/drink) treated water at 1500 ppm SO4; however at 4700 ppm SO4 the average intake of MgSO4 treated water was 6.70 ± 3.05 kg/drink compared to 15.38 ± 1.81 kg/drink for Na2SO4 (P ≤ 0.05). There was considerable variation in intake between animals, particularly at higher SO4 concentrations. These results suggest that guidelines for maximum allowable limits of SO4 in cattle drinking water need to consider the associated cation and the variability in sensitivity between animals.

Key Words: Beef cattle, Water quality, Sulphate

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The objective of the present study was to assess the kinetic parameters of digesta flow in calves under different herbage allowances of Tanzania grass (Panicum maximum cv. Tanzania-1). A randomized block design was used with two replications per block, four treatments, defined by average levels of herbage allowance (HA), and two blocks (sampling periods). Average herbage allowances (HA) were 6.1 ± 0.59; 11.1 ± 0.77; 18.0 ± 1.24 and 23.9 ± 1.15 kg DM green leaf blades/100 kg LW/day. Complex Cr-NDF was supplied to three Nelore calves (average weight: 245 kg) in each replication and stooks were collected at 0, 12, 18, 24, 30, 36, 42, 48, 60, 72, 96, 120 and 144 hours. Chromium concentration data for each replication were adjusted by non-linear regression (Dhanoa et al., 1985) and the effects of herbage allowance were interpreted by regression analysis. Changes in herbage allowances of Tanzania grass directly affected the passage rate of digesta in the rumen (%/h) (k1 = 1.875 ± 0.041**; HA; r2 = 0.991), had no impact on passage rate in post-rumen (k2 = 15.383 %/h), and generated a negative effect on mean retention time of digesta (h) (MRT = 67.21 - 0.481**HA; r2 =0.905).

Key Words: Passage rate, Tropical forage, Beef cattle

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**W169** Comparison of commercial White and Yellow Corn from Sinaloa Mexico, on starch composition, in vitro digestibility, and physical characteristics. O. G. Lozano*1, M. Chaidez-Ibarra1, A. Sanchez-Bautista1, X. Perales-Sanchez1, C. Mora-Uzeta1, and E. Vazquez-Garcia1, 2Universidad Autonoma de Sinaloa, Mexico.

The objective of this experiment was to determine the differences between White Corn (WC) and Yellow Corn (YC) for ruminant nutrition purpose. Six WC and five YC, commercial heterogeneous varieties from different companies, were sampled form Sinaloa Mexico. One YC, imported from USA, was included. The physical analysis were; density (g/L), weight of 1000 kernels (g), water absorption in 30 min (%), DM solubility (%), and PC solubility (%). The chemical analysis were: PC (%), and starch composition (α-amylase/amyloglucosidase kit; Methods AOAC 996.11 and AACC 76.13). The digestion analysis were, DM in vitro digestibility (DMIVD) at 4, 6, 8, 12, 24, and 48 h (Ankom DAISY) and rate of degradation (%/h). The experimental model was a completely random design, with two treatments; WC and YC. There are not differences (P > 0.05) between the WC and YC on: density (mean = 723 g/L), kernels weight (mean = 379 g); water absorption (mean = 6.12 ± 0.56); DM solubility (mean = 7.99 %, 1.7); CP solubility (mean = 17.44 %, 3.4); and CP composition (mean = 9.78 %, 0.6). WC had a tendency of high starch concentration (P=0.08) related with YC. As a result, the physical, chemical, and digestive analysis presented in this experiment, however, must be considered that individual grains, white or yellow, showed higher DMIVD.

Key Words: White corn, Starch, Digestibility
The objective of this work was to determine the fractions and rates of digestion of the carbohydrates for sugar cane with different cutting times. Two major carbohydrates were used to determine whether associative effects of feeds occur. Two sets of four feeds from the California alfalfa hay, AL; barley grain, BR; corn silage, CS; soybean meal, SM and four feeds from The Netherlands (grass silage, GS; corn silage, CS; citrus pulp, CP; corn gluten meal, CG) were incubated alone, and in various combinations, in buffered rumen fluid using an in vitro gas technique (Beauchemin and Steinbeck, 1990. Anim. Res. Dev. 28:7-55). The percent increase in gas production measured on combinations of feeds vs. the gas calculated to have been produced based upon incubation of individual feeds was used to assess the extent of the associative effects. Among the California samples, the AL: SM combination resulted in as high as a 9% increase in gas production at 6 h of incubation compared to values calculated from incubation of the individual feeds. The percentage increase in gas production at 24 h of incubation was less than that at 6 h and there was no increase in gas production in feed mixtures incubated for 72 h. The AL: BR mixture produced 20% more gas than individual feeds incubated for 6 h, and there was no increase in gas production at 72 h of incubation in any feed mixtures compared to feeds incubated individually. The three feed combination of AL: SM: CS resulted in a 11% increase in gas production at 24 h incubation vs. that calculated from incubation of individual feeds. The four feed combination of AL: BR: SM: CS increased in vitro gas production by about 10% at 6 h of incubation. The percent increase in gas production with mixtures of feeds from the Netherlands followed similar trends. Results suggest that feed digestibility and energy supply to ruminants can differ from values derived from calculations based on individual feed digestibility. The extent of these differences appears to vary with type and level of feed, and time of incubation.

**Key Words:** In vitro gas production, Associative effects


A ration formulated for ruminants is often a mixture of individual feeds. Its energetic value is generally calculated by summing the energy value of the individual feeds in it, on the assumption that the energy value of individual feeds will be the same when they are fed in combination with other feeds. The progress in the cut time caused linear increase of the C fraction and reduction of B2, without interaction with the cycle of production; although it has been linear, the increment was relatively small, 6 percentage of the fraction C, when compared to the other tropical graminaceae, with the same cut time. The kinetic parameters, didn't present disparities among varieties; however, the estimated average digestion rates for NFC were lower than the suggested by the Cornell system. The adjustment of the curve of cumulative gas production (bicompartimental system) was shown appropriate because the sugar cane has fractions of available carbohydrate very different with relationship to the digestion rate (CNF and B2). By presenting high content of NFC (sucrose) and low rate of digestion of the B2 fraction, researches with different sources of N to supplement sugar cane based diets are necessary.

**Key Words:** Carbohydrate digestible fraction, Digestible rate, Sugar cane
**W172** The effect of concentrate restriction on performance of Holstein steers fed only liquid whey instead of water. A. R. Bayat\(^1\), R. Valizadeh, and A. Naseei, *College of Agriculture - Ferdowsi University - Mashhad - Iran.*

This experiment was conducted to study the effects of concentrate restriction on liquid whey consumption, performance, rumen and blood parameters of the Holstein steers in a 100 days period. 12 Holstein steers with average body weight of 150 ±27 Kg were assigned to treatments. Experimental designs were Completely Randomized Design with 3 treatments. Treatments were: I. Normal concentrate feeding (ad lib) II. Concentrate restricted at the level of 2/3 of concentrate intake of treatment I. III. Concentrate restricted at the level of 1/3 of concentrate intake of treatment I. Alfalfa hay was fed at the level of 0.7 % (DM Basis) of body weight. Liquid whey was given ad lib. No drinking water was provided. Diet was formulated based on NRC (1989) recommendations. Rumen liquor and blood samples (from jugular vein) were taken 3h after morning feeding. Acid insoluble ash (AIA) was used for apparent digestibility determination. Whey consumption of treatment III increased by 12.68 percent in comparison to treatments I and II (54.6, 48.5 and 48.5 Kg/d respectively SE=4.13). The steers in treatments I, II and III obtained 41.2, 49.3 and 55.7 percent of their daily dry matter intake (DMI) from whey respectively. There was a significant difference between total DMI (p<0.05) (6.38, 5.43 and 5.31 kg/d for treatment I, II and III respectively). Alfalfa intake in treatment III was higher than treatments I and II (p<0.05). Among the apparent digestibilities (DM, OM, CP, CF, NDF and ADF) only digestibility of ADF in treatment III was significantly increased in comparison to the control (p<0.05) (64 vs. 24%). Increasing concentrate restriction leads to linear decrease of average daily weight gain although it was not significant. There was no significant difference among feed conversion ratios. Rumen and blood pH and ammonia nitrogen (NH\(_3\)-N) of rumen liquor were similar among the treatments. Plasma urea nitrogen in treatments II and III were 338 J. Anim. Sci. Vol. 81, Suppl. 1/J. Dairy Sci. Vol. 86, Suppl. 1

**Key Words:** Whey, Concentrate restriction, Steer

**W173** Effects of dry and steam processing on in situ ruminal digestion kinetics of barley grain. A. Nikkhah and G. R. Ghorban\(^2\), *Isfahan university of Technology, Isfahan, Iran.*

Effects of barley processing on rate and extent of digestion were evaluated with three ruminally cannulated ewes. Barley grain was processed with dry method (finely and coarsely ground), as well as it was steam rolled in four separate bulk densities. To distinguish four different degrees of steam-rolled barley, the processing index (PI) was measured as volume weight of barley after processing expressed as a percentage of its volume before processing which was 72.6, 63.8, 46.1, and 39.6 percent for coarse, medium, medium-flat, and flat flakes, respectively. The nylon bags containing 3 g of ground and steam-processed grains were incubated in rumen for 0, 2, 4, 8, 16, 24, and 48 h to estimate the kinetics of rumen degradation. The soluble fraction and fractional rate of DM and CP digestion were significantly higher for finely ground barley than those for other treatments. Among four degrees of steam-rolled barley grains, coarse and flat flakes had respectively the lowest and the highest soluble DM and CP as well as the fractional rate of digestion. The least amounts of slowly degradable DM and CP were for finely ground barley followed by flat, medium-flat, medium, and coarse flakes. In fact, raising the extent of both grinding and steam-rolling resulted in dramatic increase of effective degradability for DM and CP assuming two outflow rates of 5 and 8 percent h\(^{-1}\). The results of this study showed that steam processing can be more reliable than grinding of barley because it provides less amount of rapidly degradable fraction and more potential digestible DM in rumen. In other words, we can modulate the rate and extent of ruminal digestion more easily with steam processing rather than grinding of barley.

**Key Words:** Barley, Steam rolling, Degradability

**W174** Effect of the processing method of soybean meal on production response of lactating cows. C. Leonardi\(^1\), W. Stockland\(^2\), and L.E. Armentano\(^3\), *1 University of Wisconsin-Madison, 2 AG Processing Inc., Omaha, NE.*

The objective of this study was to evaluate production response of dairy cows fed soybean meal ruminantly protected by three different methods. Treatments consisted of a control diet containing soybean meal (SBM) and three diets from which part of the soybean meal was replaced either by co-processed Expeller-soybean meal (EXP), or by a mixture of expeller-soybean meal and dehulled soybeans (CX). Soybean meal was enzymatically browned with xyleose (CX, SoyPan\(^4\)) or soy meal cooked with soybean hulls and water (CSH, AminoPlus\(^5\)). Twelve multiparous and four primiparous Holstein cows were utilized in a replicated 4 x 4 Latin Square design, with 21 d periods. Diets contained 22.5% alfalfa silage, 38.3% corn silage, 4.7% cottonseed and 35.4% concentrate (DM basis). Diets were formulated to be isonitrogenous (CP = 17.5%), isergonetic and have similar NDF (29.6%) and fatty acids (4.6%) concentrations. The SBM diet was RUP deficient, while the other three were designed to have adequate and equal RUP levels. Contrasts tested RUP level (SBM vs. EXP, CX and CSH), method of ruminal protection: cooked-expeller vs. chemically treated (EXP vs. CX and CSH), and within chemical treatment the effect of different methods (CX vs. CSH). None of the tested contrasts were different for yield of milk fat, protein or DM. Milk protein percentage was greater when feeding soybean meal vs. ruminally protected soybean products. Revenue ($/cow/d) was calculated for each cow within treatment, assuming N\(_3\) 6.21 per kg of fat and N\(_4\) 4.00 per kg of protein. Revenue 90% confidence interval (least squares means ± 1.64 x SED) was 7.92 ± 0.29 for SBM, 7.95 ± 0.29 for EXP, 7.94 ± 0.29 for CX, and 8.17 ± 0.29 for CSH.

<table>
<thead>
<tr>
<th>Diets</th>
<th>EXP</th>
<th>CX</th>
<th>CSH</th>
<th>A vs B</th>
<th>D vs (B+C+D)</th>
<th>(C+D)</th>
<th>D</th>
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<td>DM/kg/d</td>
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<td>23.4</td>
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<td>0.52</td>
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<td>Milk/kg/d</td>
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<td>37.1</td>
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<td>38.5</td>
<td>0.13</td>
<td>0.27</td>
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<td>2.91</td>
<td>2.89</td>
<td>0.02</td>
<td>0.05</td>
<td>0.36</td>
<td>0.24</td>
</tr>
<tr>
<td>TP, g/d</td>
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<td>1080</td>
<td>1078</td>
<td>1100</td>
<td>19.27</td>
<td>56.22</td>
<td>33.63</td>
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<tr>
<td>Fat, %</td>
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<td>3.74</td>
<td>3.74</td>
<td>3.74</td>
<td>0.95</td>
<td>0.66</td>
<td>0.99</td>
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<tr>
<td>Fat, g/d</td>
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<td>1388</td>
<td>1388</td>
<td>1430</td>
<td>0.30</td>
<td>0.42</td>
<td>0.17</td>
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</table>

**Statistical Contrast (%)**

TP = True Protein

**Key Words:** Protein, Milk production

**W175** Sugar cane fiber effectiveness in dairy rations. M.L.M. Lima\(^1\), W. Mattos\(^2\), and L. G. Nussio\(^2\), *1Escola de Veterinaria, Goiania - GO - Brazil ; 2 Universidade de Sao Paulo, ESALQ, Piracicaba - SP - Brazil.*

Five ruminally and duodenally cannulated Holstein cows were used in a 5 x 5 Latin square design with 14-d periods to evaluate fiber effectiveness of sugar cane (SC) and sodium hydroxide (NaOH) treated sugar cane (SHSC). Low (LF) and high (HF) forage diets [14 and 22% of dietary DM from corn silage (CS) NDF, respectively] were compared to diets formulated to contain 14% CS NDF plus 8% of DM from SC NDF, SHSC NDF or alfalfa hay (AH) NDF. Forage particle size was determined using the Penn State Particle Size Separator on a wet basis. Concentration of indigestible NDF (INDF) in forage samples was determined by 144-h in vitro fermentation using the Ankom Dairy II technique. Potentially digestible forage NDF (DNDF) was determined as NDF-INDF. Forage retained on the upper and lower sieves and at the bottom pan was 26.7, 51.8 and 21.3% of DM respectively for CS, SC, and SHSC diets. Acetic acid (mol/100 mol) was higher (P < 0.05) for CS (63.9) than SC (50.1) and SHSC (50.1) diets. Total VFA concentration did not differ (P > 0.05) among diets. Acetic acid (mol/100 mol) was higher (P < 0.05) for cows fed the SC and SHSC diets than for those fed HF and AH diets. This reflects the higher acetate:propionate ratio for cows fed the SC and SHSC diets. Ruminating (min/d and min/kg of DMI) and chewing (min/d and min/kg of DMI) activities were lower (P < 0.01) for cows fed the LF diet, but did not differ among HF, SC, and SHSC diets. Rumen mat consistency was lower (P < 0.05) for
cows fed the CS diets (LF and HF) than for those fed SC, SHCS and AH diets. NDF from SC, SHSC and AH were as effective as that from CS for maintaining milk fat test and stimulating chewing.

Key Words: Sugar cane, Corn silage, Fiber


The study objectives were to test the effects of preweaning starter supplement and postweaning protein concentration on feed intake, body gain and skeletal growth rates from 4 to 180 d of age in dairy heifers. Forty two Holstein calves were individually housed and fed 4.5 kg/d milk replacer from 4 to 50 d age. Calves were fed starter supplements consisting of either a conventional calf starter mix (C) or a course starter mix (CS) containing 15% whole shell corn, 15% cottonseed, 15% ground alfalfa hay, 15% soybean meal, 15% ground corn and 25% whole barley plus minerals and vitamins (as fed basis). Beginning at 60 d, heifers were randomly assigned within pre-weaning groups to isocaloric (2.4 Mcal ME/kg DM) diets containing: low (L) (19.4% CP, 9.9% RUP); medium (M) (22.9% CP, 12.1% RUP); or high (H) (26.5% CP, 14.7% RUP) protein levels until 180 d age. Measurements included daily feed intake and weekly body weights, hip height and wither heights. Starter supplement had no effect on DM intake (0.70 vs 0.69 kg/d; C vs CS) prior to weaning. Postweaning DM intake was 3.75, 3.45, and 3.25 kg/d (P < 0.001) for the L, M, and H diets, respectively. There was a starter by protein interaction (P = 0.06) where calves fed the CS preweaning diet and L protein diet consumed greater DM postweaning than each of the other groups. Rates of body weight gain were decreased by the protein interaction (P = 0.001) for the L, M, and H diets, respectively. There was a starter by protein interaction (P = 0.06) where calves fed the CS preweaning diet and L protein diet consumed greater DM postweaning than each of the other groups. Rates of body weight gain were decreased by the protein interaction (P = 0.001) for the L, M, and H diets, respectively.

These results suggest that feeding a course starter supplement prior to weaning might encourage postweaning feed consumption. Although high dietary protein decreased feed intake and rates of body weight gain, skeletal growth rates were maintained, suggesting heifers fed the high protein diets had increased lean and decreased adipose tissue deposition.

Key Words: Protein, Skeletal growth


Two trials were conducted to study physical and chemical properties and ruminal digestion of 39 corn grain genotype. In the first trial physical and chemical properties and ruminal dry matter (DM) and starch (S) degradability (28 h of incubation) of all hybrids ground to 2 mm were evaluated. Three dry Holstein cows (705 kg) fed with 40% alfalfa hay and 60% concentrate were used. Hybrids were classified in colours yellow (Y) orange (O) and red (R) of endosperm according to visual evaluations. Hybrids were tested for: test weight (TW), thousand grain weight (TGW), apparent density (AD), percent floating grain (PPG), milling ratio (MR), colours index of whole (CWI) or ground kernels (CFG) to 2 mm, vitreousness (in eight hybrids evaluated in second trial), CP, NDF, and S. The Y hybrids had less (P<0.05) TW and MR than the average of O and R (78.3 vs 80.2 kg/hl and 3.67 vs 4.62, respectively). The PFG, CWI and CIG was higher (P<0.05) in Y than in O and R (41.0 vs 17.1, 72.9 vs 69.1 and 85.3 vs 83.3, respectively). The Y and O hybrids had higher (P<0.05) TGW (average 354.5g) than R (308.0g). The O and R hybrids (average 83.2%) tended (P<0.10) to had higher vitreousness than Y (72.7%). The CP was lower (P<0.05) in Y (8.6%) than O and R (9.5%). The ruminal degradability of S was higher (P<0.05 in Y (87.0%) than in R (72.7%) while O (73.3%) hybrids was not different (P>0.05) from both. The Y genotypes with low proportion of horny endosperm (lower vitreousness) may have intrinsic features reflected in difference physical and chemical grain properties which also make them more susceptible to ruminal digestion respect to other corn genotypes.

Key Words: Corn grain, Physical, chemical properties, Ruminal digestion


Twenty-four high producing Holstein dairy cows were used in a randomized complete block design experiment to determine the utilization of pet food grade poultry protein meal (PPM) as a ruminally undegraded protein (RUP) supplement. All cows were fed diets relatively high in both fat and fiber to accentuate the need RUP. Cows in early lactation ranging between 30 and 120 DIM, were blocked into six groups based on their level of milk production. One cow from each block was assigned to each treatment group. The diets contained approximately 55% wheat silage, 31% forage NDF, 15.5% CP and 6.5% fat on a DM basis. Treatments varied due to protein supplementation that are described as: 1)positive control (PC) composed of soybean meal (SBM) and a RUP blend of fish meal, blood meal, and dry distillers grains 2) negative control (NC) composed of only SBM; 3) 50% PPM composed of 50% pet food grade poultry protein meal (PPM) substituted for the RUP blend in treatment 1; and 4)100% PPM composed of 100% substitution of PPM for the RUP blend in treatment 1. Cattle were fed
behind Calan gates a common diet for two weeks and treatment diets for 12 weeks. Daily DM intake (21.9 ± 0.79 kg) was 10% lower (P < 0.01) and milk production, corrected to 4% fat (30.6 ± 1.1 kg) was 5.5% lower (P < 0.1) with cattle fed NC as compared to the other diets. Milk fat, fiber digestibility and body weight loss were all lower in cattle fed NC as compared to other diets. Digestible energy (2.85 ± 0.07 Mcal/kg) and net energy of lactation (1.54 ± 0.05 Mcal/kg) was 4.6 and 6.0% (P < 0.05), lower for NC as compared to the other diets. Efficiency of net energy use did not differ among treatments. Back fat accretion, detected from ultrasonography, was 68% greater in cattle fed NC (0.2 vs. 0.11 cm; P < 0.05). Blood urea nitrogen (22.6 ± 0.58 mg/dl) was 3.5% higher in cattle fed NC. In-situ rumen dry matter and degradation kinetics were determined on all dietary components. Pet food grade poultry protein meal had a CP kg of 2.45%/h, a RUP of 58.5% and an intestinal digestibility of 85.4%. These results indicate that cattle fed high fat and fiber diets require more RUP and PPM is 58.5% and an intestinal digestibility of 85.4%. These results indicate that cattle fed high fat and fiber diets require more RUP and PPM is 58.5% and an intestinal digestibility of 85.4%. These results indicate that cattle fed high fat and fiber diets require more RUP and PPM is 58.5% and an intestinal digestibility of 85.4%.

**Key Words:** Dairy cattle, Rumen undegradable protein

**W180 Effects of physically effective NDF on rumen fermentation and digestion of dairy cows fed diets based on barley or corn silage. W. Z. Yang1 and K. A. Beauchemin1, 1Agriculture and Agri-Food Canada, Lethbridge, Canada.

Two studies were conducted to investigate the effects of physically effective (pe) NDF content in dairy cow diets on rumen fermentation and digestion with two forage source. Each study was a double 3 x 3 Latin square design using six lactating dairy cows with ruminal and duodenal cannula. The treatments included three levels of peNDF (high, medium and low) measured using the Penn State Particle Separator. In study 1, three levels of peNDF were prepared by using original, chopping once or chopping twice of corn silage, which had peNDF content 16.0, 14.8 and 13.2%, for high, medium or low, respectively. In study 2, two cutting barley silages were prepared, coarse (3/8” TLC) and fine (3/16” TLC). The high, medium or low peNDF diets were formulated using coarse, equal coarse and fine or fine barley silage with peNDF content, 16.1, 14.4 and 13.6%, respectively. Cows were offered ad libitum access to a TMR. Dry matter intake was not affected by the treatments regardless of silage fed. Digestibilities of nutrients in the total tract were significantly increased (P < 0.01) from 67.7 to 71.5% and from 48.5 to 57.5% for OM and NDF, respectively with increased peNDF content of the diet cows fed corn silage based diet. However, effect of peNDF content of the barley silage based diet on digestibility in the total tract was limited. Only a quadratic effect of peNDF level on NDF digestibility was observed (P < 0.08) when barley silage was fed. In addition, A linear effect (P < 0.04) of peNDF content was observed for rumen total VFA concentration and proportion of propionate for cows fed corn silage based diet. However, this effect was not appeared for cows fed barley diet. The results suggest that manipulation of the peNDF content of the diet can improve feed digestion and rumen fermentation. However, the magnitude of the improvement depends upon forage source fed to dairy cows.

**Key Words:** Physically effective NDF, Forage source, Digestion

**W181 Increased concentrations of wet corn distillers grains in dairy cow diets. A. R. Hippen1, K. N. Linke1, K. F. Kalscheur1, D. J. Schingoethe1, and A. D. García1, South Dakota State University, Brookings.

Sixteen multiparous Holstein cows were used in a replicated 4 x 4 Latin square design to measure the effects of increasing wet corn distillers grains in dairy cow diets. The forage portion of the diets was constant and consisted of (DM basis) 30% corn silage and 15% grass hay. Wet corn distillers grains (WDG) was included at 10, 20, 30, or 40% of the diet DM. The WDG replaced soybean meal, soybean hulls, and animal fat as inclusion rates increased. All diets were balanced to provide (DM basis): 1.65 mcal NEL/kg, 18% CP, 22.8% forage NDF, 20.9% ADF, and 6.5% ether extract. Ruminally undegradable protein was estimated to be near the high end of recommended inclusion rates. Diet DM decreased (46.9, 43.9, 39.4, and 36.5% for 10, 20, 30, and 40% WDG, respectively) as diet WDG increased. Dry matter intakes decreased (P < 0.01) as diet WDG increased (22.9, 23.0, 19.4, and 17.2 kg/d). Milk production increased (27.3, 26.9, 25.0, and 25.5 kg/d; P < 0.05) in respect to diet WDG concentration. Concentrations of fat (2.80, 2.90, 2.80, and 2.72%), protein (3.45, 3.55, 3.57, and 3.52%), urea nitrogen (14.9, 15.4, 14.9, and 14.4 mg/dl), and lactose (4.78, 4.86, 4.80, and 4.78%) in milk did not change (P > 0.10) with diets; however, yields of milk fat (0.72, 0.72, 0.68, and 0.67 kg/d), lactose (1.28, 1.25, 1.20, and 1.18 kg/d), and urea nitrogen (41.4, 40.2, 38.9, and 35.7 g/d) were decreased (P < 0.05) by increasing diet WDG. Increasing WDG above 20% of dry matter in diets of lactating dairy cows decreased DMI and yield of milk and milk components.

**Key Words:** Wet corn distillers grains, Dairy cow, Lactation

**W182 Performance of lactating dairy cows fed wet corn gluten feed. G. D. Marx1, C. R. Dahlen1, A. DiConstantino2, T. L. Durham1, and R. T. Ethynals3, 1University of Minnesota, Crookston, 2University of Minnesota, St. Paul, 3ADM Corn Processing, Marshall, MN, 4Kansas Feeds, Inc., Dodge City, KS.

Sixty-nine lactating Holstein cows were used to determine the effects of dietary inclusion of wet corn gluten feed on milk production, component production, and DMI. The objective of the study was to determine the replacement value of CGF for corn grain and soybean meal. Cows were assigned to one of two treatments: 1) diet DM consisting of alfalfa haylage (25%), corn silage (25%), high moisture corn (32.5%), soybean meal (12%), sunflower seeds (3.2%), and a vitamin and mineral supplement; Control (n = 39) or 2) diet DM consisting of alfalfa haylage (25%), corn silage (25%), high moisture corn (20%), wet corn gluten feed (20%), soybean meal (8.5%), sunflower seeds (3.2%), and a vitamin and mineral supplement; CGF (n = 30). Cows were housed in an individual tie-stall barn. Feed was mixed in a truck-mounted TMR and delivered once daily. Milk production was measured daily and feed intakes and refusals were determined once weekly. Body weight and BCS were measured on d 8, 35, and 71 of the experiment. Cows were assigned to one of two dietary treatments based on body weight, BCS, milk production, DIM, and lactation number. Cows were adapted to their respective diet over a period of 14 d prior to the initiation of the 70d trial. General linear models of SAS were utilized to determine statistical significance of the data. Daily milk production, milk fat and milk protein for cows fed CGF were 38.34, 1.28 and 1.21 kg and control cows were 38.18, 1.29 and 1.21 kg. Milk production and milk components did not differ (P > 0.05) between treatments. Daily DMI was similar (P > 0.05) for both the CGF and control group with 22.65 and 22.04 kg. Average body weight gains during the experimental period for the CGF and control cows were 0.47 and 0.36 kg. Ending BCS of the CGF and control cows were similar with scores of 3.56 and 3.54. No unusual health conditions or nutritional disorders occurred with any of the cows. Results of this feeding trial indicate that the wet corn gluten feed was an acceptable component when fed at 20% of the ration dry matter for lactating dairy cows.

**Key Words:** Corn gluten feed, Lactating dairy cows, Byproduct feeding

**W183 Total antioxidant capacity: A tool for evaluating the nutritional status of dairy heifers and cows. P. Mandeubre1,2, J. B. Castillo1, D. J. Steckley1, and E. Evans1, 1Maple Leaf Foods Research Groupeau, Guelph, ON, Canada, 2W.H. Miner Agricultural Research Institute, Chazy, NY 12921, USA.

The nutritional status of dairy heifers and multiparous cows in Nova Scotia and Ontario was evaluated by measuring the total antioxidant capacity (TAC) of antioxidants in plasma relative to a synthetic vitamin E analogue. In Nova Scotia 4 heifers, 5 dry cows and 50 lactating cows were fed a TMR containing ingredients similar to the TMR fed in Nova Scotia for ad libitum intake throughout the year. Lactating cows had higher TAC levels compared to dry cows (P < 0.01). The TAC levels in cows were higher in Ontario compared to Nova Scotia (P < 0.001), and varied with seasons (P < 0.001). Animals fed different dietary regimes had different TAC levels, suggesting that TAC could be used as a tool to evaluate the nutritional status and to detect if different diets or dietary ingredients are being fed, or to evaluate the general nutritional status of animals throughout the year or season.

**Key Words:** Dairy heifers, Dairy cows, Vitamin E, Antioxidant capacity, Total antioxidant capacity.
W184  | Utilization of sugarbeet pulp and a high-sugar product for early lactation dairy cows. G. D. Marx1, C. R. Dahlen1, and A. C. Cox2, 1 University of Minnesota, Crookston, MN, 2 Malt-O-Meal Company, Northfield, MN.

In the first of two feeding trials, 40 early lactation primiparous and multiparous Holstein cows were assigned equally to either a diet containing 10% sugarbeet pulp (SP) or a control diet containing corn forage (CF) at equal ration nutrient and DM content. The second trial utilized 18 early lactation cows with three equal treatment groups including a control (C), cows fed 0.45 kg (S1) or 0.90 kg (S2) of a 24.9% sucrose breakfast cereal product. The objective of these studies was to determine the ration substitution value of these byproducts. Both trials were conducted using a 1 wk standardization period followed by a 12 wk experimental period. Total mixed rations were fed once daily and balanced to meet NRC requirements for high producing cows. All cows were kept in individual tie stalls and fed to appetite plus 1.8 kg adjusted daily according to intake. Daily DMI and feed refusal were measured on each individual cow. General linear models of SAS were used to determine statistical significance of the data. Daily milk production, milk fat and milk protein for cows fed SP were 40.9, 1.34 and 1.24 kg and cows fed CF were 42.1, 1.30 and 1.30 kg and resulted in no differences (P>0.05) between treatments. Peak milk was 47 kg for both SP and CF fed cows. Average daily DMI did not differ between treatments and were 23.8 and 25.1 kg for the SP and CF cows. Average body condition scores were similar for both the SP and CF treatments with scores of 3.22 and 3.35. Average daily BW gains of cows during the experimental period for both the SP and CF were 0.18 kg and 0.32 kg. In the second trial, average daily 4% FCM for the C, S1 and S2 treatment groups were 36.7, 34.6 and 34.4 kg. Milk production and milk components were not significant (P>0.05) between groups. Average daily DMI were similar (P>0.05) with 25.0, 24.3 and 24.2 kg for the C, S1 and S2 fed cows. No unusual health conditions or nutrient disorders occurred on either trial. These feeding trials indicate that 10% beet pulp in the diet can be substituted for calculation of MRT of DNDF overestimates MRT, due to the constant field. Energy utilization, Dairy cows, Forage:concentrate ratio

Key Words:  Total antioxidant capacity, Nutritional status, Dairy cows


The objective of this experiment was to evaluate effects of reducing corn silage particle size on eating behavior, chewing activity, and rumen fermentation in lactating dairy cows. Four cannulated, multiparous cows (110 ± 40 kg BW) were assigned to a 4 × 4 Latin Square. During each of four periods, animals were offered one of four diets that were chemically similar but varied in corn silage particle size: short (SH), mostly short (MSH), mostly long (MLG), and long (LG). Reducing particle size increased dry matter intake (DMI) linearly (28.0, 26.8, 26.8, 25.7 kg/d for SH, MSH, MLG, and LG respectively). At 8, 16 and 24 h post feeding, the NDF concentration of feed remaining in the bunk decreased linearly with reduced particle size. Time spent eating or ruminating was not different across treatments, however, total chewing activity (TC; sum of time spent eating and ruminating) exhibited a quadratic response with highest chewing activities observed for diets with shortest and longest particle size. Eating or ruminating time per kg of DMI was not affected by corn silage particle size, but TC per kg of DMI decreased linearly with decreasing particle size. In comparison, when expressed as minutes per unit of NDF intake (NDFI), eating, ruminating, and TC were linearly reduced as particle size decreased. Rumen pH was not affected by corn silage particle size even though total concentration of VFA increased linearly from 89.1 mM/L to 93.6 mM/L as diet particle size decreased. The same linear effect was observed for acetate and butyrate concentrations, but propionate exhibited a quadratic effect with the highest concentration observed in animals consuming the shortest ration. Milk yield and protein were similar across diets and averaged 41.6 kg and 2.8%. However, 3.5% FCM showed a quadratic response, with highest production observed on MSH and MLG treatments. Results of this experiment suggest that reducing corn silage particle size may increase DMI, positively affect rumen fermentation, and reduce sorting behavior. Particle size measurement is useful in understanding some factors that affect feeding behavior and rumen fermentation of high producing dairy cows. Energy utilization, Dairy cows, Forage:concentrate ratio

Key Words: Effect of forage to concentrate ratio on the efficiency of utilization of energy for milk production in dairy cows. E. Kebrab1, J. France1, J.A.N. Mills2, L. A. Crompton1, R. A. E. Agnew2, and T. Yan3, 1 The University of Reading, Reading, United Kingdom, 2 The Agricultural Research Institute of Northern Ireland, Hillsborough, United Kingdom.

The objective of the study was to investigate the effect of quantity of concentrate in dairy cow diets on the efficiency of utilization of metabolizable energy intake (MEI) for milk production ($k_1$). A database containing 652 dairy cow observations was assembled from calorimetry studies in the UK. The dataset was subdivided into four sets containing diets with a forage:concentrate ratio of 0.10 to 0.39 (FC1), 0.40 to 0.74 (FC2), 0.75 to 0.99 (FC3) and 1.0 (all forage, FC4). The following equation was fitted to the dataset:

$$E_2 = a + b \times \frac{[MEI - (T_0/k_2)] - (T_1 \times k_2) + c,}$$

where $E_2$ is milk energy (MJ/kg W$^0.75$/d), $a$ is the intercept and $b$ is $k_1$, $T_0$ and $T_1$ (both in MJ/kg W$^0.75$/d) are tissue energy gain and loss respectively, $k_2$, and $k_3$ are the efficiencies of utilization of energy for growth and body stores for milk production respectively, and $c$ is an error term. Meta-analysis of the data using a nonlinear mixed model procedure estimated the values of $k_2$, and $k_3$ to be 0.84 and 0.66 respectively, which were significantly different from previous reports of 0.6 for $k_2$ and 0.84 for $k_3$. The value of $k_1$ was estimated to be 0.60 (SE 0.0054), 0.59 (SE 0.0069), 0.60 (SE 0.0018) and 0.40 (SE 0.051) for FC1, FC2, FC3 and FC4 subsets, respectively. There was no significant difference in the estimate of $k_1$ among forage:concentrate ratios of 0.1 to 0.99 (FC1, FC2, FC3 and FC4). However, there was a very significant difference in $k_1$ when compared to cows fed diets containing forage only. It appears that dietary energy consumption is converted to milk energy with an average efficiency of about 60% in cows consuming diets containing concentrates but in cows fed concentrate free diets, the efficiency decreased by about 40%.

Key Words: Energy utilization, Dairy cows, Forage:concentrate ratio

W187  | Estimation of mean ruminal retention time of DNDF in dairy cows based on combined data from rumen evacuations and marker excretion curves. P. Lund*, M. R. Weisbjerg, and T. Hvelplund, Danish Institute of Agricultural Sciences, Denmark.

Mean retention time (MRT) of digestible neutral detergent fiber (DNDF) has been determined in vivo in fistulated Holstein dairy cows, based on the ratio between rumen pool size determined using rumen evacuations and rumen output. However, uncritical use of this method for calculation of MRT of DNDF overestimates MRT, due to the constant digestion and passage, as the one compartment model does not account for selective retention. We propose that MRT of DNDF can be calculated as $\text{MRT}_{COR}$ by solving the equation: $(k_p \times k_v \times y)^{-1} = \text{MRT}_{COR} + k_p \times \text{MRT}_{COR} \cdot 1 - 0$, based on an equation by Allen & Mertens (1988), and where fractional rates of digestion ($k_p$) and passage ($k_v$) of DNDF are obtained using the rumen evacuation method, and the distribution of $\text{MRT}_{COR}$ between the first ($y$) and the second
compartment (1−y), y(0;1), can be estimated from duodenal excretion curves of ytterbium and MRT of INDF. MRT and MRT\textsubscript{COR} of DNDF were evaluated in four 4x4 latin square experiments. Two hay [grass (GH) and alfalfa (AH)] and six silages [early cut grass (ECGS), late cut grass (LCGS), whole crop barley (WCB), corn (CS), whole crop pea (WCP), and clover/grass (CGS)] were fed ad libitum to dry cows or cows in late lactation as the only feed (Unsuppl.), or supplemented with concentrate (5.8 kg DM/day) high in starch and low in NDF and fed to cows in early or mid-lactation (Suppl.). DNDF was determined from 21 d rumen in situ incubations. MRT\textsubscript{COR} varied from 59 h for CS (Unsuppl.) to 129 h for EGS (Unsuppl.). MRT estimated from the rumen evacuation method was overestimated with on average 46 h, equal to 47% compared to MRT\textsubscript{COR}. MRT\textsubscript{COR} for DNDF was on average 29 h higher than MRT for INDF, indicating a selective retention.

Key Words: Kinetics, NDF, Selective retention


The goal of this trial was to compare the DMI and NDF rumen fill, directly measured of fistulated crossbred cows, with milk production averaging 13.5 kg, with the results estimated by different equations based on elephantgrass rumen degradation parameters. The experimental design was a Latin Square (3 x 3), with three cows, three periods and three treatments (chopped elephant grass harvested at 30, 45 and 60 days, offered ad libitum). The Latin Square was repeated three times over time. Within each treatment a split-plot design included four schedules of ruminal evacuation: 0, 2, 4 and 6 hours after feeding. Daily DMI were measured in a Calan Gates system by the difference between offered and refused feed. The different equations based on in situ degradation parameters were: DMI = −1.19 + 0.035 (a+b) + 28.5e(1), DMI = [%FDF]*[NDF]/[(1-a-b)/Kp+b+e/c+kp]/24(2), DMI = −0.822+0.0748(a+b)+40.7e(3) and DMI=([%FDF]*[consumption of FDF]/[(1-a-b)/Kp+b+e/c+kp]/24)/([FR]x100) (using directly measured values(4)). The equations overestimated the average DMI obtained directly (9.0 kg/cow/day) in Calan-Gates, except the equation (3) that underestimated (7.7 kg/cow/day). The mean elephantgrass DMI of 13.7 and 13.4 kg/cow/day obtained, respectively, in the equations (1) and (2) were similar (P>0.05) and both are higher (P<0.05) than the 9.7 kg/cow/day obtained in the equation (4). The values measured directly in Calan-Gates (9.0 kg/cow/day) were similar (P>0.05) to the 9.7 kg/cow/day obtained by the equation (4) and higher (P<0.05) than the 7.7 kg/cow/day obtained by the equation (3). The average NDF rumen fill (7.5 kg) was higher (P<0.05) than the mean value (5.2 kg) estimated by the equation (2). The prediction equations based on rumen degradation characteristics were not efficient in the DMI and NDF rumen fill estimations of chopped elephantgrass harvested with 30, 45 and 60 days of age.

Key Words: Elephant grass, Prediction equations, Rumen fill


Fifteen Holstein bull calves were fed 0, 6, or 12 g/d of amylase (Amaize, Altech Inc.) in calf feed to compare rumen development from birth to 5 weeks of age. Calves received milk replacer (20% all-milk protein, 20% fat) reconstituted to 12.5% dry matter twice daily at 10% of arrival body weight/d. Calf starter and water were fed once a day on an ad-lib basis. Body weight, heart girth, withers height, and hip width were measured at birth and weekly thereafter at 4 h post a.m. feeding. Fecal and health scores were monitored daily. Blood samples were taken at each weekly weighing via jugular venipuncture and analyzed for hematocrit and beta-hydroxybutyrate. Calves were euthanized at 35 d of age, and GI tracts and rumens were harvested. Papillae length, width, papillae per cm\textsuperscript{2}, and rumen wall thickness were measured in 9 regions to quantify development in the entire reticulorumen. Regions sampled included: caudal portion of the caudal ventral blind sac, right and left caudal dorsal blind sac, right and left cranial ventral sac, and right and left caudal ventral blind sac. Milk and grain intake were similar for all treatments. Papillae length was greater (P<0.05) for the 6 g treatment in 4 areas when compared to the 0 g treatment and one area compared to control. Papillae width was greater (P<0.05) in 6 areas for the 6 g group compared to the control and greater in 4 areas compared to the 12 g treatment. Papillae length and width were similar in all regions for the 12 g group and control. Number of papillae per cm\textsuperscript{2} was greater (P<0.05) for the 6 g treatment than the control in 3 regions. More papillae per cm\textsuperscript{2} were observed for the 12 g treatment compared to the 6 g treatment in 2 regions; the 12 g treatment also had more papillae per cm\textsuperscript{2} than the control in 2 regions. Rumen wall thickness and blood beta-hydroxybutyrate were not affected by treatment. All animal growth measurements were similar for all treatments. When fed at 6 g/calf per d, amylase appeared to be beneficial in increasing rumen papillae length and width in 5-wk-old dairy calves. Results of feed higher levels of amylase generally were not different from controls, except in papillae counts.

Key Words: Calves, Rumen development, Amylase

W190 Grain processing, forage:concentrate, and forage length effects on ruminal N degradation and flows of amino acids to duodenum in lactating dairy cows. W. Z. Yang1, K. A. Beauchemin1, and L. M. Rodé1.1 Agriculture and Agri-Food Canada, Lethbridge, Canada, 2Rosebud Technologies Development, Ltd. Lethbridge, Canada.

The objectives of this study were to evaluate effects of dietary factors on rumen N degradation, microbial protein synthesis and amino acid (AA) flows to the duodenum. The objectives were to evaluate the effects of ruminal N intake (NI) on AA flows to the duodenum, simultaneously. The trial was designed with 4 dietary factors (NI) in a 2x2 factorial arrangement of treatments. The dietary factors were extent of barley grain processing, coarse (processing index PI=75.5%) or flat (PI=60.2%); forage to concentrate (F:C) ratio, low (35:65) or high (55:45); and forage length (FPL), long (7.59 mm) or short (6.08 mm). Eight lactating cows with ruminal and duodenal cannulas were offered ad libitum access to a TMR. Passage of microbial protein to the duodenum was improved (P<0.09) with increased F:C of the diet but was not affected by grain processing or FPL. Ruminal digestibility of N was increased (P<0.04) by 21 or 16% with increased F:C or reduced FPL, respectively. Increased grain processing enhanced (P<0.08) duodenal flows of AA from 2.0 to 2.3 kg/d. In contrast, reducing FPL tended to lower (P<0.15) flows of AA to the duodenum. Increased F:C of the diet did not change flow of total AA (2.2 kg/d), but there was a reduced (P<0.05) flow of dietary AA (0.90 vs 0.60 kg/d) and increased (P<0.05) flow of microbial AA (1.27 vs 1.55 kg/d). An interaction between grain processing and FPL was detected for flows of AA. Diets formulated with flatter rolled barley plus long FPL consistently increased (P<0.05) Arg, His, Thr, Asp, Glu, Ser, Tyr, total, EAA and NEAA by more than 40% compared to other combinations of grain processing and FPL. The results indicate that manipulation of dairy cow diets can improve ruminal N degradation and flows of AA to duodenum. Combining dietary factors can be more beneficial than changing individual dietary factors for improving the delivery of AA to the small intestine.

Key Words: Grain processing, Forage particle length, Amino acid flow

Eight lactating cows with ruminal and duodenal cannulas were used in a study designed as a double 4 x 4 Quasi-Latin square with a 2^2 factorial arrangement of treatments to examine effects of dietary factors on digestibility of amino acids (AA) in the intestine. The dietary factors were extent of barley grain processing, coarse (processing index [PI]=75.5%) or flat (PI=60.2%); forage to concentrate (F:C) ratio, low (35:65) or high (55:45); and forage particle length (FPL), long (7.59 mm) or short (6.08 mm). Cows were offered ad libitum access to a TMR. Increased grain processing improved (P<0.05) N digestibility both in the intestine (15%) and in the total tract (8%). Reduction in the FPL of the diets reduced (P<0.05) intestinal N digestion by 14% without affecting the N digestion in the total tract. Digestibility of essential AA in the intestine (68%) was higher (P<0.05) than that of nonessential AA (63%) but digestibility of total AA (65%) was similar to that of total N (66%), confirming that intestinal N digestibility is a good predictor of total AA digestibility in the intestine. Digestibilities of individual AA in the intestine ranged from 46 to 77%, and were improved (P<0.05) with increasing grain processing. However, effects of F:C or FPL on digestion of AA were limited. Similarly, amount of AA absorbed in the intestine (range of 1.25 to 1.59 kg/d) was increased (P<0.03) with increasing grain processing. The magnitude of increase (27%) in the amount of absorbed AA was much higher than the increase (6%) in digestibility, indicating that actual quantity of AA absorbed depends largely on the amounts entering the duodenum. Dietary treatments resulted in no differences in the ranking of limiting AA relative to milk protein synthesis. The results indicate that manipulation of dairy cow diets, especially grain processing, can significantly improve AA availability in the intestine.

Key Words: Grain processing, Forage length, Amino acid digestion

W192 Chemical composition of sugar cane varieties (Saccharum spp l.) with different cycles of production in three cut time. A. Fernandes*, A. Queiroz*, L. Cabral3, E. Pereira3, and A. Arruda3, Universidade Estadual do Norte Fluminense, 2Universidade Federal de Viçosa, 3Universidade Estadual do Oeste do Paraná, 4Universidade Estadual do Oeste do Paraná.

The objectives of this work were to determine the chemical composition, the potentialy degradable fraction of NDF (B2) and undegradable fraction (C) and to estimate the ruminal fill of sugar cane with different cycles of production (early and intermediate), in three cut times (426, 487 and 549 days). The laboratorial analysis consisted in dry matter (DM), organic matter, ash, crude protein (CP), ether extract, lignin, neutral detergent fiber (NDF), neutral detergent fiber corrected for ash and protein, acid detergent fiber (ADF), neutral detergent insoluble protein, acid detergent insoluble protein and neutral detergent soluble protein. The TDN was calculated by chemical composition. The degradable and undegradable fractions, and fiber digestion rate, as well as the ruminal fill were estimated by kinetic parameters obtained through in situ incubation. The advanced cut time increased the DM in 9.5 percentage.

The intermediate varieties presented higher TDN than early varieties, which had the highest contents of NDF and ADF, whose respective values were 487.56 and 471.03, and 287.87 and 247.54 g/kg DM for the early and intermediate varieties, respectively. The TDN increased linearly with the cut time, varying from 62.45 to 63.50 percentage however the NDF and ADF contents presented quadratic behavior. The early varieties presented higher content of CP than the intermediate only in the cut time of 549 days; contrarily, the brix of the sugar cane was superior to the intermediate varieties in the last cut. The early varieties presented larger total ruminal fill and lower fiber digestion rate. The degradable fraction of the fiber was reduced and the undegradable fraction was linearly increased with the age of the plants.

Key Words: Carbohydrate, Sugar cane, Ruminal degradation


Nutrient analysis data from three conserved forages: corn silage; alfalfa silage; and alfalfa hay were used to determine the statistical properties of the nutrients within each forage. The data was collected from a commercial feed analysis laboratory in the northeast of the US. Distributions of 16 nutrients were studied: these nutrients were dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), lignin, ash, non-structural carbohydrates (NSC), calcium, phosphorous, magnesium, potassium, iron, manganese, zinc, and copper. The nutrient distributions were analyzed for higher order statistical properties, including skewness and kurtosis. These properties indicate whether the nutrients are distributed normally. Of the 48 nutrients examined, all showed statistically significant deviations from the normal distribution. Correlation analysis also showed that many nutrients exhibited strong relationships with others within the same feed. In conclusion the results suggest that the assumption of normally distributed nutrients, within the feeds examined, does not hold. This may have important implications for livestock producers, ration formulators and researchers when they attempt to provide rations that are of consistent quality to achieve the goals of the livestock business, or to quantify or qualify the response of animals to a particular nutrient or nutrition program.

Key Words: forages, nutrient composition, normality


Objectives were to determine the effects of a LYP on performance and patterns of antibiotic resistance in fecal Escherichia coli in dairy calves. Forty-eight Holstein calves, 6 d of age with serum total protein (STP) below 5.2 g/dl and IgG below 1.5 g/dl, were blocked by body weight (BW) and STP and randomly assigned to one of four treatments: 1. no added LYP (Control); 2. LYP added to the starter grain (LYG); Saccharomyces cerevisiae; Levucell SC); 3. LYP added to the milk replacer (LYMR; S. cerevisiae; spb boulardii; Levucell SB); and 4. LYP added to the starter grain and to the milk replacer (LYGMR). Calves were offered 440 g of milk replacer DM containing 20% CP and 20% fat for the first 42 d of study and grain (18.1% CP and 3.1 Mcal of ME/kg) for ad libitum intake. Calves were weighed every 2 wk during 84-d study. Blood was sampled weekly for analyses of concentrations of glucose and -hydroxybutyrate. A fecal swab was collected from every calf every 2 wk for isolation of E. coli and determination of antibiotic resistance patterns. Continuous, binomial, and count data were analyzed using the MIXED, LOGISTIC, and GENMOD procedures of SAS (2001), respectively. Grain intakes (g/d) tended to be higher (P=0.07) for calves fed LYP prior to and after weaning and they were, respectively, 438 and 2184 for Controls, 682 and 2576 for LYG, 611 and 2579 for LYM, and 500 and 2400 for LYGMR. Feeding LYP improved BW gain prior to weaning (298 vs 420 g/d; P=0.04), but not after weaning (907 vs 996 g/d; P=0.27). Feed efficiency (DM intake/BW change) was unaffected by treatment (P=0.40). Plasma glucose was higher for calves fed LYP than controls (74.3 vs 78.9 mg/dl; P=0.02). Number of days with diarrhea prior to weaning tended to be lower for calves fed LYP compared to controls (5.8 vs 4.4; P=0.06). Patterns of antibiotic resistance in E. coli were affected by age of calves, but not by treatment. Addition of a LYP to the diet of calves with failure of passive transfer has the potential to improve animal performance by increasing feed intake and decreasing days with diarrhea.

Key Words: Yeast, Calves, Antibiotic resistance

W195 Effect of age on ruminal fermentation in growing calves fed high concentrate diets with two levels of NDF. A. Rotger, A. Ferret*, S. Calsamiglia, and X. Manteca, Universitat Autonoma de Barcelona.

There is limited information on rumen development in calves from weaning to 255 kg BW on ruminal fermentation profile (VFA, ammonia nitrogen concentration, pH and ruminal passage rate). Six female Holstein calves (initial BW 81.1 3.2 kg) fitted with ruminal cannula were used...
to describe the changes in the rumen fermentation profile during the growth period. Animals were offered ad libitum one of two TMR diets (15% CP; 2.75 Mcal ME/kg DM). The diets differed in the forage to concentrate ratio (11 to 89 vs. 30 to 70) and the NDF level (19% vs. 28%). A repeated measure trial with three experimental periods at 85, 155 and 258 kg of BW was conducted. Data were analyzed using the PROC MIXED procedure of SAS for a completely randomized design. The model contained effects of diet, period and their interaction. Animal was the random effect and period the repeated factor. Intake of DM increased with age and no differences were observed in the intake of DM, OM, CP and NDF between treatments even when the offered diets were different in the NDF content, suggesting that animals selected feed ingredients. Diet and age had no significant effect on average ruminal pH (6.36 ± 0.16) or on the time pH was below 5.8 (5.1 ± 3.8 h). Ammonia nitrogen concentration was lower in the high fiber diet (5.5 vs.13.1; P < 0.05). Diet had no effect on total and individual VFA concentrations. Total VFA concentration (P < 0.05) and molar percentage of propionic acid (P < 0.01) increased with age. Molar percentage of acetic acid (P < 0.05) and the acetic to propionic ratio (P < 0.01) decreased with age. Solid passage rate, estimated with chromium, was not affected by diet or age (0.063 ± 0.0033/h). Liquid passage rate, estimated with Co-EDTA, increased with age (P < 0.05) and was higher in the high NDF diet. Overall, ruminal fermentation seemed to increase with age presenting no problems of acidosis. The lack of significant differences between diets could be explained by no differences in nutrient intake.

**Key Words:** Age, Calves, Ruminal fermentation

**W196** Effect of age on in situ degradation kinetics of plant protein supplements in growing calves fed high concentrate diets with two levels of NDF. A. Rotger, A. Ferret*, S. Calsamiglia, and X. Manteca, *Universitat Automa de Barcelona.*

Six female Holstein calves (initial body weight 81.1 ± 3.25 kg) fitted with ruminal cannula were used to study the effect of age and NDF intake on degradation kinetics of plant protein supplements. Animals were offered one of two TMR (15% CP; 2.75 Mcal ME/kg DM) ad libitum. The two diets differed in the forage to concentrate ratio (11 to 89 vs. 30 to 70) and the NDF level (19% vs. 28%). Three experimental periods were conducted at 85, 155 and 258 kg of BW in this repeated measure trial. Degradation kinetics of CP of four protein supplements (peas, soybean meal, lupin seeds and sunflower meal) and degradation kinetics of NDF of alfalfa hay were estimated with in situ incubations. A fractional passage rate of 0.06 /h was used to estimate ruminal degradability. Data were analyzed using the PROC MIXED procedure of SAS for a completely randomized design. The model contained fixed effects of diet, period and their interaction. Animal was the random effect and period the repeated factor. Intake of DM increased with age. There were no differences in the intake of DM, OM, CP and NDF between treatments even the differences in the offered rations, suggesting that animals selected feed ingredients. Degradation of CP increased with age (P < 0.01) in sunflower meal and tended to increase in peas and lupin seeds (P < 0.10). Degradability of CP in lupin seeds (P < 0.01) and NDF in alfalfa hay (P < 0.05) was higher in the high NDF diet. Age and diet had no significant effect on the soluble or potentially degradable fraction of any protein supplement. The fractional rate of degradation increased with age (P < 0.10) in all plant protein supplements except for soybean meal. In general, protein degradability and the fractional rate of degradation increased with age suggesting an increase in the fermentative potential of the rumen. The similar nutrient intake between diets may be responsible for the lack of diet effect on CP degradation in most supplements.

**Key Words:** Age, Calves, CP degradation

**W197** Effect of substitution of a corn-canaloa meal blend by cull chickpeas on apparent digestibility of diets for sheep. J. F. Orobeon*, R. Barajas, and A. Estrada, *FMVZ-Universidad Automa de Sinaloa (México).*

To determine the effect of substitution of a corn-canaloa meal blend by cull chickpeas on apparent digestibility of diets for sheep, a digestibility experiment was conducted. Four Pelibuey sheep, males (BW=25±0.79 kg) were used in a cross over design experiment. The animals were placed individually in metabolic crates (0.6 x 1.2 m), and were randomly assigned to consume one of two diets in that consists the treatments: Treatment 1) Diet 14.77 % of CP and 3.36 Mcal of DE/kg, containing (DM basis), ground corn 55 %, canola meal 12 %, sudan grass hay 18 %, sugarcane molasses 12 %, urea 0.8 %, limestone 1.2 %, and mineral premix 1 % (control); and Treatment 2) Diet 14.88 % CP and 3.47 Mcal DE/kg, containing ground corn 28 %, cull chickpeas 39 %, sudan grass hay 18 %, sugarcane molasses 12 %, urea 0.8 %, limestone 1.2 %, and mineral premix 1 % (control). Diets were offered twice a day (0800 and 1600 h), after six days of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. Samples were dried, and weighed. DM and CP analyses were performed, and apparent digestibility was calculated. The inclusion of cull chickpeas not affected (P>0.10) dry matter digestibility of the diet with values of 77.5 % vs. 77.1 % for control and chickpeas diet, respectively. The digestibility of crude protein was similar between treatments (3.31 vs. 3.30 Mcal/kg), as consequence of that, the DE content of cull chickpeas was estimate to be proximate to 3.66 Mcal/kg, that is the calculate DE value for the 31:69 corn-canaloa meal blend that was substituted by cull chickpeas in the diet. It is concluded, that cull chickpeas can be include up to 40 % in sheep diets substituting usual ingredients as corn or canola meal, and that its DE content is close to 3.66 Mcal/kg.

**Key Words:** Cull chickpeas, Canola meal, Digestibility


Fermentation characteristics, consumption and apparent digestibility of apple pomace (AP) ensiled with different levels of wheat straw (WS) were studied using 12 Awassi rams averaging 56 kg BW. The study was conducted for a 4 wk trial with 1 wk collection period. The experimental treatments were: 1) 100% AP silage (APS), 2) 100% barley silage (BS) as control, III) 70% APS + 30% WS and IV) 60% APS + 40% WS. In addition to ad libitum silage feeding, each lamb received 0.8 kg concentrate (14% CP on DM basis) per day. Changes in temperature of ensiled AP (treatments I, III, IV) were not significantly different (P > 0.05) at 7, 14, 21, and 28 d of ensiling. The molar percentage of acetic acid (P < 0.05) was higher in the high NDF diet. Age and the NDF level (19% vs. 28%) had no significant effect on the soluble or potentially degradable fraction of any protein supplement. The fractional rate of degradation increased with age (P < 0.10) in all plant protein supplements except for soybean meal. In general, protein degradability and the fractional rate of degradation increased with age suggesting an increase in the fermentative potential of the rumen. The similar nutrient intake between diets may be responsible for the lack of diet effect on CP degradation in most supplements.

**Key Words:** Age, Calves, Ruminal fermentation

**W199** Effect of substitution of alfalfa hay by hay from long time stored mature Clitoria ternatea on apparent digestibility of diets for growing sheep. A. Estrada*, R. Barajas, and J. F. Orobeon, *FMVZ-Universidad Automa de Sinaloa (México).*

With the objective of determining the effect of substitution of alfalfa hay by hay from long time stored mature Clitoria ternatea on apparent digestibility of diets for growing sheep, a digestibility experiment by total fecal collection was conducted. Four Pelibuey sheep, males (BW=12.37 kg) were used in a cross over design experiment. The animals were placed individually in metabolic crates (0.6 x 1.2 m), and randomly were assigned to consume one of two diets in that consists the treatments: 1) Diet 18.3% of CP and 3.015 Mcal of DE/kg, containing (DM basis), alfalfa hay 50%, ground corn 27.8%, soybean meal 9.3%, mineral premix 1.15% (control); and 2) Diet similar to control, but containing 30% APS + 70% WS. The study was conducted for a 4 wk trial with 1 wk collection period. The experimental treatments were: I) 100% APS silage (APS), II) 100% barley silage (BS) as control, III) 70% APS + 30% WS and IV) 60% APS + 40% WS. In addition to ad libitum silage feeding, each lamb received 0.8 kg concentrate (14% CP on DM basis) per day. Changes in temperature of ensiled AP (treatments I, III, IV) were not significantly different (P > 0.05) at 7, 14, 21, and 28 d of ensiling. The molar percentage of acetic acid (P < 0.05) was higher in the high NDF diet. Age and the NDF level (19% vs. 28%) had no significant effect on the soluble or potentially degradable fraction of any protein supplement. The fractional rate of degradation increased with age (P < 0.10) in all plant protein supplements except for soybean meal. In general, protein degradability and the fractional rate of degradation increased with age suggesting an increase in the fermentative potential of the rumen. The similar nutrient intake between diets may be responsible for the lack of diet effect on CP degradation in most supplements.
the control diet. Diets were offered twice a day (800 and 1600 h), after six day of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. Samples were dried, and weighed. DM and CP analyses were performed, and apparent digestibility was calculated. Clitoria hay diminished (P<0.02) in 14.9% the dry matter digestibility of alfalfa hay, with values of 63.4% and 74.1% for clitoria hay and alfalfa hay diets, respectively. Crude protein digestibility, tended (P=0.06) to be 6% lower in the clitoria hay diet than alfalfa hay diet (73.1% vs. 78.0%). The DE content of the diet was decreased (P<0.05) in 14.9% by inclusion of clitoria hay (2.692 vs. 3.164 Mcal/kg). The observed/expected DE of the diet was lower (P<0.05) in clitoria hay diet (0.89) than in alfalfa hay diet (1.05). The digestibility of DM of clitoria was calculated to be 21% lower than alfalfa DM digestibility. The CP of clitoria was 10% less digestible than alfalfa CP, and the DE content of the mature clitoria was calculate to be near of 2.2 Mcal/kg. It is concluded, than Clitoria ternatea harvested after bloom is not a good substitute of alfalfa in diets for growing sheep.

Key Words: Clitoria ternatea, Alfalfa hay, Digestibility

W200 Effect of substitution of alfalfa hay by clitoria hay (Clitoria ternatea L.) on performance of sheep feed growing diets. A. Estrada*, R. Barajas, and J. F. Obregon, FMVZ Universidad Autonoma de Sinaloa (Mexico)

To determine the effect of substitution of alfalfa hay by clitoria hay (Clitoria ternatea L.) on performance of sheep fed growing diets, a 28 days growth performance experiment was conducted. Twenty-four Pelibuey sheep, male (initial BW=15.23 kg) were used in a complete randomized block design experiment. The animals were weighed and grouped by weight. Five kg subsamples of the yards were allocated as one of eight pens, one pen (2x3 m), fitted with metal feed bunks (1x0.33 m) and drinkers. The pens inside of blocks were randomly assigned one of two diets in that consists the treatments: 1) Diet 18.3% of CP and 0.15 Mcal of DE/kg, containing (DM basis), alfalfa hay 50% (18.01% CP), ground corn 27.8%, soybean meal 7.95%, sugar cane molasses 9.58%, urea 0.54%, limestone 1.15%, and mineral premix 1.15% (control); and 2) Diet as control, but containing 50% of clitoria hay (19.09% CP). The sheep were weighed at day 1 and 28 of experiment, DM intake was recorded daily. The mean final weight of experiment was 20.77 kg and was not altered (P=0.58) by roughage source in diets. Dry Matter intake was not affected (P=0.67) by treatments with values of 0.876 and 0.884 kg/day for alfalfa and clitoria diets, respectively. There are no differences (P=0.98) in the dry matter intake/ADG ratio, with values of 4.45 and 4.24 kg/kg for alfalfa hay and clitoria hay diets respectively. It is concluded that clitoria hay can be included up to 50% in the diets of growing sheep substituting alfalfa hay without detrimental effect on performance.

Key Words: Clitoria ternatea, Alfalfa hay, sheep

W201 Ruminal degradation of dry matter of sudan grass hay grew in a subtropical weather, harvested at two ages in rumen of sheep using nylon bag technique. R. Barajas*, J. F. Obregon, and A. Estrada*, 1FMVZ Universidad Autonoma de Sinaloa (Mexico).

With the objective of determining the ruminal degradation of dry matter of sudan grass hay grew in a subtropical weather, harvested at two ages in rumin of sheep using nylon bag technique, four sheep (Pelibuey, males BW=34 kg) fitted with ruminal cannula were used. The animals were individually placed in concrete flour pens (1.5x2 m), and fed twice a day (800 and 1600 h) with a 37:63 roughage:concentrate diet. Nylon bags (10x18 cm) containing 5 g of sudan grass hay harvested 60 days after homogenization cut (SGH-60), or sudan grass hay harvested 90 days after homogenization cut (SGH-90), in agreement with a complete randomly experimental design, were randomly assigned to be incubated in rumen of sheep during 24, 48, and 72 hours. Once complete the incubation time, the bags were washed with tap water, dried, and DM was determined. Solubility was measured by five minutes immersion of bags in a 0.15 N solution of NaCl at 39 Celsius degrees. The solubility of DM of SGH-60 was higher (P<0.05) than SGH-90 (10.6 % vs. 8.5 %). Rumen degradability of DM from SGH-60 at 24 h incubation time was higher (P<0.05) than the correspondent to SGH-90 (40.3 % vs. 30.1 %). At 48 h incubation time, the digestibility of DM from SGH-60 suppers (P<0.05) to DM ruminal degradability of DM of SGH-90 (44.1 % vs. 39.7 %). After 72 h of incubation in rumen, the degradability of DM of SGH-60 continued be higher (P<0.05) than DM of SGH-90 (47.4 % vs. 44.1 %). It is concluded, that sudan grass grew in a subtropical weather, needs be harvested near of 60 days after previous cutting, to prevent loosing of its nutritional value as roughage for ruminants.

Key Words: Sudan grass, Sheep, Rumen degradability

W202 Effect of substitution of sesame meal by cotton seed meal on apparent digestibility of diets for sheep. R. Barajas*, J. F. Obregon, and J. J. Portillo, FMVZ Universidad Autonoma de Sinaloa (Mexico).

With the objective of determining the effect of substitution of cotton seed meal by sesame meal on apparent digestibility in diets for sheep, a digestibility experiment was conducted. Four Pelibuey sheep, males (BW=21.25±1.95 kg) were used in a cross over design experiment. The animals were placed individually in metabolic crates (0.6x1.2 m), and were randomly assigned to consume one of two diets in that consists the treatments: 1) Diet 19.6 % of CP and 3.106 Mcal of DE/kg, containing (DM basis), cotton seed meal 29.7 %, ground corn 37.3 %, sudan grass hay 19.6 %, sugar cane molasses 10.7 %, urea 0.54 %, limestone 1.1 %, and mineral premix 1.1 % (control); or 2) Diet similar to control, but containing 29.7 % of sesame meal as substitue of cotton seed meal. Diets were offered twice a day (800 and 1600 h), after six days of adaptation period, samples of diets (1 kg) and the total of feces produced were collected during four continuous days. Samples were dried and weighed. DM and CP were performed, and apparent digestibility was calculated. Dry matter digestibility was not affected (P>0.10) by treatments with values of 69.2 % and 69.6 % for cotton seed meal and sesame meal diets, respectively. The apparent CP digestibility of the diets containing sesame meal was higher (P<0.05) than CSM diet (73.1 vs. 68.5 %). The digestible energy content of diets was not affected by treatments (P>0.10), as consequence of that DE of sesame meal was estimate to be near of 3.13 Mcal/kg, that is the value attributed to cotton seed meal, ingredient that was substitute by sesame meal. It is concluded, that sesame meal can be a substitute of cotton seed meal as protein source in the diets for sheep, without affect negatively the nutritional value of the diet.

Key Words: Sesame meal, Cotton seed meal digestibility, Sheep


Direct fed microbials based on the fermentation of Aspergillus oryzae (AO) have been used as feed supplements for cattle but with inconsistent results. To improve the consistency of animal response, the mechanism of action needs to be understood. Therefore, we measured the effects of AO extract in powder or liquid form in both stationary and stirred cultures of a rumen fungus, Neocallimastix frontalis EB 188 (ATCCC #76100). Cultures were periodically sampled and assayed for extracellular and intracellular protein and enzymes, gas production, zoospore production and maturation, and carbon source utilization. Mobile zoospores matured into germination entities more rapidly (e.g., 3 hours) in treated cultures, and when powdered product was used, 38% (P<0.05) more motile zoospores were produced by 50 h of fungal growth. Furthermore, by 110 h of growth 97% (P<0.01) more germinated zoospores were found in treated cultures than in controls. Levels of intracellular zoospore malate dehydrogenase and lactate dehydrogenase were increased in treated cultures by 6.4-fold (P<0.01) and 2.7-fold (P<0.05), respectively. The wheat bran used as carrier for the product and tested as either soluble extract or powder had little effect on fungal cultures. Soluble extract increased fungal physiology and treated cultures produced significantly (at least P<0.05) higher levels of secreted enzymes including amylase (213%), CMCase (22%) and β-glucosidase (34%). Culture gas production was higher (P<0.04) at 48 and 66 h of growth in extract treated cultures but not thereafter. Culture utilization of glucose increased by 37% (P<0.05) in treated cultures yet higher levels of extract (e.g., 5 times recommended) inhibited glucose utilization. AO fermentation extract effects the physiology of
W204 Effects of Aspergillus oryzae fermentation extract on growth, enzyme production, and carbon source utilization of rumen bacteria grown separately and in co-culture with and without rumen fungi. S. Albright, G. Calza, and R. Calza*. Washington State University, Pullman.

Soluble components of Aspergillus oryzae (AO) were tested in vitro using rumen bacteria and a fungus in single and mixed cultures. Bacteria (from ATCC or Rowett Research Institute (RRI) and rumen fungus, Neocallimastix frontalis EB188 (ATCC #76100), were grown and periodically assayed for protein and enzymes, culture gas production and carbon source utilization, growth rate, and cellular size. Extract of AO had no effect on the growth rate of monocultures of Prevotella ruminicola GA 33 (Pr) (RRI), significantly (P ≤ 0.05) increased the initial (up to 4 h) growth rate of Succinivibrio amylolyticus B24 (Sa) (RRI), increased (P ≤ 0.01) the growth rate of Selenomonas ruminantium NADL GA-192 (Ss) (RRI) throughout the 10 h experiment, and significantly decreased (P ≤ 0.02) the growth rates of Succinibiotrucha dextrinosolvens 6554 (Sd) (RRI) and Eubacterium cellulosolvens 6 (Ec) (RRI). Measurements of cell size using FACS suggested Fibrobacter succinogenes (Fs) (ATCC #19169), and Ruminococcus albus (Ra) (ATCC #27210) grown in the presence of extract tended (P ≤ 0.1) to be larger, whereas Ec and Sd tended (P ≤ 0.1) to be smaller, and Pr, Sa and Ss were unchanged in size. Extract failed (89% in control versus 91% in treated) to increase the extent of cellulose utilization in co-cultures containing all bacteria and the rumen fungus. Supernatant and intracellular amylase and β-glucosidase were higher (P ≤ 0.05) in co-cultures treated with AO extract whereas total protein and total gas produced were unchanged. Xylanase was significantly (P ≤ 0.01) decreased in all extract treated co-cultures. Gel electrophoresis methods recorded only slight differences in protein patterns of cellular lysates from bacteria grown either with or without extract. Mixed cultures grown in vitro might provide clues to the mode of action in vivo for AO based direct fed microbials.

W205 RUSITEC to characterize Aspergillus oryzae extracts effects on in vitro fermentation and populations of microorganisms. R. Calza*1, F. McIntosh2, J. Wallace2, and J. Newbold2, 1Washington State University, Pullman/U.S.A., 2Rowett Research Institute, Aberdeen/Scotland.

Rumen simulation devices possessing 15 vessels, fed daily with hay, with or without Amaferm® extract or an inhibitor isolated from the extract were used to measure in vitro fermentation. Vessels were monitored periodically and run for a total of 21 days. There were no significant differences (at P ≤ 0.05) in the number of total bacteria, fungi, or protozoa in vessels. Cellulolytic bacteria numbers were different (P ≤ 0.01) at 1.91 x 10^7/ml for control vessels, 4.73 x 10^7/ml for treated vessels, and 2.70 x 10^7/ml in inhibitor containing vessels. Total (Menke) gas and methane production were similar in all vessels as were concentrations of ammonia and major VFA’s but lactate tended to be lower (P ≤ 0.1) in inhibitor treated vessels at 0.60 mmol/d. Measured pH values were similar in all vessels and ranged between 6.65-6.68 on days 11 and 20. Dry matter disappearance was significantly different (P ≤ 0.05) in control vessels (5.53 g/24 h), treated vessels (6.11 g/24 h), and inhibitor containing vessels (5.07 g/24 h). Serum bottles containing antibiotics to inhibit bacteria and promote fungal growth were set up from RUSITEC vessels at day 20, and assayed over 2-7 days. We failed to record differences in displacement gas or methane produced between treatments at any time of experiment. Fungal produced H2 was lower (P ≤ 0.06) in control bottles at 757 μl/ml than in treated bottle at 870 μl/ml and lower yet at 505 μl/ml in bottles containing inhibitor. Zoospore numbers tended to be lower (P ≤ 0.1) at 9.4 x 10^7/ml in controls than in treated bottles at 12.9 x 10^7/ml but both higher than inhibitor containing bottles at 4.9 x 10^7/ml at day 7. Fungal cellulase was lower (P ≤ 0.04) in the control bottles (2.94 μIU/ml) than in treated bottles (4.29 μIU/ml) but there was no difference between those samples and inhibitor treated bottles (3.13 μIU/ml). Research suggests that Amaferm® influences microbial populations including rumen fungi in RUSITEC.


The presence of growth inhibitor in extracts of Aspergillus oryzae (AO) cultures was determined in a common bacteria and a rumen fungus, Bacillus subtilis (ATCC #6633) exposed to AO extract (1 h water extraction) dried on discs at concentrations of 0.5, 2, and 4 times the dietary recommended level as supplement, resulted in zones of inhibition surrounding the exposure discs on growth plates measuring 0.2 +/- 0.1, 1.4 +/- 0.2, and 2.1 +/- 0.4 mm, respectively. Twenty-four to 30 h of mixing of AO powder with water was necessary to extract components that completely inhibited the growth of rumen fungus, Neocallimastix frontalis EB188 (ATCC #76100). Fungal and bacterial growth inhibiting compounds were extracted effectively and rapidly using ethyl acetate but not with hexane or methanol. Boiling, freezing, bleach (hypochlorite), and protease pre-treatments of crude extract tended (P ≤ 0.1) to reduce the inhibition of secreted cellulase in rumen fungus to 67%, 49.9%, 96.6%, and 80.1% of control, respectively. Fractions that strongly absorb 340-365 nm light and stimulated or inhibited fungal growth have been partially purified using HPLC and TLC. At least 4 growth inhibitors were detected from the ethyl acetate extract at TLC Rf values of 0.14 to 0.40 when developed with benzene-ethyl acetate (16:1). Anion exchange chromatography separated inhibitor fractions that caused a significant (P ≤ 0.01) reduction (49% of controls) in the growth of rumen fungus. Such inhibitor fractions reduced (both at P ≤ 0.05) cellulase and amylase secretions in rumen fungus to 25% and 6% of controls, respectively. Dialysis membranes possessing a nominal exclusion of 3Kd molecular weight resulted in partial removal or inactivation (to 77% of controls) of column separated inhibitor(s). Additional detailed purification studies are needed to identify the inhibitor components of AO.


To determine the ruminal degradation of crude protein of raw cull Chop suey beans (Vignia radiata L., Wilzek) in sheep. Two Pelibuey sheep (31.5 kg) fitted with ruminal cannulas were used. The animals were fed with a diet 25:75 roughage:concentrate, containing 20% of raw cull chopsuey beans. Nylon bags (10 x 18 cm) containing 5 g of raw cull chopsuey beans (CCB) or soybean meal (SBM), and were randomly designated to be incubated in rumen of sheep during 3, 6, 9, 12, 18, 24, or 36 hours. Once complete the incubation time, the bags were washed with tap water, dried, and CP was determined. The ruminal degradation of CCB-CP at 18 h incubation time was higher (P<0.01) than SBM-CP (96 % vs. 77.4 %). After 36 h of rumen incubation, there are no differences (P>0.10) between CCB-CP and SBM-CP (96.9 % vs. 94.3 %). Soluble fraction(a), degradable fraction (b) and rate of degradation by CCB-CP were 28.63 %, 71.7 % and 0.06 %/h, respectively. While by SBM-CO were 11.75%, 88.20 % and 0.13 %/h, respectively. The effective crude protein of CCB degraded in rumen was calculated in 90.6 %. It is assumed that undergradable crude protein content of CCB is 9.4 %. It is conclude that crude protein of raw cull Chop suey beans is highly and rapid degraded in rumen of sheep.

Key Words: AO supplement, Rumen fungus, Cellulase
Slick bunk management (SB) offers feedyards the potential to simplify daily feed allocation decisions. However, the effects of SB on performance and carcass quality are unclear. Therefore, we evaluated SB and non-slick bunk management (NSB) in a 122-d finishing trial using 192 Angus steers (initial BW=92 kg) stratified by BW and assigned randomly within BW strata to one of two treatments (SB or NSB) in a randomized block design with eight pens per treatment and 12 steers per pen. All cattle were fed the same 91% concentrate diet (steam-flaked corn base with 9% alfalfa). The objective of the SB treatment was for feed to be consumed at least 0.25 kg/d per steer at 2230 and 0.0 kg at 0700, before feeding at approximately 0800. The objective of the NSB treatment was for bunk to contain approximately 0.23 kg of feed per steer at 0700 before feeding at approximately 0800. When the quality of accumulated feed in the NSB treatment became compromised, it was removed, weighed, and analyzed for DM. Average DMI for each pen was determined with and without removed accumulated feed. Cattle were weighed individually on d 0, 41, and on d 122 before harvest and subsequent carcass data collection. Daily DMI averaged 0.20 kg/d less (P<0.16) for the SB treatment (0.52 vs 0.72 kg/d) when discarded accumulated feed was subtracted from feed delivery data. Leaving discarded accumulated feed in the feedlot, as would occur in a commercial feedyard, resulted in 0.25 kg/d less (P<0.09) apparent DMI for the SB treatment. Feed efficiency did not differ (P>0.33) using DMI derived by either method. No difference (P=0.65) in ADG (1.84 vs 1.86 kg/d for SB and NSB, respectively) was observed between the treatments, however, marbling score was lower (P<0.04) for SB than for NSB, and Chi-square analyses indicated a greater (P=0.09) proportion of carcasses with a modest or higher degree of marbling for the NSB treatment. These data indicate that it is possible to manage bunks to obtain the slick status described herein without adversely affecting performance. However, carcass data indicate the possibility that marbling could be adversely affected by SB; possibly as a result of the slightly reduced DMI and(or) effects on central energy metabolism.

**Key Words:** Beef cattle, Bunk management, Performance

**W209 Effects of winter implant status and monensin feeding on winter and subsequent summer performance by steers grazing tallgrass prairie.** T. N. Bodine, H. T. Purvis II, G. W. Horn, and D. A. Cox, Oklahoma Agricultural Experimentation Station.

We conducted three experiments to evaluate the effects of winter implant status and monensin feeding on winter and subsequent summer grazing performance. Experiment 1 evaluated Synovex-S implants given during the winter and/or summer with season-long grazing. Experiment 2 evaluated winter Synovex-S implants and two summer season-long stocking rates (single and double). Experiment 3 evaluated winter Synovex-S and Revalor-G implants, as well as monensin feeding, followed by summer intensive early stocking. Winter implant usage and monensin feeding increased (P<0.05) winter ADG by 33 and 49%, respectively, across all three studies. During summer grazing in Exp. 1, steers that had been implanted in the winter had 3% lesser (P<0.04) ADG, whereas steers with summer implants had 6% greater (P<0.01) ADG. Additionally, steers without winter implants that received summer implants had 10% greater (P<0.01) ADG than steers that received both implants. In Exp. 2, steers with or without winter implants had similar (P>0.21) summer ADG when double-stocked. However, single-stocked steers without winter implants had 6% greater (P<0.03) ADG than steers with winter implants. Across the combined winter and summer grazing period, double-stocked, winter-implemented steers had greater (P=0.03) ADG than steers without winter implants, whereas, single-stocked steers had similar (P>0.17) ADG among winter implant status. Steers with winter implants and steers fed monensin had decreased (P<0.02) summer ADG (-6, -10%) than steers without implants or monensin in Exp. 3. Combined winter and summer grazing period ADG was not different (P>0.15) due to winter implants or monensin. The use of implants in the monensin increased animal performance. When potential summer ADG is low, steers implanted in the winter retained their greater BW. However, when summer gain potential is greater, winter implant status and monensin feeding had no effect on combined winter and summer total weight gain.

**Key Words:** Growth promoters, Ionophores, Stocking rate

**W210 Correlation of marbling and yearling weight EPD’s with performance and carcass characteristics of early-weaned Simmental steers.** N. A. Pyatt, L. L. Berger, D. B. Faulkner, P. M. Walker, University of Illinois at Urbana-Champaign, Illinois State University, Normal.

One hundred forty-four early-weaned three-quarter or greater Simmental steers of known genotypes were individually fed to determine correlations of marbling EPD (MARB) and yearling weight EPD (YW) with feedlot performance and carcass characteristics. Mean MARB was 0.04 (range from -0.12 to 0.25), and YW was 56.4 (range from 17.6 to 88). Steers were weaned at 87.0 14.9 days and fed a high concentrate diet for approximately 90 days prior to allotment. Calves were implanted with Synovex C at weaning and successively with Synovex S and Revalor-S. Steers were fed a 90% concentrate, whole shelled corn and silage diet, supplemented to contain 15% CP using soybean meal for 247.0 9.1 days and harvested at 422.0 19.9 days of age. Final weight was calculated by dividing hot carcass weight (HCW) by a common dressing percent. Samples of longissimus dorsi (LD) were collected to verify percent intramuscular fat (%FAT). Steers gained 1.63 0.19 kg/d, consumed 8.99 1.29 kg DM/d, and converted 0.183 0.025 kg gain/kg DM. Steers finished with 649.0 kg final weight, 402.8 kg HCW, 1.12 cm 12th rib fat, and 93.8 cm² LD area. USDA yield grades (YG) were 23.2% 1's, 54.9% 2's, 20.4% 3's and 1.4% 4's. USDA quality grades (QG) were 17.7% Select, 44.7% low Choice ( C− ) and 36.9% average Choice or better. The American Simmental Association database reported steers of the same breed type graded 55% C− or better under traditional management, while early weaning resulted in 81.6% C− or better QG. MARB was correlated (P<0.01) with gain to feed (G:F) (-0.29), DMI (0.41), QG (0.20), University of Illinois (UI) determined QG (0.26), marbling score (MS) (0.25) and %FAT (0.28). YW was correlated (P<0.01) with G:F (0.45), DMI (0.42), HCW (0.25) and YG (-0.31). %FAT was correlated (P<0.01) to ADG (0.27), QG (0.63), UI QG (0.70), MS (0.72), YG (0.31) and UI calculated YG (0.50). R-values for ADG with G:F, ADG with DMI, and G:F with DMI were 0.40, 0.49 and -0.59, respectively (P<0.01). Selecting for greater MARB can improve carcass quality. Selecting for greater YW may increase HCW and lower YG.

**Key Words:** Early-weaned, EPD, Correlation


Our objective was to investigate effects of early weaning calves on first calf heifer and mature cow performance and serum concentrations of non-esterified fatty acid (NEFA) and serum urea nitrogen (SUN). Treatments were arranged in a 2 x 2 factorial and included 14 crossbred (Angus x Gelbvieh x Hereford) and 14 crossbred (Angus x Gelbvieh x Hereford x Barzona x Senepol or Red Angus x Charolais x Tarentaise) first calf heifers and 14 crossbred (Angus x Gelbvieh x Hereford x Barzona x Senepol x Salers) mature cows assigned randomly to one of two treatments: early weaned (EW, calves weaned at 114 d) or normal weaned (NW, calves weaned at 197 d). Blood samples were collected on d 114, 141 197, and 205 post-partum via jugular venipuncture. Overall, BW was greater (P<0.01) for mature cows vs heifers and for EW vs NW dams (P<0.01). Heifers with calves EW had 3.06% increase (P<0.01) in BW than heifers with calves NW, but no change (P>0.10) in BW was observed for mature cows. Early weaning increased body condition (P<0.05) and change in body condition compared with NW. No effects of weaning or parity were observed for ADG (P>0.10). There was no parity x weaning x d or parity x weaning interactions observed (P>0.10) for NEFA or SUN. There was a parity x d interaction for both NEFA (P<0.10) and SUN (P<0.05), but no differences (P>0.10) were observed between first calf heifers and mature cows within d. Early weaning decreased (P<0.10) SUN compared with NW status. We hypothesize that early weaning decreased SUN concentrations due to decreased metabolism of muscle protein. Results suggest that EW
can increase BW and body condition in first calf heifers and decrease SUN concentrations in both first calf heifers and mature cows in open rangeland conditions of the desert southwest.

Key Words: Beef cattle, Early weaning, Parity

### W212 Serum progesterone in cycling ewes treated with progesterone-impregnated intravaginal inserts on the day of estrus.

J. L. Duffey*, D. M. Halford, C. A. Gifford, and R. L. Rosencrans, New Mexico State University, Las Cruces, NM/USA.

Progesterone-impregnated intravaginal inserts (CIDR) can synchronize estrus in ewes but conception may be reduced. This study compared progesterone (P4) profiles in cycling Rambouillet ewes (control, n = 10) with those in cycling ewes (n = 10) receiving a CIDR (0.3 g P4, Pharmacia and Upjohn Ltd. Co., Auckland, NZ) on the day of estrus (d 0) and ovariolectomized (OVX, n = 6) ewes treated with a CIDR. The CIDR’s were removed after 14 d; intact ewes were then placed with raddle rams during a 21-d breeding season. Ewe BW were similar (P > 0.68) among groups averaging 74 ± 3 kg and serum P4 was less than 1 ng/mL on d 0 in all ewes. On d 1, serum P4 differed in controls and in CIDR-treated intact and OVX ewes (0.2 < 2.9 < 4.4 ± 0.3 ng/mL, respectively; P < 0.01). On d 3, control ewes had a P4 concentration of 0.8 ng/mL (P < 0.01) compared with 3.4 ± 0.2 ng/mL in CIDR-treated intact and OVX ewes. This similarity in P4 value in the two CIDR treatments (P > 0.10) continued through d 7 at which time ewes in all three groups averaged approximately 4 ng/mL. Serum P4 in control ewes rose during the luteal phase to peak at 6.4 ± 0.5 ng/mL on d 12 and was greater (P < 0.01) on d 12 through 14 than values in both CIDR-treated groups. However, serum P4 was similar (P > 0.10) in CIDR-treated intact and OVX ewes from d 12 to 14 (2.8 and 1.9 ± 0.5 ng/mL, respectively, on d 14). Serum P4 averaged 6.2 ± 0.7 ng/mL in controls (P < 0.01) compared with 0.3 and 0.2 ng/mL in the two CIDR-treated groups on the day after CIDR removal. Control ewes were marked by rams on an average of d 17.9 compared with d 15.5 (± 0.4) for CIDR-treated intact ewes (P < 0.01). Ten percent of control ewes were marked by rams at a subsequent cycle compared with 60% of CIDR-treated intact ewes (P > 0.02). Results demonstrate that intact cycling ewes produce more P4 during the mid and late luteal phases than that released by the CIDR. The observation that ewes receiving a CIDR on d 0 have the same P4 on d 12 to 14 as CIDR-treated OVX ewes suggests premature demise of the corpus luteum which may have influenced the poor conception rate. (Thanks to Meg Oeller, DVM, CVM, FDA for INAD 10-321)

Key Words: Sheep, CIDR, Synchronize

### W213 Progesterone release and clearance patterns of progesterone-impregnated intravaginal inserts in ewes.

C. A. Gifford*, J. L. Duffey, R. L. Rosencrans, and D. M. Halford, New Mexico State University, Las Cruces, NM/USA.

Six ovariolectomized Rambouillet ewes (BW = 73 ± 4 kg) were utilized to determine progesterone (P4) uptake and clearance patterns after insertion and removal of P4 containing controlled internal drug releasing devices (CIDR, 0.3 g P4, Pharmacia and Upjohn Ltd. Co., Auckland, NZ). Animals were maintained in a single pen (12 x 4 m) under ambient conditions with access to shade, water, salt, and alfalfa hay (2 kg/d). In period 1, serum was collected before and hourly for 12 h after CIDR insertion. Serum P4 concentration was 4.7 ± 0.6 ng/mL 1 h after CIDR insertion compared with 0.1 ng/mL (P < 0.01) immediately before CIDR insertion on d 0. Serum P4 peaked at 6.3 ± 0.6 ng/mL (h 4) and remained elevated for the remaining 12 h on d 0. Additional samples were collected daily for 14 d in period 1, and all P4 values were 2 ng/mL or greater. Each CIDR was removed on d 14, and serum was collected intensively for 12 h after CIDR removal. At 15 min after CIDR removal, serum P4 was 1.2 compared with 1.9 (± 0.1) ng/mL before removal. At 1 and 2 h after CIDR removal, serum P4 values averaged 0.8 and 0.7 (± 0.1) ng/mL, respectively; and 12 h after CIDR removal, P4 had declined to 0.2 ng/mL. After 2 wk, the same CIDR was reinserted in the same ewe from period 1 for second and third 14-d periods. Daily P4 concentrations were compared to determine the efficiency of a CIDR multiple times. Serum P4 averaged 4.4, 2.1, and 0.7 (± 0.4) ng/mL on d 1 of periods 1, 2, and 3, respectively (P < 0.01). On d 7, period 1 P4 value was 3.6 ng/mL compared with 1.5 and 0.3 (± 0.3) ng/mL during periods 2 and 3, respectively (P < 0.01). Serum P4 was < 1 ng/mL after d 9 of period 2 and never averaged greater than 0.7 ng/mL during period 3. On d 14, P4 values were 1.9, 0.7, and 0.3 (± 0.2) ng/mL in the three respective periods. Results show that P4 from the CIDR rapidly enters the circulation (within 1 h) at the time of insertion and is rapidly cleared after CIDR removal (< 1 ng/mL by 1 h). Also after 2, 15-d periods in situ, CIDR’s were no longer able to increase serum P4 concentrations. (Thanks to Meg Oeller, DVM, CVM, FDA for INAD 10-321)

Key Words: Sheep, CIDR, Synchronize

### W214 Effects of seminal traits and mating behavior on number of progeny sired in multi-sire herds.

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Effects of serving capacity (SC), social dominance rank (SDR) and physical characteristics of bulls on reproductive performance in multi-sire herds were evaluated. Spermatozoal traits and presence of fertility-associated antigen (FAA) were allocated into treatment groups. In experiment one, Brahman (n=6) and Bonsmara (n=6) bulls (18-24 mo of age) were evaluated for body condition score (BCS), SDR, SC, sperm motility and morphology, and FAA status (positive/negative). Bulls were joined with multiparous cows (n=305) for 90 d. Paternity was verified by DNA typing of 251 calves. Regression analyses were used to determine traits associated with variability in number of calves sired per bull. Chi square analyses were used to determine effects of morphology and FAA status on numbers of calves born early (<14 d or) or total. All bulls were FAA-positive and more calves were sired by Brahman (P<0.05) bulls. Bull breed, motility, morphology, and SDR rank were positively associated with variability in number of calves sired per bull (P<0.05, R-square = 0.75). Bulls with >80% normal sperm sired more calves early in the calving season (P<0.05). In experiment two, Bonsmara (n=6, 13-14 mo of age), Tuli (n=6, 15-18 mo of age), and Waygu (n=6, 18-19 mo of age) bulls were evaluated as in experiment one, along with BW, scrotal size and service efficiency (ratio of mounts to services). Bulls were joined with multiparous cows (n=290) for 90 d. Sire was determined for male calves (n=125). More calves were sired by older (Waygu) bulls (P<0.05). Age of bull, FAA-status, and BW explained variation in number of calves sired per bull (P<0.01, R-square = 0.64). There was a linear relationship (P<0.05) between service efficiency and number of calves sired per bull. Assessment of FAA status of sperm, SDR, and service efficiency in conjunction with a breeding soundness exam will identify bulls that can potentially sire increased numbers of early-born calves.

Key Words: Beef cattle, Bull fertility

### W215 Effects of an injectable trace mineral supplement on conception rate of lactating dairy cows.

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A total of 830 dairy cows from a commercial dairy farm located in central California were used to evaluate the effects of a single or double dose of a trace mineral supplement (Multimin®) on first service conception rate. Cows were randomly assigned to treatment groups and joined with multiparous cows between 38 to 45 days in lactation (TREATMENT 1 n=191) receiving a single injection of 5ml of Multimin®. Two hundred and twenty eight similar cows were used as a CONTROL 1. In Experiment 1, cows between 38 to 45 days in lactation (TREATMENT 1 n=191) received a single injection of 5ml of Multimin®. Two hundred and twenty eight similar cows were used as a CONTROL 1.
served as a CONTROL 2. Health and reproductive events post calving such as retained placenta and mastitis were recorded. The odds of first service conception for cows and heifers experiencing retained placenta and mastitis prior to first artificial insemination were significantly lower compared with their controls (OR 0.44 to 0.52, P-value 0.01). In Experiment 1, the odds of first service conception were not significantly different for cows and heifers given the one-dose regimen of Multimin compared to their untreated controls (OR 0.94, P-value=0.63). In Experiment 2, the odds of first-service conception were significantly lower for cows and heifers given the two-dose regime of Multimin compared to their untreated controls. (OR 0.66, P-value=0.002). No significant differences in first-service conception were found between cows and heifers given the two-dose compared to the one-dose regime of Multimin (OR 1.17, P-value=0.51).

Key Words: Conception rates, Trace minerals, Multimin


The ubiquitous use of ultrasound in evaluating carcass traits in cattle can be enhanced with convenient and accurate procedures for estimating backfat, longissimus area, and intramuscular fat. It was found that a 5 MHz transducer (Aloka) provided more accurate measures of backfat over the region of the 12th and 13th rib with a sagittal than a transverse scan with average absolute errors of 1.6 and 2.2 mm, respectively. R² values were similar (.70 and .69 - 146 cattle) but the bias was less with the sagittal orientation (1.4 vs 2.1 mm). Longissimus area was estimated from the muscle depth or the distance from the bottom of the backfat to the features representing the transverse processes at the first and second lumbar. In a set of 139 cattle the correlation between this measure and carcass longissimus area was .67. Because this measure is commonly expressed in English measure an equation was developed for technician use (REA = muscle depth in mm/ 4 minus 1). This had an average error of 6.26 cm² (± 97 in²) and a bias of 1.9 cm². The procedure can be executed using the electronic calipers on most ultrasound instruments although algorithms for these measures on a digitized image were used. Ultrasound technicians should become proficient at estimating percent intramuscular fat from visual interpretation of images. The transverse image between the 12th and 13th ribs was viewed and the amount of ultrasonic speckle plus using the rib bone and spinous processes as densitometers to estimate beam attenuation were considered in making estimates. Results of the accuracy of the visual estimates to predict carcass marbling were compared to computer interpretations of the image using validated programs. Results expressed as R² values (n = 42) were .65, .57, .58 and .53 for the visual estimates (using a 12 cm 3.5 MHz transducer) and computer estimates for a 12 cm 3.5 MHz, 17 cm, 3.5 MHz, and a 5 MHz transrectal transducer, respectively. Relative accuracies of the visual estimates were .49, .52, .48 and .44 marbling score units. These results should assist ultrasound technicians to perform rapid evaluations where interpretation software is not available.

Key Words: Ultrasound, Cattle, Carcass

W217 Effect of a birth weight selection index on Hereford calves from inbred and outcross matings. D. C. Anderson1, D. D. Kress2, and K. C. Davis2, 1Northern Agricultural Research Center, Havre, 2Montana State University, Bozeman.

The effect on calf performance and proportion assisted births from selecting linebred (LB) or outcross (OC) sires based on a birth weight selection index (SI) was evaluated for five years at the Northern Agricultural Research Center (NARC), Havre, MT. Selection of both LB and OC sires was on an index of adjusted yearling weight minus 3.2 X adjusted birth weight (SI). Linebred sires (FX=16.3%) were from the LB Hereford herd at NARC with 15 yr selection based on SI and OC sires were selected from different purebred herds in Montana unrelated to NARC sires. Calves (375) were produced by mating two LB and two OC sires per year to LB and OC females with of calves each year from repeat matings. Sires were used two years. The general linear model procedure of SAS included year, age of dam, sex of calf, dam line, sire line, with covariate of calf birth date. Dependent variables were birth weight (BW), weaning weight (WW), weaning hip height (HH), yearling weight (YW), and average daily gain on feed (ADG). CATMOD procedure by SAS was used to evaluate proportion assisted calving (AC). Date of birth, year and age of dam were important (P<0.01) for all weight and height traits.

Key Words: Beef cattle, Environment, Feed intake


Feed intake data from 52 individual 140-d feeding trials conducted over a 13-yr period (1978 to 1998) and corresponding selected environmental data from three locations in Arkansas were analyzed to define more precise relationships between feed intake and selected environmental factors of performance-tested beef bulls. Feed intake data originated from bulls (n = 2,002) used in University of Arkansas Cooperative Bull Tests at Fayetteville, Hope and Monticello. After a 21-d adjustment period, bulls were fed on an individual basis twice daily in the same stall for 140 d. Initial age and weight were recorded at the beginning of the experiment. Year and weight were significant (P<0.01) for initial weight and age were 273 ± 1 kg and 274 ± 0.9 d, respectively. Selected environmental data, which included thermal heat index (THI), relative humidity from 0600 to 1000 (RH6-10) and rainfall, were obtained from the National Climatic Data Center (Asheville, NC). Data were pooled, divided into five 28-d periods beginning with the start of each test, and data from each period were analyzed separately by the General Linear Model procedure of SAS. All was influenced by initial age in all periods (P<0.01) and initial weight in Periods 3 through 5 (P<0.01). Initial weight x breed interactions were present in Periods 1 and 2 (P<0.01). There were THI x breed interactions evident in all periods (P<0.01). A RH6-10 influence was noted in Period 2 (P<0.01). During Periods 3 and 4 there were RH6-10 x breed interactions evident (P<0.01). A rainfall x breed interaction (P<0.01) existed during Period 4. Data suggest that environmental effects on feed intake are strongly influenced by breed, and that initial age and weight of cattle when placed on feed affect intake throughout the feeding period.

Key Words: Beef cattle, Environment, Feed intake

W219 Effect of live weight, preslaughter handling, and gender on blood acid-base status in finishing pigs. D. Hamilton1, M. Ellis1, T. Bertol2, and K. D. Miller2, 1University of Illinois, Urbana, IL, USA, 2Elanco Animal Health, Greenfield, IN, USA.

Live weight has been suggested as an important factor influencing metabolic response of pigs to handling stress and, consequently, the incidence of deaths and downer animals during transport and, ultimately, pork quality. Thus, the objective of this study was to determine effects of preslaughter handling intensity on blood acid-base levels in pigs of varying live weight. Eighty pigs were used in a randomized block design (4 x 2 factorial arrangement of treatments: 1) live weight (light [104 kg] vs heavy [128 kg]), 2) handling intensity (low vs high), and 3) gender (barrows vs gilts). On the morning of handling test, baseline measurements of blood parameters, rectal temperature, and live weight were collected. Pigs were allowed 2 h rest prior to handling, which consisted of moving pigs through a course (12.2 x 0.91 m) for a total of eight lanes. Animals on high intensity treatment were moved rapidly through the course and given 2 shocks/lap with an electric prod while pigs on low intensity were moved at their own pace using a livestock panel and paddle. There were no treatment interactions (P>0.05) and no effect (P>0.05) of treatment on baseline blood measurements taken prior to handling. Post-handling, pigs from light treatment group had higher (P<0.04) blood SO₄ concentrations than pigs from hiltreatment. Blood pH (light vs heavy [13.6 vs 13.7]; SE = 0.05) and showed a greater increase (P=0.05) in PO₄ from baseline to post-handling than did heavy pigs (15.6 vs 8.3; SE = 0.05).
Post-handling, pigs on high-intensity handling had greater (P < 0.001) lactate (19.1 vs 4.9; SE = 0.56) and PO4 (51.6 vs 36.5; SE = 2.44) with lower (P < 0.001) TCO2 (18.6 vs 34.7; SE = 0.64), pH (7.02 vs 7.36; SE = 0.015), HCO3 (16.7 vs 33.0; SE = 0.62), and base excess (-14.2 vs 7.5; SE = 0.75) values than pigs on low-intensity treatment. Results from this study highlight the major impact of pig handling intensity and a limited effect of live weight and gender on blood acid-base status.

Key Words: Acid-base balance, Preshlaughter handling, Pork quality

W220 Prediction of wool base, vegetable matter base, fiber diameter, and prickle factor of greasy wool with near-infrared reflectance spectroscopy (NIRS). C. J. Lupton*, J. W. Walker, B. S. Engdahl, and F. A. Pfeiffer, Texas Agricultural Experiment Station, San Angelo.

A near-infrared reflectance spectrophotometer (Feed and Forage Analyzer Model 6500M, Foss North America, Eden Prairie, MN) fitted with a transport mechanism and using a customized sample holder (scanning area = 82 cm2) was used to obtain spectra (at 2 nm intervals in the range 400 to 2498 nm) of 427 core samples (in duplicate) of greasy wool. Twenty-five scans were averaged for each of the duplicate subsamples. The core samples were supplied and had previously been subsampled and analyzed using standard methodology by Yocom-McColl Testing Laboratories, Denver CO. The samples represented a broad cross-section of U.S. wool production. WinISI II software (version 1.0.4, Infrasoft International, Port Matilda, PA) was used to transform spectral data and calculate prediction equations and expected levels of precision for wool base (WB), vegetable matter base (VMB), average fiber diameter (AFD), SD and CV of fiber diameter, and prickle factor (PF, % of fibers > 30 pm). The SE of calibration (SEC), cross validation (SECV) and prediction (SEP) are presented in the table. The SEP and R2(P) values for the predictions of the validation set were obtained by using a randomly selected half of the spectra to calculate a calibration equation that was then used to predict constituent values of the other half (actually 207) of the samples. Because SEP > SECV > SEC, possible sampling errors and lack of fit between NIRS-predicted and lab-determined values are indicated. We are attempting to reduce SE and SEP as much as possible by repeating samples on a selected population of the actual subsamples that were scanned.

Key Words: Near-infrared reflectance spectroscopy, Wool

W221 Field versus lab measurements for four important wool traits. F. A. Pfeiffer*, C. J. Lupton, and A. A. Simpson, Texas Agricultural Experiment Station, San Angelo.

The OFDA2000 instrument (Interactive Wool Group, Fremantle, Australia) was developed to measure average fiber diameter and fiber length properties of raw wool under field conditions. An experiment was designed to compare OFDA2000 field measurements of greasy wool with measurements obtained on the same staples after cleansing and re-measuring on a standardized instrument (OFDA 100, BSC Electronics, Perth, Australia) in a conditioned laboratory. Mid-side samples were removed from 1320 sheep representing 18 groups (differentiated by age and sex) from 8 different flocks in western Texas and measured for (inner alia) average fiber diameter (AFD), coefficient of variation of fiber diameter (CV), comfort factor (CF, % fibers ≤ 30 pm) and average fiber curvature (APC). Means (and ranges) for the field-tested samples were 20.1 pm (15.8 to 27.3 pm), 16.8 % (12.7 to 23.5 %), 98.8 % (79.3 to 100 %), and 88.0 deg/mm (47.3 to 134.2 deg/mm), respectively. After cleaning, drying, and conditioning, the samples were re-measured using the OFDA 100. Average differences (OFDA 100 - OFDA2000) and r2 values for the two sets of data were AFD, -0.22 pm and 0.87; CV, 0.96 % and 0.55; CF, -0.08 % and 0.68; and APC, 20.04 deg/mm and 0.74. The AFD differences were greatest for groups containing yearling sheep having wool that tapered naturally to a tip (i.e., previously unshorn ewes and rams). For mature sheep, average AFD differences between instruments were close to 0, and r2 values were high (> 0.9). Average values for CV and CF were similar between instruments but measurements from the two instruments were not as highly correlated as the AFD values. The OFDA2000 consistently underestimated AFC. However, the results were highly correlated with those for the standard instrument (r2 = 0.74). We concluded that AFC measurements obtained in the field using the OFDA2000 are accurate enough to assist with and benefit selection decisions. Field estimates of the other three traits (CV, CF, and AFC) are not as accurate and should be used with caution.

Key Words: Objective measurement, Wool, Sheep

W222 Protocols of reproductive management and their influences on improvement of fertility in Iranian Holstein dairy cattle. G. Koolabadi1, R. Tahmasbi2, B. Saraei2, and A. Naseri2, 1Dasht Dairy Farm, Neyeshabour, Khorasan, Iran, 2 Ferdowsi University of Mashhad, Khorasan, Iran.

The objective of this study was to compare existing methods for synchrony in Holstein dairy cattle and their influence on factors exhibited fertility status. This study carried out in Dasht dairy farm (2000 head), which is located in northeast of Iran (Neyeshabour City) and have an acceptable and computerized record keeping system, between years 2002-2003. Cows that did not show heat until (43±2d) postpartum selected and allocated to each method randomly. Method 1: Injection 2.5 cc prostaglandin after 24-72h. Cows show heat were inseminated, otherwise steps would be repeated. Method 2: Implantation CIDR on d 0, removing on d 8, injection of 1cc estradiol on d 9 and if heat was detected on d 10-12, insemination was done. Pregnancy test was done 40-45d after insemination by rectal palpation. Parity, Days in milk (DIM), Adjusted milk production (Milk305), Conception rate (CR), Calving ease (CE) and Open days (OD) were collected individually and analyzed by General Linear Model procedures of SAS v6.12. After using method 1 and were significantly different (P<0.0001, 0.031 and 0.0004 respectively). Based on these results, it seems that using method 1 under Iran conditions should be better and reproductive performance will be improved.

Constituent N Mean SD SEC R2 SECV SEP R2(P)
WB, % 408 45.8 4.07 1.45 0.87 1.92 0.77
VMB, % 403 1.84 0.75 0.25 0.66 0.87 0.22
AFD, µm 412 23.5 3.09 0.66 0.95 0.76 1.31 0.83
SD, µm 410 5.34 1.15 0.31 0.93 0.36 0.50 0.83
CV, % 416 22.4 2.18 1.10 0.74 1.23 1.34 0.66
PF, % 411 14.0 14.5 3.28 0.95 3.70 6.36 0.83

Key Words: Near-infrared reflectance spectroscopy, Wool

W223 Milk citrate as a potential metabolic indicator in dairy cows. L. L. Masson1, T. T. Mottram1, and P. C. Garnsworthy2, 1Silsoe Research Institute, Silsoe, U.K., 2University of Nottingham, Sutton Bonington, U.K.

Citrate is a normal constituent of cow's milk, being an important member of the tricarboxylic acid cycle. It is correlated with de novo fatty acid synthesis and may be a useful indicator to assess energy balance. On-line monitoring of milk composition with biosensors during milking may be useful to assess metabolic status. Citrate may be a potential metabolite to measure but sources of variation within cows need to be determined and quantified for accurate data interpretation. The aim of this study was to investigate sources of variation in milk citrate. Three groups of 8 Holstein cows from the University of Nottingham’s dairy herd were selected according to days in milk. All cows were fed on the same diet and milked 2 times daily. Milk samples were collected from early (days 4-29), mid (days 103-156) and late (days 265-306) lactation cows for 10 consecutive days to investigate diurnal, day-to-day and lactational variation. Citrate was determined by high performance liquid chromatography and data analysed by General ANOVA. Day-to-day variation were greater at 3.2mM, although there was no significant difference between samples taken at AM and PM milkings (P=0.129). There was a significant effect of lactation stage (P<0.001) with citrate
being 10.89±0.24 mM, 9.76±0.14 mM and 10.26±0.15 mM in early, mid and late lactation respectively. Variability between cows was greatest in early lactation, ranging from 0.66-3.22 mM. These variations would make interpretation of daily measurements difficult with current knowledge. Several other factors also affect milk citrate, including nutrition, health status and season and these must be taken into consideration if citrate is to be measured automatically as an indicator of metabolic status. However, the amount of data required initially to establish variability within cows and normal baseline levels would likely be very large and in practice this nutritional management system may not be feasible.

Key Words: Milk citrate, Variation, On-line monitoring


Our objectives were to assess frequency of mortality of Jersey calves in the United States, and examine relationships between nutrition, management, and mortality. Fifteen percent of 577 herds were selected (n=88) by region, rolling herd average milk, and herd size to obtain a representative sample of the population. Herds were located in PA, OH, or IN (n=25), Southeast (n=16), Northeast (n=17), WI (n=8) and West (n=22). Surveys were conducted by personal interview between December 2000 and June 2001. Herds averaged 7180 ± 757 kg rolling herd average milk, 153 cows, and 199 births annually. Mortality averaged 5.0 ± 6.1% during first 24 h of life including stillbirths, 6.7 ± 8.4% from 24 h to 3 mo of life, and 1.3 ± 1.6% from 3 mo to calving. First colostrum was fed 3.8 ± 3.0 h after birth at 1.9 ± 0.6 L. Calves were weaned at 9.4 ± 3.2 wk. Higher herd milk production and more liquid fed to calves were correlated with reductions in mortality by 24 h. Frequency of mortality by 24 h was highest in herds that calved cows on pasture, and registered less than 100% of calves. Less mortality from 24 h to 3 mo was associated with herds that used maternity pens, and weaned calves at a younger age. Increased mortality from 24 h to 3 mo was observed in herds that offered calf starter and forage at a later age, used colostrum supplements, and used natural service to breed heifers. Mortality in Jersey calves may be reduced by offering calf starter to younger calves, using maternity pens, and reducing age at weaning to 8 wk of age.

Key Words: Jersey calves, Survey, Mortality


Two experiments (Exp.) were performed to study the effect of ozonation on air quality and growth performance of weanling piglets. Ozone was generated using a commercial apparatus outside the nursery building and infused into the house through a duct at a level of 0.03 ppm. In Exp. I, concentrations of harmful gases and temperature of the nursery house were recorded every two hours for 21 days. In Exp. II, 40 cross-bred weanling piglets weighing approximately 7 kg were raised in two ozonated or unozonated control pens alternatively for three weeks and this procedure was repeated three times. In Exp. I, concentrations of ammonia and carbon dioxide of the nursery house were reduced by 22% and 12%, respectively, by the ozonation compared with those of unozonated control house. However, hydrogen sulfide concentration and temperature were not affected by the ozonation. In Exp. II, weight gain, feed intake and feed conversion efficiency were not affected by the ozonation. Collectively, results indicate that ozonation is effective for improving the indoor air quality of the swine nursery unit without affecting the production efficiency.

Key Words: Weanling piglets, Ozone, Harmful gas


In Hungary, 90% of honey production is for human and based on the estimations the rest 5-10% of the honey production is used by the industry (baking industry, sweets industry, pharmaceutical industry and cosmetics) and social programmes. As for the sales of honey, there are several marketing channels. The wholesalers purchase 10-13 thousand metric tons of honey from the producers each year depending on the fluctuation of honey production, which is the most significant part of the total production annually. Nominal capacity of the Hungarian honey processing plants is about 40 thousand metric tons, which is double the highest production level of the last ten years. Most of the commercial companies operate their own honey processing plants. This is the reason, why capacities of honey processing exceed level of actual production. The production potentials could make it possible collect 40-46 thousand metric tons of honey, and this quantity could also be processed by actual processing capacity. The cost-income analyses do not justifiy the exploitation of Acacia forest. Cost-income calculations were made in two different categories. In the category of horizontal hives with frames, the calculations refer to honeybee keeping farms with 50, 100, 150, 200 bee colonies, while in category of hives with supers-boxes honeybee keeping with 200, 400, 600, 800, and 1000 colonies were referred to. Yields were determined by categories. Real incomes were generated at honeybee keeping farms provided with hives with supers. Larger stocks with higher yields resulted in higher profitability indicators. However the high risks, like risk of animal health, of large yields cannot be ignored. Bee keeping farms with less than 100 bee colonies cannot be competitive in the market. In order to remain on markets their co-operation is indispensable.

Key Words: Honeybee-keeping, Real incomes, Competitive on market

W227 Particle size, feed intake, milk yield and chewing activity in Holstein cows. P. Melendez*, N. Back1, S. Lanhart1, and A. Donovan3, 1 College of Veterinary Medicine, University of Florida, 2 North Florida Holstein, Inc.

The objectives were to determine the relationship between fractions of a particle size evaluator at initial feeding and the weigh-back (WB) and to establish the association of fractions with milk yield, feed intake and chewing activity of lactating cows. Models were designed considering fractions as fed and DM basis. The study was conducted in a Florida dairy farm with a RHA of 10,500 kg. One side of a free-stall barn with 160 mid lactation cows was used. Cows were fed a TMR 3X. Nutritional composition was 59.5% back was the sum of the 3X. During March 2002 a TMR sample was collected daily from the feed bunk immediately after a.m., noon and p.m. feeding and WB. Particle size was evaluated using the Penn State separator. Initial and WB samples were processed daily after collection. After processing, a sub-sample from each fraction was taken for DM content. Max and min daily temperatures were recorded. Four h after the am feeding, numbers of cows chewing and eating were counted. Milk yield was recorded daily. Linear regression models were developed. Models were for feed intake, coarse, medium and fine fractions from WB, milk yield, and rate of chewing. Table shows that significant models were feed intake, coarse plus medium fraction, medium, milk yield and chewing proportion both as fed and DM. Differences between models were minor. This suggests that when a particle size separator is used to evaluate a TMR, DM content of fractions is not critical.
Alfalfa is one of the most important forages in the world for dairy cattle production because of its high nutritional value. Although there are many studies on cultivated alfalfa in temperate regions, studies on the nutritional quality of alfalfa under tropical conditions are scarce. Recently, Embrapa, Brazil’s national agriculture research service, has initiated alfalfa breeding studies and developed several cultivars. The objective of this research was to evaluate the production and nutritional quality of the Embrapa alfalfa germplasm bank under tropical conditions, specifically in the Zona da Mata region of Minas Gerais state in Brazil. Twenty alfalfa cultivars were evaluated over a 2-year period in a randomized block experimental design with three replications and five different harvest intervals for nutritional quality and 18 harvest intervals for production determinations. Data were analyzed statistically for the effects of cultivars, harvest interval and the interaction. There were significant differences among cultivars for forage production (P < 0.04), CP content (P < 0.02), NDF (P < 0.05), and in vitro and in situ digestibility (P < 0.05), but no differences were found in lignin (P > 0.05). These results indicate that Crioula CNPGL1, P 58N58, and F 686 were superior for dry matter production, crude protein and neutral detergent fiber. The Embrapa alfalfa cultivar Crioula CNPGL1 was 14% more productive than P58N58 (P < 0.05) and 20% more productive than F 686 (P < 0.05). The superior production and quality of the Crioula CNPGL1 alfalfa cultivar reflect good adaptability to soil and environmental conditions of the Zona da Mata area. Therefore, it is evident that potential exists for immediate utilization of these cultivars in this area; however, further studies are needed for different soil types as well as field-testing by producers.

Key Words: Alfalfa, Nutrition Quality, Tropics


Management strategies are critical for a successful transition period and may differ for cows and first calf heifers. The objective of this study was to compare behaviors between transition cows and heifers, emphasizing feeding behaviors and the relationship of these behaviors with DMI and milk yield. Five multiparous Holstein cows (C) and five Holstein heifers approaching first calving (H), were housed in tiestalls from 28d prior to expected calving and provided feed ad libitum. The C and H were videotaped 24 h/d, using time-lapse video recording, beginning 15d prior to expected calving until 14d after calving. On d-6, d-2, d2 and d8 relative to actual calving the durations of the following behaviors were measured: standing (S), lying (L), resting (R), feeding (F), ruminating (R) and ruminating while lying (RL). Daily DMI and postpartum milk yield were recorded. The model selected for analyses included effects of parity group (C and H), day, and interactions. There were no significant differences between C and H in L, F or RL. For both parity groups, L (P < 0.05) differed across d and there were d by parity group interactions for F (P < 0.05) and RL (P < 0.01). For all animals, L decreased through d2 and then increased on d8. For C, F decreased through d2 and then increased on d8; while for H, F increased until d-2, decreased at d2 and then increased on d8. Through d2, RL decreased for C and then increased on d8; but for H, RL did not decrease until d2 and then increased on d8. As expected, C had greater milk yield (P < 0.05) and DMI (P < 0.01) than H. Milk yield on d8 was significantly affected by Ref on d-6 (P < 0.01). The DMI on d8 was significantly affected by F on d2 (P < 0.01). Behaviors, DMI and milk yield differed for transition C and H, indicating that managing them differently during the transition period may be beneficial.

Key Words: Dairy cattle, Transition, Behavior

W229 Nutritional quality of twenty alfalfa (Medicago sativa L) cultivars from Embrapa’s Brazil germplasm bank. H. Carneiro1, M. de A. Bortel1, F. de S. Sobrinho1, and M. Villaquiran2, 1EMBRAPA, CNPGL, Minas Gerais, Brazil, 2E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.

Forages & Pastures: Grazing, cultivars, forage management


Because of its cold tolerance and double-cropping potential, triticale can play an important role in bridging the feed shortage gap in late fall and winter in north Alabama when other cool season grasses become dormant. Field trials were conducted in 2001 and 2002 at Winfred Thomas Agricultural Research Station (WTAIRS) and Sand Mountain Agricultural Substation (SMAS) in north Alabama to evaluate the forage yield and quality of six triticale (X Triticosecale Wittmack) cultivars (TCL105, TCL111, TX98D955, TX96V75019, Triticale 498 and Triticale 2700). The cultivars were planted in four replicated 6-row plots 6.1 m long with rows 1.22 m apart in a randomized complete block design. At both locations, TX98D955, TX96V75019 and Triticale 2700 produced higher (P < 0.05) forage DM than the other cultivars (2-yr average of 4.134, 3.851 and 4.063 kg/ha for TX98D955, TX96V75019 and Triticale 2700, respectively versus 2.744, 3.070 and 3.077 kg/ha for TCL105, TCL111 and Triticale 498, respectively at WTARS and 6.326, 5.974 and 5.938 kg/ha for TX98D955, TX96V75019 and Triticale 2700, respectively versus 4.531, 3.784 and 4.060 kg/ha for TCL105, TCL111 and Triticale 498, respectively at SMAS). Crude protein, ether extract and gross energy contents were lower (P < 0.05) for TCL105 and TCL111. Acid-detergent fiber content was higher (P < 0.05) and IV DMD lower (P < 0.05) for TCL105. The cultivars TX96V75019 and TX98D955 had higher (P < 0.05) P content and the cultivars TCL105, TCL111, TX96V75019 and TX98D955 higher (P < 0.05) Ca content than the rest. The cultivars TCL105 and TCL111 were higher (P < 0.05) in Mg and lower (P < 0.05) in K than the other cultivars. Sulfur was higher (P < 0.05) for Triticale 498 and Zn higher (P < 0.05) for TCL498, TX96V75019 and TX98D955. Iron content was lower (P < 0.05) for TX96V75019 and TX98D955 than for the other cultivars.

Key Words: Triticale cultivars, Forage production, Forage quality

Key Words: Alfalfa, Nutrition Quality, Tropics

Key Words: Particle size, Chewing, Dairy cows

Nutritional quality of twenty alfalfa (Medicago sativa L) cultivars from Embrapa’s Brazil germplasm bank. H. Carneiro1, M. de A. Bortel1, F. de S. Sobrinho1, and M. Villaquiran2, 1EMBRAPA, CNPGL, Minas Gerais, Brazil, 2E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.

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Key Words: Triticale cultivars, Forage production, Forage quality

Key Words: Particle size, Chewing, Dairy cows

Forages & Pastures: Grazing, cultivars, forage management
W231 Grazing and supplementation effects of lablab (Lablab purpureus) on weight gains of St. Croix white hair sheep lambs during the dry season. E. Valencia*, R. W. Godfrey, and S. Weiss, University of the Virgin Islands, Agricultural Experiment Station.

Scarcity of guineagrass (Panicum maximum Jacq.), particularly during the dry season, is a major limitation to growing small ruminants in the eastern Caribbean islands. Lablab (Lablab purpureus) is a fast growing and high yielding semi-annual forage legume, but its potential as an animal feed for grazing or supplementation has not been documented. The feeding value effect of lablab on ADG of weaned lambs (15 kg BW) during June-August 2002 (dry season) was investigated. Treatments were unrestricted grazing of guineagrass supplemented with lablab (SL; 0.5% animal liveweight on a dry matter basis), unrestricted grazing of both guineagrass and lablab (GL), and unrestricted grazing of guineagrass (control) in a randomized complete block with two replicates. Lambs (n = 4) grazed pastures (.14 ha) and were supplemented for a 96-d period, after a preliminary adjustment feeding period of 14-d. Lambs were weighed weekly throughout the trial. Herbage mass for a 96-d period, after a preliminary adjustment feeding period of 14-d for four days and was performed with random sequencing of horses. Data were analyzed using GLM procedures of SAS and mean separation when significant was conducted with LSMEANS. There were significant differences (P < 0.05) among treatments ADG. There was a four-fold increase in ADG for GL (72.8 ± 6.2 g/d) compared to the control (18.5 ± 6.9 g/d). Average daily gain of lambs on GL was also much higher than SL (36.4 ± 6.4 g/d). There were differences among treatments for HM (P < 0.05). At season end, HM on offer for GL (3.64 ± 0.3 Mg/ha) was two-fold higher than SL (1.9 ± 0.3 Mg/ha) and control (1.3 ± 0.3 Mg/ha). These results indicate that weight gains of St. Croix White lambs can be increased with summer grazing or supplementation of lablab. The increased weight gains observed with unrestricted grazing of lablab justify its establishment as a special purpose pasture for use with weaned lambs during the dry season.

Key Words: Grazing, Supplementation, Sheep


Cattle, sheep, and goats, prefer forage cut in the afternoon to that cut in the morning because of the greater sugar concentration. However, no quantitative studies have been reported for horses. We tested horses’ preference for PM- vs. AM-cut alfalfa-grass hay grown in southeastern Montana. Hay consisted of 70% Grimm alfalfa at 15% bloom and 30% Fairway crested wheatgrass. The hay was cut on July 5, 2002 at 1900 hr and again the next morning at 0700 hr using a swather equipped with a conditioner. Hay was air-dried for 24 h and hauled into 300 kg round bales, stored on pallets, tarped, and placed under a metal hay shed. Five kg of each hay were offered ad libitum to each of five American Quarter horses for 10 minutes. Feeding was replicated twice a day for four days and was performed with random sequencing of horses and positioning of the hay buckets placed on the ground. Dry matter intake was determined by weighing before and after feeding. Four samples of each bale were dried in a convection oven at 60°C for two weeks, then ground into a fine powder. Each 1-g sample was combined with 9 ml distilled water, boiled for 5 min, and vacuum filtered through Whatman #1 qualitative paper. Sugars in the filtrate were determined using a Bausch and Lomb 4005D refractometer having range of 0 - 60%. Data were tested with analysis of variance. Horses preferred the PM-cut hay (P = 0.001) which had a significantly higher concentration of sucrose (P = 0.038). Horses were able to identify the forage having the greater concentration of sugar and ate larger quantities of that hay.

Key Words: Horse, Hay, Preference

W233 Rabbit preference, intake and digestibility of afternoon- or morning-cut alfalfa hay fed ad libitum as pellets. H. F. Mayland*, J. C. Burns2, and B. E. Mackey3. 1USDA-ARS, Kimberly, ID, 2USDA-ARS, Raleigh, NC, 3USDA-ARS, Albany, CA.

Ruminants show a preference for afternoon- versus morning-cut forage, which is likely a response to accumulated sugars during daylight. We determined rabbit (Cuniculus oryctolagus) preference, intake and digestibility of pelleted alfalfa (Medicago sativa) hay that was cut either in the afternoon (PM) or in the morning (AM). Preference was determined by ad libitum feeding of both hays for 21 days. Dry matter intake of each hay, when fed alone, was determined in a cross over design for two consecutive 2-week periods followed by one-week period. Apparent dry matter digestibility was determined by daily fecal collections for three consecutive days. Animals had free access to trace mineral salt and fresh water. Feed allocations were replaced daily and subsamples of forage and refusals were composited by group and week for analyses. Rabbits strongly preferred the PM pellets, which formed 95, 97, and 98% of their diet during weeks 1, 2, and 3 respectively. When not given a choice, rabbits ate the same amount of each feed (P = 0.54). Rabbits, during the final week, had a dry matter intake of 6.7% of body weight. The apparent dry matter digestibility, as measured by the rabbits, was 640 g kg⁻¹. Like ruminants, rabbits could sense the difference between the afternoon- and morning-cut hays, but contrary to ruminants, rabbits ate the same amount of each hay when not given a choice.

Key Words: Rabbits, Hay pellets, Preference

W234 Effect of previous exposure of sheep to monoterpane odors on intake of alfalfa pellets treated with camphor or α-pinene. R. E. Estell1*, E. L. Fredrickson1, D. M. Anderson1, K. M. Havstad1, and M. D. Remmenga2. 1USDA-ARS, Jornada Experimental Range, Las Cruces, NM, 2New Mexico State University, Las Cruces, NM.

Lambs were exposed to aromas of two monoterpenes that had previously been found to decrease intake to determine if exposure during feeding modified effects of these terpenes on subsequent intake. Two experiments were conducted using a split plot design. Thirty-six ewe lambs (mean BW = 23.1 and 42.2 kg in Exp. 1 and 2 respectively) were group-fed alfalfa pellets (4% of BW, DM basis) in enclosed portable buildings (3.0 x 3.7 m) for 2 h each morning for 56 d. Nine lambs were randomly assigned to each of four buildings, and the appropriate chemical (25 g of camphor in Exp. 1 or 50 ml of α-pinene in Exp. 2) was placed in a mesh-covered container in the center of the feeder in two buildings immediately before feeding (two buildings served as controls). After the 8-wk exposure period, lambs were individually fed alfalfa pellets (640 g, DM basis) for 20 min each morning for 10 d (5-d adaptation, 5-d intake measurement) in a metabolism building. Treatments were sprayed on alfalfa pellets at levels representing the concentration of that chemical in Flourensia cernua or at 10-fold that concentration. Controls received ethanol carrier only. Lambs were fed in three groups (n = 12), stratified such that one lamb from each building was placed on each treatment in each group. Lambs were housed as one group and fed alfalfa pellets at 5% of BW (DM basis) except during the 20-min tests. No day effect was detected for intake with either chemical (P > 0.05); therefore, data for collection periods were pooled across day. Exposure to the volatile aroma for 8 wk had no effect on intake during the 10-d interval for either monoterpene (P > 0.05). Moreover, intake during the 10-d interval was not affected by treatment concentration (P > 0.05). Neither concentration of the terpene applied to feed nor previous exposure to the volatile aroma from camphor or α-pinene altered feed intake under the conditions of this study.

Key Words: Intake, Sheep, Terpene

W235 Effects of polyethylene glycol and feed blocks on carbohydrate fermentation of woody shrub species. A. Boubakri1, C. Kavouli1, and A. Buldgen2. 1Institut National Agronomique Tunis, 2Faculté des Sciences Agronomiques Gembloch Belgique.

In vitro gas production and organic matter (OM) fermentation were investigated using a closed fermenter containing rumen contents from five ewes receiving 70% of DM of eatable leaves and 30% of concentrate. Shrubs species were incubated separately (Erica arborea, Phyllela angularis, Pistacia lentiscus, Myrtus communis, Quecus suber and Viburnum tinus). Vetch oat hay was used as a reference for tannin-free forage. The effects of polyethylene glycol (PEG 4000) and feed block supply were investigated on the mixture of these shrubs. Feed blocks contained (crude weight basis) wheat bran (38%), wheat flour (10%), molasses (10%), salt (10%), urea (10%), quicklime (15%), dicalcium phosphate (5%), mineral and vitamin supplement (2%). All studied species were
relatively low in crude protein (59-91 g/kg dry matter) and high in fibre (ADF: 266-407 g/kg dry matter). There were differences in volume of gas produced after 72 h with Vibernum tinus producing the highest volume (77.8 ml/g OM) and Quercus suber (27.4 ml/g OM) producing the lowest. However, all shrub species showed less fermentation activity than hay (96 ml/g DM). Volume of gas production, rate of fermentation, volatile fatty acid production and organic matter fermentation were increased (P<0.05) by the addition of PEG. The rate of such increase was relatively low with feed block addition. However, both PEG and blocks addition had greater effects on VFA and OM fermented than on gas production.

Key Words: Shrubs, Gas production, Feed blocks

W236 Effects of windrowed or baled forage on forage quality and beef cattle production during the winter. V. Nayighugu*1, A. D. Schleicher2, B. W. Hess3, D. W. Koch2, and J. W. Flake4, 1Department of Animal Science, 2Department of Plant Science, University of Wyoming.

The objectives of this study were to determine the effects of previous windrow grazing on forage production, forage quality of hay left in windrows or harvested as bales, and BW change of cows offered each forage type during a winter feeding period. Windrow grazing occurred on two meadows (16.2 and 10.1 ha) during the winter of 2000. Samples were collected every 1.22 m perpendicular to the center of the previously grazed windrow in the spring and the summer of 2000, after which the meadows were harvested. Windrows were combined together to double windrow size. On one half of each meadow, all bales were removed, while on the other half, alternate windrows were baled and removed. Forage samples were then collected once monthly until January 2001. Beginning in November, 54 pregnant cows (BW = 551 ± 16.9 kg) were assigned to windrowed or baled forage for 42 d (16.2-ha meadow = 13 cows/treatment and 10.1-ha meadow = 14 cows/treatment). Forage DM production in the spring was greater (P < 0.0001) at 2.44 and 4.88 m compared to where the windrow was grazed the previous year, but this effect was not observed (P = 0.39) in the summer. Acid detergent fiber of forage left in windrows was greater (P = 0.05) than baled forage from September through January. Estimated DMD was greatest (P = 0.05) at harvest and declined more progressively for windrowed forage than baled forage. Forage NDF (P = 0.09) and CP (P = 0.08) tended to be greater for forage left in windrows compared to forage harvested as bales. Cattle offered windrows lost BW while cattle fed baled hay gained BW, resulting in lower (P < 0.0001) ADG for cattle grazing windrows compared to cattle fed baled forage. The reduction in forage nutrient content observed for forage left in windrows appeared to result in reduced production by cows grazing windrowed forage.

Key Words: Cattle, Forage, Grazing

W237 Performance comparison of three hay rake designs. W. A. Greene*, D. A. Munn, and G. L. Sautter, The Ohio State University, Wooster USA.

The main objective was to compare the drying efficiency and nutritional value of baled hay resulting from three types of hay rake (bar, rotary, wheel). Dry matter (DM), crude protein (CP), and neutral detergent fiber (NDF), determined by wet chemistry methods, were used for these comparisons. First and second cuttings were harvested from a twenty acre mixed (orchardgrass/alfalfa) and a twenty acre alfalfa field. Hay was moved with a 12 ft. disc-mower conditioner. The six outside swaths of each field were not included in the trial. Alternate swaths of the hay used in the trial were assigned to each of the three rakes. Representative pre-raking samples were obtained for chemical analyses from the first cuttings. Hay was baled into large round bales with a fixed chamber baler. Within 24 h after baling, representative samples were taken from each bale for chemical analysis (DM, CP, NDF). Although there were no significant differences (P>0.05) for pre-raking and post-baling chemical analyses, there tended to be a loss in nutritional value during the raking and baling processes for the alfalfa hay (5.0% lower CP, 6.4% higher NDF). In general, type of rake had little effect on dry matter, crude protein, and NDF of either the mixed or the alfalfa baled hay.

Key Words: Rake, DM, CP, NDF


Many management-oriented recommendations are available presently to reduce the impacts of grazing Neotyphodium coenophialum - infected tall fescue pastures (IF). Our objective was to evaluate the impact of pasture rotation frequency (twice monthly = 2X vs. twice weekly = 8X) and weaning date (early April = EARLY vs. late May = LATE) on performance by fall-calving cow-calf pairs grazing IF mixed with crabgrass. Sixty cows (495 ± 9.6kg initial BW) were allocated randomly by BW and age to one of eleven IF pastures initially. Pasture groups were allocated randomly to either 2X or 8X and half of each rotation frequency were allocated randomly to EARLY or LATE weaning dates in a 2 x 2 factorial treatment arrangement. Open cows were replaced at the start of the breeding season with first-calf heifers with calves. Cow weights, milk production, and quantity of hay offered did not differ (P > 0.10) between weaning dates or rotation. Cow BCS at calving did not differ (P > 0.10) across treatments, but were higher (P < 0.05) from 2X vs. 8X at breeding. On the date EARLY calves were weaned, EARLY managed in a 2X rotation were heavier (P < 0.05) than LATE from a 2X rotation or EARLY from an 8X rotation. As expected, however, actual weaning weight was lower (P < 0.05) from EARLY vs. LATE, but was not impacted (P > 0.10) by rotation frequency. On the late-May weaning date, LATE were still 40 kg heavier (P < 0.05) than EARLY, although EARLY had approximately 56 d to recover from weaning. Adjusted 205-d weaning weights did not differ (P < 0.10) across treatments. Therefore, at the end of the second calf cycle, rotational grazing management had no impact on forage species composition and cow or calf performance. Calves weaned in April weighed substantially less, even in late May, when later-weaned calves were weaned, implying a high level of stress in response to the April weaning.

Key Words: Tall fescue, Cattle, Forage management


Weaning fall-born calves grazing Neotyphodium coenophialum - infected tall fescue pastures (IF) in April (EARLY) rather than late May (LATE) has had serious negative effects on calf weight, even when measured 56 d later. The objective of this study was to evaluate long-term implications of weaning calves from IF pastures managed using a twice monthly (2X) vs. twice weekly (8X) rotation schedule in April vs. waiting until late May or early June. A total of 113 Gelbvieh-sired calves were vaccinated against 7 Clostridial strains, IBR, BVD, PI3, and BRSV 28 d prior to weaning and received a booster vaccination 14 d later. At weaning, calves were gathered at approximately 0800h from their respective pastures, weighed, commingled, and transported directly to a local auction facility. Calves were weighed at the auction facility at approximately 1700, returned to the research station the following morning, and placed in drylots and fed alfalfa hay and 0.9 kg/ld daily of ground corn for 21 d. At the end of the receiving period, calves were grazed as a group on
common bermudagrass pastures. Total BW loss to the auction barn was greater (P < 0.05), ADG during the subsequent 21-d receiving period was lower (P < 0.05), and time required to recover weight loss was longer (P < 0.05) from LATE vs. EARLY, but percentage shrink did not differ (P > 0.10) among weaning or rotation treatments. Heifer BW was 58 kg greater (P < 0.05) at breeding from LATE calves. Steers previously managed in a 8X rotation schedule and weaned LATE were heavier (P < 0.05) at the time they were shipped to a feedlot than EARLY steers. Steers weaned EARLY from a 8X rotation weighed less (P < 0.05) at the time they were shipped to a feedlot than EARLY steers.

W240 Performance of cow/calf pairs grazing common crabgrass
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Performance of cows and calves grazing crabgrass was evaluated in each of two summers in Southwest Louisiana. Crabgrass was established in mid March by broadcasting 3.6 kg of seed plus 52 kg of 14-14-14 fertilizer per ha. When the crabgrass was approximately 7.5 cm high, 67 kg of N was applied per ha. Control pastures also received the same amount of N at this time. Control pastures in Year 1 were bahiagrass and were combinations of common bermudagrass and bahiagrass in Year 2. Cow/calf pairs were stratified by weight and randomly assigned to either control or crabgrass pastures. Cows and calves were weighed on two consecutive days at the start and the end of each experiment. Cows were scored for condition at the time they were weighed. In Year 1, 120 cow/calf pairs were used, with six 10-cow groups on each treatment. In Year 2, 140 cow/calf pairs were used, with seven 10-cow groups on each treatment. In both years, the stocking rate was 2.5 cow/calf pairs per ha. Cow/calf pairs were placed on crabgrass on June 13 during Year 1 and were grazed for 78 days. In Year 2, grazing did not begin until July 2. This delay was due to a lack of moisture needed for germination and growth of the crabgrass and resulted in a 58-day grazing period. Both trials were terminated at the end of August so the ground could be prepared for ryegrass planting. Cows grazing crabgrass gained 10 ± 4 kg during Trial 1, while the cows grazing bahiagrass lost 21 ± 4 kg (P < 0.05). Calves that grazed crabgrass in Trial 1 had higher weight gains than those grazing bahiagrass (P < 0.05). The weight gain of calves grazing crabgrass was 76 ± 2 kg during the 78-d period while the calves grazing bahiagrass gained 52 ± 2 kg. In Trial 2, cows grazing crabgrass had higher (P < 0.05) weight gains and body condition scores than cows grazing bahiagrass pastures. Calves grazing pastures planted to crabgrass also had higher gains (P < 0.05) than calves grazing the control pastures.

Key Words: Tall fescue, Cattle, Weaning

W241 Effects of corn or soybean hulls supplementation to bermudagrass hay on ruminal in situ disappearance of DM, NDF, ADF and CP of hay, corn and soybean hulls, V. T. Nguyen*, I. A. Orr, B. J. Rude, and D. G. St. Louis, Mississippi State University, MS.

Six ruminally fistulated crossbred steers (181±23.9 kg) were randomly assigned in a 3X3 Latin square design with replication to compare the effects of corn or soybean hulls supplementation on ruminal in situ disappearance of DM, NDF, ADF and CP of hay, corn and soybean hulls, V. T. Nguyen*, I. A. Orr, B. J. Rude, and D. G. St. Louis, Mississippi State University, MS.

The carrying capacity of irrigated pastures established with monocultures of three cool-season grass species was determined using yearlong crossbred beef heifers. Six adjacent 0.5-ha paddocks were established with three grass species, two paddocks/species: orchard grass (OG) (Dactylis glomerata, "Ambassador"), tall fescue (TF) (Festuca arundinacea, "Fawn") and perennial ryegrass (PRG) (Lolium perenne, "Moyie"). Sixty yearling, crossbred beef heifers (360 kg) were stratified into six groups of 10 heifers each. One group was randomly assigned to each of the six paddocks. Grazing commenced in late May and concluded in late September. Flood irrigation and fertilization of paddocks occurred between five grazing periods during the grazing season. The number of heifers assigned to each paddock was adjusted at the beginning of each grazing period depending on forage availability. Management intensive grazing was used allowing the heifers a fresh pasture allotment each 24 hours. Pasture allotment size was adjusted daily to allow heifer ad-libitum intake with an 8 cm post-grazing stubble height.

Key Words: In situ disappearance, Low quality bermudagrass hay, Soybean hulls supplement

W242 Effect of wintering period growth rate on finishing growth rate, final weight and carcass parameters from forage or high concentrate finished cattle. J. P. S. Neel1, J. P. Fontenot2, W. M. Clapham1, and S. K. Duckett3 1USDA-ARS, AFSRC, Beaver, WV, 2Virginia Tech, Blacksburg, 3The University of Georgia, Athens.

Seventy two English-type crossbred steer calves were used to compare growth rate, final weight and carcass parameters from cattle finished on forage (FOR) or high concentrate (CON), after being wintered at low (LOW, ADG = 0.36 kg), medium (MED, ADG = 0.55) or high (HIGH, ADG = 0.82) growth rates. Steers were harvested on the same dates, across treatments, at a commercial meat plant. Data were analyzed as a 3x3 factorial design with winter treatment, finishing treatment and two-way interaction in the model. Steer ADG during finishing was greater (P < 0.01) for LOW than HIGH and tended to be greater (P < 0.10) for MED than HIGH wintering treatments. Animals had greater (P < 0.001) ADG for CON than FOR. Final weight (FW) was greater (P < 0.05) for MED and LOW wintering treatments and greater (P < 0.001) for CON than FOR. Carcass weight (CW) was greater (P < 0.001) for MED and HIGH than LOW and tended to be greater (P < 0.10) for HIGH than MED. Animals finished on CON had greater (P < 0.001) CW than FOR. Wintering treatment did not influence (P > 0.10) dressing percentage (DP), yield grade (YG), rib fat (RF), ribeye area (REA) or percent kidney, pelvic and heart fat (% KPH), however quality grade (QG) was greater (P < 0.001) for HIGH than LOW and tended to be greater (P < 0.12) for HIGH than MED. Animals finished on FOR had greater (P < 0.001) ADG, FW, CW, DP, YG, QG, RF, REA and % KPH. Wintering steers on the LOW treatment resulted in greater ADG during the finishing period, and lower CW and QG than HIGH but did not influence other carcass characteristics. Finishing cattle on CON resulted in greater ADG, FW, CW, DP, YG, QG, RF, REA and % KPH.

Key Words: finishing, forage, wintering


The carrying capacity of irrigated pastures established with monocultures of three cool-season grass species was determined using yearlong crossbred beef heifers. Six adjacent 0.5-ha paddocks were established with three grass species, two paddocks/species: orchard grass (OG) (Dactylis glomerata, "Ambassador"), tall fescue (TF) (Festuca arundinacea, "Fawn") and perennial ryegrass (PRG) (Lolium perenne, "Moyie"). Sixty yearling, crossbred beef heifers (360 kg) were stratified into six groups of 10 heifers each. One group was randomly assigned to each of the six paddocks. Grazing commenced in late May and concluded in late September. Flood irrigation and fertilization of paddocks occurred between five grazing periods during the grazing season. The number of heifers assigned to each paddock was adjusted at the beginning of each grazing period depending on forage availability. Management intensive grazing was used allowing the heifers a fresh pasture allotment each 24 hours. Pasture allotment size was adjusted daily to allow heifer ad-libitum intake with an 8 cm post-grazing stubble height.
Clip plots were taken daily to determine DM availability of each paddock allotment. Heifers were weighed before and after each 24 d (approximately) grazing period. Heifers consuming PRG consumed slightly more DM than those consuming TF (9.7 vs 9.5 kg/h/d, P = 0.005). Intake of OG was intermediate, 9.6 kg/h/d. No difference in ADG resulted from grass species could be detected (P > 0.05). All heifers were gaining BW at an acceptable rate (1.2 kg/d). The carrying capacity of OG and PRG did not differ (194 vs 129 grazing d/ha, respectively, P > 0.05). The TF exhibited increased carrying capacity compared to OG (264 vs 194 grazing d/ha, respectively, P > 0.05) and PRG (264 vs 129 grazing d/ha, respectively, P < 0.05). Based on the results of this study, TF is superior to either OG or PRG for irrigated pasture in northern Utah for development of yearling beef heifers.

Key Words: Grazing, Heifers, Carrying capacity

W244 Influence of turning cows out to pasture on fatty acid profile of milk. R. C. Khanal, T. R. Dhiman, and R. L. Bomman, Department of Animal, Dairy and Veterinary Sciences, Utah State University.

Five late lactation Holstein cows milking an average of 25.4 ± 6.4 kg/d were used to study the influence of turning cows out to pasture on fatty acid profile of milk. The 45-d experiment was divided into 3 phases. During first 2 d (Phase 1) of the experiment cows were fed TMR containing 50% forage and 50% grain mix, from 3-31 d (Phase 2) cows were grazed on a predominantly ryegrass pasture with no grain supplementation, and from 32-45 d (Phase 3) cows were fed a diet similar to phase 1. Milk yield was recorded daily. Daily milk fat content and fatty acid profile was determined for samples collected from both a.m. and p.m. milkings. Linear regression was performed to determine the changes in fatty acid profile during different phases. Cows produced an average of 25.2 ± 6.1, 14.0 ± 4.8, and 11.2 ± 5.6 kg/d of milk with 3.4, 4.0, and 3.6% fat in phase 1, 2, and 3, respectively. The CLA content was 4.54 mg/g of fat in phase 1 and reached a maximum of 25.3 mg/g of fat on d 25 of the experiment. No significant change (P > 0.05) occurred thereafter in phase 2. The C18:2 fatty acid declined gradually with no further decrease observed after d 24 (P > 0.05) of the experiment while C18:3 increased significantly (P < 0.05) with no further increase after d 9 (P > 0.05) of the experiment in phase 2. There was no significant change (P > 0.05) in other fatty acids after d 7 once the cows were moved to phase 3. In the present study it took 23 days to establish the highest level of CLA in milk fat after cows were turned out to pasture for grazing with no grain supplementation. Other fatty acids were also stabilized near d 23 after turn out of cows to pasture.

Key Words: CLA, Pasture, Cows


Consumer acceptability characteristics of CLA enriched milk and cheese was studied in two experiments. Experiment 1: 15 cows were randomly assigned either to a diet containing 51:49 forage to concentrate ratio (TMR), grazed on pasture (PS) or PS with 3.2 kg/d of full-fat extruded soybeans (ES). TMR contained 51% grass silage, 48% corn grain and molasses on DM basis, respectively (ES). Experiment 2: 18 cows were randomly assigned either to a TMR, PS, or PS with 3.2 kg/d of full-fat extruded soybeans (ES) diet. Cheese was manufactured from the milk collected during wk 4 to 6 of the experiment. Cheese had 4.7, 15.7, and 14.6 mg of CLA/g of fat for TMR, PS or ES diet, respectively. An open panel of consumers (n=75) evaluated CLA enriched milk (mouth-fill, color, flavor, and overall quality) and cheese (color, flavor, texture, and overall quality) and from experiment 1 and 2, respectively, over a scale of 1-9. A trained panel evaluated the milk (n=8) and cheese (n=7) for evenness of color, flavor, and overall quality in a scale of 1-10. There were no significant differences (P > 0.05) among treatments for any of the parameters studied for milk and cheese by both open and trained panels except for oxidized flavor in cheese. Trained panel scored significantly lower (P < 0.04) for oxidized flavor in cheese from ES treatment (2.6) compared to either of the cheese from TMR (2.9) or PS (3.0) treatments. In conclusion, CLA enriched milk and cheese were similar in color, flavor, and consumer acceptability characteristics except for oxidized flavor in cheese made from the milk of cows fed full-fat extruded soybeans while on pasture.

Key Words: CLA, Milk and cheese, Consumer acceptability

W246 Influence of genotype, heading date and cutting date on fatty acid composition of ryegrass. V. R. Loyola, J. J. Murphy, M. O’Donovan, G. W. P. R. Deverall, and J. J. Murphy, Teagasc, Dairy Production Research Centre, Moorepark, Fermoy, Ireland, 1 Teagasc, Dairy Production Research Centre, Moorepark, Fermoy, Ireland, 2 Universidade Estadual Paulista, UNESP, Jaboticabal, Brasil, supported by FAPESP.

Ruminant products are the only significant source of conjugated linoleic acid (CLA) and they are an alternative as a source of omega-3 fatty acids, which may be beneficial components in the human diet. Linoleic and α-linolenic acids in feed are the precursors of these fatty acids in milk and meat. Animals grazing fresh grass have higher levels of omega-3 and CLA in their meat and milk, when compared with those consuming conserved forages. Therefore, it is important to quantify the variation in the precursors of these fatty acids in grasses. Our objective was to evaluate the effects of genotype, heading date and cutting date on the concentration of fatty acids (FA) in perennial ryegrass (Lolium perenne L.) cultivars. Ryegrass samples were taken at four cutting dates (22/05, 12/06, 03/07 and 28/08/2000) from a 2x2 factorial experiment in a split-plot design with three replications. The four ryegrass cultivars used were: Millennium, Portstewart, Napoleon and Spelga. Forage samples were freeze-dried and grounded. Fatty acids were methylated using a one-step methylation, and analyzed by gas chromatography. The genotype effect was significant (P < 0.05), with tetraploid cultivars resulting in higher total FA concentrations (19.03 g/kg DM), in comparison to diploid cultivars (16.73 g/kg DM). Intermediate heading cultivars presented higher (P < 0.05) total FA levels (19.38 g/kg DM), compared to late heading (16.38 g/kg DM). There was also a significant effect of cutting date (P < 0.01) on total FA concentrations, with the highest levels of 18.52 and 19.97 g/kg DM, found in May and August, respectively. The June and July total FA concentrations, 16.59 and 16.45 g/kg DM, respectively, differed only from August (P < 0.05). This work demonstrates the viability of manipulation of ruminant products through management and breeding of grasses, aiming alter its FA levels.

Key Words: Ryegrass, Growth stage, Fatty acids

Extension Education

W247 Consumer response to beef quality assurance certification of producers. J. W. Comerford, J. P. Slayton and L. Zerby, 1Penn State University, University Park, PA USA, 2Pennsylvania Beef Council, Middletown, PA USA.

A study was conducted to evaluate the response of consumers to information about beef quality assurance certification training of producers. Two marketing treatments were used. First, six focus groups were interviewed after observing three separate informational posters about beef quality assurance training at a mock retail meat case. Secondly, 168 consumers were interviewed while shopping at the meat case at one of nine retail food stores in central and eastern Pennsylvania. Group interviews revealed that consumers were receptive to information about beef products: implications of "advertisement" and the use of the terms "animal welfare" and "training of producers" were highly negative, while "safety" and "quality" were neutral; some form of validation of the program was positive and desirable; and information should be located on the meat package or within the meat case. Store interviews revealed 74% of consumers thought quality assurance labeling had "some importance" to
them, 87% felt producers were "concerned about the quality and safety of beef", and 63% indicated quality assurance information positively influenced their "confidence in buying beef". The results indicated consumer confidence in the quality and safety of beef can be enhanced by providing beef quality assurance certification labeling.

Key Words: beef quality assurance, consumers, food safety

W248 Dairy beef: Maximizing quality & profits—an educational program for dairy producers. D.A. Moore1, J. Kerk1, F. Garry2, W. Wales3, J. Dalton4, J. Busboom4, D.J. Klingborg1, M. Payne1, J. Marchello5, and M. Poe1. 1University of California, Davis, 2Colorado State University, 3University of Idaho, 4Washington State University, 5University of Arizona.

Dairy producers not only ship milk, they are in the beef business too! Dairy market cattle are a major source of beef and can represent up to 15% of a dairy’s income. In western states alone, over 800,000 dairy cows worth about $500 million are marketed to slaughter every year. Demands on meat packers as a result of Hazard Analysis Critical Control Point plan implementation have focused their attention on the quality of incoming cattle. In response to this, a 7-western state collaborative project was developed to create a distance learning program for dairy producers, cooperative extension advisors, and dairy veterinarians to provide a consistent message about dairy beef food safety. Project coordinators at the University of California-Davis designed this program with input from dairy and meats scientists, veterinarians and media specialists from six other western states: Arizona, Colorado, Idaho, New Mexico, Oregon and Washington. The curriculum was developed in a modular format and individuals from different states took lead on specific segments. Educational segments include videos, narrated slide sets, written materials, and interactive evaluation tools (quizzes, discussion questions, and evaluations) as well as links to more detailed informational websites. The course was also designed to be packaged as a trainer’s and participant’s CD-ROM for individuals requesting in-residence training or without access to the Internet. As part of the development process, the project team solicited formative evaluations from extension specialists, dairy producers, veterinarians, and milk processor representatives that allowed these individuals to be part of the project and make important suggestions to improve program quality. Twenty individuals reviewed all course segments, completed an evaluation tool, and provided written comments. They highlighted correctable navigation problems and image quality on different computers and internet access but all were positive about the content and messages. “Dairy Beef: Maximizing Quality and Profits” http://dairybeef.ucdavis.edu is a distance learning program that focuses on improving the quality of the dairy cattle going to slaughter to increase income from cull dairy cattle and assure future access to beef markets.

Key Words: Dairy beef, Food safety, Training

W250 Oregon dairy environmental stewardship program. M. E. French*, T. W. Downing, and P. D. French, Oregon State University, Corvallis, OR/USA.

The Oregon Dairy Environmental Stewardship Program was designed to recognize dairies for producing high quality milk and providing safe dairy products to Oregonians as well as educating the public. Today many of the dairy’s neighbors have been removed from agriculture. There is a wealth of misinformation that has generated consumer concerns, from antibiotic residues to odor issues. The Oregon Dairy Environmental Stewardship Program focuses on the need for environmental soundness, but assumes the producer’s care and concern for the environment and considers how to work with the producer to achieve this goal. As animal agriculture becomes more consumer driven, dairy producers will be challenged to enhance product value, while simultaneously controlling cost, animal well being, integrity of the environment, and food safety. This is a voluntary program that will put the dairy industry in the forefront of any future regulations. In order to become an Oregon Dairy Environmental Steward, a ten-step process must be completed. These include: a nutrient management plan, milk sanitation permit to produce and sell Grade A milk, completion of a water quality evaluation, wildlife protection assessment / wetlands determination, odor management plan, elimination of mercury, emergency action plan/ farm plan, confined animal feeding operation (CAFO) compliance, six hours of continued education - completed within 18 months, and some form of public outreach. The dairy must remain in compliance with changing state regulations, take at least three hours of continued education within a twenty-four month period after certified and update plans as needed. Many dairies have already achieved several of the stewardship criteria and should be recognized for their continued achievements. The Stewardship program was patterned after several programs already in existence and was revised to meet the needs of both Oregon dairy producers and Oregon citizens. Overall, the Oregon Dairy Environmental Stewardship Program was designed to protect the long-term growth of the entire dairy industry.

Key Words: Environment, Stewardship, Voluntary

W251 Effect of artificial insemination versus natural service breeding on production and reproduction parameters. J. W. Smith, L. O. Ely, W. D. Gilson, and W. M. Graves, University of Georgia.

U.S. dairy cows are bred by artificial insemination (AI), natural service (NS), or by a combination. This study examines the effect of four breeding systems on production and reproduction performance parameters and the interaction of region and herd size on breeding system. DHI Holstein herd summary records for the year ending 2001 obtained from DRMS, Raleigh, NC were sorted and classified by region (North, Midsouth, South) and herd size [small (< 100 cows], medium [100-249], and large [> 250]). Herd's were assigned to breeding systems by % NS usage as follows: (1) 0, (2) 2-1, (3) 21-69, and (4) 90-100. The average % AI and % NS usage by breeding system was: (1) 100, 0; (2) 93, 7; (3) 54, 46; and (4) 1, 99. The main effects of breeding system on milk production and reproductive performance parameters are in the table. Milk production and actual calving interval (CI) were lower (P < 0.05) with breeding system 4 within each region. Milk production was not different between breeding systems 1 and 2 within each region. Actual CI was not different for breeding systems 1, 2, and 3 in the Midsouth and South regions and breeding systems 1 and 2 in the North region. Days dry tended to be higher for breeding systems 3 and 4 than breeding systems 1 and 2. Breeding system 4 had the lowest average % in milk within each region. The % dry 40-70 days was lowest for breeding system 4 within each region and within each herd size group (P < 0.05).
W252 Ranking of dairy farms based on economic measures per cwt milk sold and per cwt milk equivalent. A. E. M. de Araujo* and A. de Vries, University of Florida.

Our objective was to compare the ranking of dairy farms based on economic performance measures per cwt milk sold and per cwt milk equivalent. A common method is to calculate cost, revenue, and profit per cwt sold. A disadvantage of this straightforward method is that the production cost per cwt cannot be directly compared to the price received for milk when other revenue is obtained, such as from the sale of livestock.

Therefore, an alternative method is to calculate economic performance measures based on cwt equivalent. Cwt equivalent is calculated as the total revenue divided by the price of milk per cwt. It is the amount of milk produced to obtain the same total revenue if no revenue was obtained from other sources but milk on the farm. The total production cost per cwt equivalent can be directly compared to the price of milk. The same price of milk should be used to compare the economic performance of dairies. Data were collected through the Dairy Business Analysis Project (DBAP) from dairy farms in Florida, Georgia, and Alabama between 1995 and 2001 (n = 15, 20, 33, 44, 20, 15, 39, respectively). Average milk price used was $17.50. The ratio of cwt sold to cwt equivalent was on average 0.93, ranging from 0.65 to 1.26. Total production cost / cwt sold ranged from $12.71 to $25.28 (average $17.58) while total production cost / cwt equivalent ranged from $11.59 to $23.54 (average $16.19). Average net farm income from operations (NFIFO) / cwt sold was $1.52 and average NFIFO / cwt equivalent was $1.31. The top 6 dairies based on NFIFO / cwt sold and NFIFO / cwt equivalent were identical for 1995, 1996, 1999, and 2000. One of the top 6 dairies was replaced in 1997, 1998, and 2001. The lowest Pearson correlation coefficient between NFIFO / cwt sold and per cwt equivalent of the seven years was 0.984 (1996). The Pearson correlation coefficient between total production cost / cwt sold and per cwt equivalent ranged from 0.419 (2001) to 0.878 (1995). We concluded that the ranking of dairies based on the cost of production may be significantly affected by the method of choice, whereas the ranking based on NFIFO is hardly affected.

Key Words: Dairy, Economics, Production equivalent

W253 Lamb carcass education program for Oregon sheep producers indentifies characteristics that determine carcass value. R. R. Mills*, J. M. Thompson, and K. Walburger, Oregon State University, Corvallis, OR.

A lamb carcass education program in conjunction with the Umatilla County Fair was established in 1990 as a carcass value information feedback system for purebred and commercial sheep producers in northeast Oregon. The program provides the opportunity for participants and other producers to evaluate value-determining factors of market lambs and correlate live animal characteristics with the carcasses from the same lambs. Detailed lamb carcass data, including ribeye area were collected and analyzed on market lambs (n=241) entered by producers from the years 1990 to 2002. Sire breed types represented were SF (Suffolk, n=200), TX (Texel and Texel x Suffolk, n=28), and OT (other sire breeds, n=13). Lambs from TX sires had lighter live weights, lighter carcass weights, and lower dressing percentages than SF and OT sired lambs (live weight = 48.8, 54.1, and 52.4 kg; carcass weight = 24.9, 29.3, and 28.3 kg; and dressing percent = 50.9, 54.1, and 53.9%, respectively; P<.05). There were no sire type effects (P>.05) for fat thickness, leg conformation score, ribeye area, USDA Quality Grade, or USDA Yield Grade. However, TX sired lambs produced larger ribeye areas / unit of carcass weight than SF and OT sired lambs (0.64, 0.59, and 0.57 cm²/kg carcass weight, respectively; P<.05). Over the 13 year history of the program there was no change (P>.05) in fat thickness, dressing percentage, ribeye area, or USDA Yield Grade. During the same time, live weight and carcass weight declined (3.4 and 0.5 kg, respectively; P<.05), but leg conformation score and ribeye area per unit of carcass weight increased (0.57 conformation score and 0.08 cm²/kg carcass weight, respectively; P<.05). The data from this study (2.1% Yield Grade 4 and 5) confirms that genetics and management / production systems currently exist in the US lamb industry to produce high quality, lean, heavily muscled lamb that can be competitive with other sources of human dietary protein.

Key Words: Reproduction, Breeding, DHI


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.

Forty-one dairies submitted financial data for 2001. Thirty-nine dairies were included in the summary with complete data. Of these, 27 were located in Florida, 11 in Georgia and 1 in Alabama. The average herd size was 977 cows and 477 heifers with 17.170 lbs. of milk sold per cow. The average culling rate was 36 percent. There was an average of 19 FTE workers per farm with 51.5 cows per FTE worker and 880,000 lbs. milk sold per FTE worker. Total revenue per cwt was $20.08/cwt. with $18.24/cwt. milk income. The average total expense was $17.75/cwt. The largest expense items were purchased feed ($7.32/cwt.), labor ($2.69/cwt), and livestock ($1.64/cwt). Net farm income from operations was on average $2.25/cwt. and net farm income was $2.39/cwt. The debt to equity ratio was 0.72, the rate of return on assets was 0.09, the rate of return on equity was 0.11, the operating profit margin ratio was 0.09 and asset turnover rate was 0.90. Individual expense items did not have a clear association with either herd size or level of production.

Key Words: Dairy, Financial, Management


The major objective of the study was to determine the biological and economical efficiency of an accelerated, value-added cow-calf production system. The system contains three major components, which are grazing, feedlot and wintering periods. Thirty-two mature crossbred beef cows (700 kg) with superior milking ability (10 kg/d) were selected and mated to bulls known for exceptionally rapid growth EDPs. From May through October, cow-calf pairs grazed improved, irrigated pastures using management intensive grazing practices. On September 1, calves were stratified into early weaned (EW) and normal weaned (NW) groups. The EW were weaned from their dams and placed back on pasture September 1, while the EW remained with their dams on pasture until weaning on November 1. On November 1, all calves were placed in a feedlot and stepped up to an 80% concentrate finishing diet in
case scenarios using farm-specific values. In addition, the farm manager farm business managers to evaluate the economic worth associated with the adoption of long-day lighting technology was developed. New technologies requiring capital investment in assets that have useful lives greater than one year should be analyzed using Net Present Value analysis model, the authors estimated net present values over the ten-year expected useful life of $56,990 and $28,915. All investments with positive net present values are attractive investments, since they assure a rate of return that is greater than the minimum acceptable rate specified for the individual farm business. Sensitivity analyses results suggest that factors having a negative impact on overall economic worth include low milk production response, high electricity costs, and high ration costs. Farm managers should utilize this analysis tool in decision-making should find this tool valuable for estimating the economic worth associated with long-day lighting technology.

Key Words: Net present value, Photoperiod manipulation, Economic analysis model

W258 Regionalization of dairy Extension in-service training in the Mid-Atlantic and Northeast states. R. R. Peters1, M. L. O’Connor2, L. J. Hutchinson3, M. L. Westendorf4, E. A. Claypoole5, G. W. Anderson1, D. P. Marcinkowski5, W. E. Graves6, S. M. Andrew7, W. L. Shockey6, P. S. Erickson5, and J. W. Barlow8. 1University of Maryland, 2Pennsylvania State University, 3Rutgers University, 4Cornell Cooperative Extension, 5University of Maine, 6University of Massachusetts, 7University of Connecticut, 8West Virginia University, 9University of New Hampshire, and 10University of Vermont.

The Middle Atlantic Consortium was awarded a grant from the Kellogg Foundation to develop a project titled, Regionalization of Programs in the Mid-Atlantic and Northeast to Enhance the Quality and Accessibility of Education in Animal Science. The objective for Extension training was to develop a high quality, regional program by increasing the cooperation among institutions and reducing redundant development and delivery of training materials. The organizational structure to plan the annual two-day dairy Extension in-service training program has been through a regional steering committee. The themes and location for the training programs during the last four years are as follows: 1999, Cat- tle Health Assurance Training, New Palz, NY; 2000, Environmental Management of Dairy Farms, Hagerstown, MD; 2001, Tools for Dairy Production and Finance, Wilkes-Barre, PA; 2002. Clearing the Way to Profitability: Nutrition and Herd Health, Labor Management, and Profitability, Wilkes-Barre, PA. Nationally recognized keynote speakers with expertise on the theme subject have participated each year. Attendance has ranged from 55 to 65 educators. A valued feature of this training program is that speakers prepare presentations in PowerPoint. These presentations and other resources in electronic format are copied to a CD and presented in a notebook at registration. The training program has provided the opportunity to capitalize on cooperative efforts that provides excellent in-depth, regular training. Participants have rated the program as excellent or very good (84%), and 94% plan to use some part of their learning experience in their next year’s Extension programs.

Key Words: Regional, Extension, Training


The objective of this study was to investigate if there was any correlation between cow hygiene score and individual cow SCC. A scoring system scale from 1 to 5 was selected to score cows for hygiene. Score 1 indicates a cow that is clean while a score 5 indicates a very dirty cow. The cow hygiene scorecard was broken down into five general areas: tail head, Flank, Belly, Udder and Rear legs. Nine herds were selected for the trial (8 free stall, 1 tie stall). All herds were deemed to have predominantly environmental mastitis problems as indicated by bulk tank cultures. Individual cow SCC and culture data were used to edit known contagious mastitis pathogen infected cows from the data. A total of 1093 cows in the 9 herds were hygiene scored within 2 days of DHIA test day. Each cow was scored in each of the five body areas. An udder-leg composition score was created, by averaging the udder and rear legs scores. A regression model was used to determine the effect that hygiene score had on SCS: SCS = Herd + Parity + DIM + DIM + “Hygiene score”; where SCS is the linear somatic cell count on DHIA test day, there were four parity groups (1, 2, 3, and 4 or greater), and DIM is the days in milk on DHIA test day. The model was run separate- ly for each hygiene score trait. The mean SCC, SCS, FCM, DIM, and 305ME for the 1093 cows in the study were 405,242 (SD 1,017,000).

Key Words: Dairy, Manure, Nutrient cycling


New technologies requiring capital investment in assets that have useful lives greater than one year should be analyzed using Net Present Value methods to assess whether the technology should be adopted. Photoperiod manipulation, also known as long-day lighting, is an emerging technology in the dairy industry. A Net Present Value Analysis Model to determine discounted cash flows over a ten-year expected useful life associated with the adoption of long-day lighting technology was developed by the authors. The model, in electronic spreadsheet form, allows farm business managers to evaluate the economic worth associated with the investment, and perform quick assessment of “best” and “worst” case scenarios using farm-specific values. In addition, the farm manager can easily develop more extensive sensitivity analyses on key variables. Using farm level data from two operating dairy farm businesses and the model, the authors estimated net present values over the ten-year expected useful life of $56,990 and $28,915. All investments with positive net present values are attractive investments, since they assure a rate of return that is greater than the minimum acceptable rate specified for the individual farm business. Sensitivity analyses results suggest that factors having a negative impact on overall economic worth include low milk production response, high electricity costs, and high ration costs. Farm managers should utilize this analysis tool in decision-making should find this tool valuable for estimating the economic worth associated with long-day lighting technology.

Key Words: Beef, Pasture, Nutrition


UW-FARM (Field Nutrient Application and Recommendation Manager) is designed to identify acceptable strategies for managing on-farm and purchased nitrogen and phosphorus in a profitable and environmentally responsible manner. The program relies on latest test results consistent with best management practices and NRCS-590 (USDA-Natural Resources Conservation Services-Wisconsin, 1993). UW-FARM can also be used to ask “what if” when producers are considering expansion or other modernization practices. Assessing the impact of moving current best management practices and NRCS-590 prior to actual expansion will allow producers to meet environmental constraints in a proactive manner. UW-FARM runs on all versions of Microsoft Windows beyond version 3.x. The program can be downloaded from www.uwlabs.soils.wisc.edu or requested on CD. Entering herd cow numbers on the “expansion/modernization options” screen will show in white the manure quantity, available N and corn acres needed to use manure available produced from these animals. The impact of raising heifers on or off-farm is available. Increasing cow numbers increases the need for feed and dairy producers traditionally have met forage requirements by growing and feeding alfalfa. UW-FARM calculates forage needs for cows and replacements. Producers may opt to grow less alfalfa and more corn for silage when acreage is limited because greater tonnage can be realized from corn silage. Users can estimate the percentage of the forage requirement to be supplied as alfalfa and corn silage. Total acres of each forage and total N need for corn silage is estimated. The impact of raising replacement heifers on or off-farm on forage needs manure N production can be evaluated. The total tons of P2O5 required at optimum soil test P levels are totaled for the alfalfa/corn silage options. The impact of raising replacement heifers on or off-farm on forage needs manure N production can be evaluated. The total tons of P2O5 required at optimum soil test P levels are totaled for the alfalfa/corn silage options. The potential decrease in available manure phosphorus by limiting dietary phosphorus or cow numbers can be evaluated.

Key Words: Dairy, Manure, Nutrient cycling
The number of food and other dietary products containing live Bifidobacterium and Lactobacillus bacteria has increased in recent years. In the large intestine, prebiotics, in addition to their selective effects on bifidobacteria and lactobacilli, have influenced many aspects of bowel function through fermentation. The selected symbiotic pairs of stimulated lactobacillus strains and oligosaccharide enhancing their growth were studied to determine the effect of prebiotics, probiotics and symbiotics. This research was investigated effective ability of L. acidophilus ATCC 43121 bacteria on minimal media by ratio of adding prebiotics which was used as substrates. Viable cell count of L. acidophilus ATCC 43121 and pH of media were measured during twelve, twenty four hours incubation at 37 with seven prebiotics which were of different concentrations to increase the growth of L. acidophilus ATCC 43121 selectively. From this experiment results, the effect of prebiotics was significantly (P<0.05) higher in control media compared to media adding ratio of fructooligosaccharide, lactulose, raffinose for twenty four hours. The addition ratio expansion of this three prebiotics was increased consequently by strains growth but pH was decreased. For this experiment response surface methodology to create the right mix ratio which will maximize the bacteria’s vital energy by using mix of selected three prebiotics and from this, the right mixture ratio was 36.5%, 0.00% and 63.5%.

Key Words: Lactobacillus acidophilus, Prebiotics, Symbiotics

**W262** selection of prebiotics utilization from Lactobacillus acidophilus ATCC 43121 for symbiotics. E. Y. Ahn1, S. Oh2, and S. H. Kim1, 1Korea University, 2Hankuk Yakult Institute.

Recent evidence suggests that the addition of bifidobacteria as a dietary adjunct or probiotic may have important health benefits. However, in order for these bacteria to manifest beneficial effects, they need to achieve an essential mass through aggregation. Consequently, the ability of bifidobacteria to aggregate is a desirable property sought for use in commercial food preparations. The objective of this research was to determine the effect of media composition and incubation temperatures on autoaggregation behavior of bifidobacteria. Another objective of this work was to determine the cell surface characteristics of bifidobacteria as related to autoaggregation. Autoaggregation behavior of bifidobacteria was determined using different media (TPY, Wilkins-Chalgren and

Key Words: Exopolysaccharides, Co-culturing, Nutrient supplementation
mMRS) and incubation temperatures (34, 37, and 42 °C). Autoaggregation ability was measured as autoaggregation percentage. In this procedure, overnight culture was shaken at different times (30, 60, 90, 120, and 150 min). After shaking, 2 ml of the upper suspension of the culture was transferred to anther tube and the optical density (O.D 610nm) was measured. Three types of autoaggregation behavior characterized the strains: (1) autoaggregation sensitive (S) for strains that formed a precipitate resulting in a clear solution, (2) autoaggregation resistant (R) for strains that produced consistent turbidity, and (3) autoaggregation moderate (M) for strains that showed slight turbidity. Results on the media composition showed that TPY broth increased the autoaggregation behavior of the tested strains, whereas Wilkins-Chalgren and MRS reduced autoaggregation behavior. Calcium ions induced the autoaggregation. Tween 20 and Tween 80 reduced autoaggregation behavior. Higher incubation temperature (42 °C compared to 34 °C) increased the ability of strains to autoaggregate. Hydrophilic and electrostatic surface properties influence the autoaggregation behavior of bifidobacteria. Our data indicated that media selection; incubation temperature, and calcium ions are important factors affecting autoaggregation behavior of bifidobacteria. Autoaggregation should be considered when selection of bifidobacteria for their specific use in commercial preparations.

Key Words: Bifidobacteria, Autoaggregation


Probiotic supplements are becoming increasingly popular in the United States and Europe. Although there are many different types of probiotics, the most common live cultures found in yogurt products are L. bulgaricus, S. thermophillus, L. acidophilus, and bifidobacteria. In addition to these beneficial cultures, some dairy industries are beginning to add Lactobacillus reuteri to their products as a beneficial culture. L. reuteri helps prevent and treat both viral and bacterial diarrhea enhancing the body’s resistance to gastrointestinal disease. However, in order to survive and colonize in the gastrointestinal tract, L. reuteri needs to show high tolerance to acid and bile salt. The purpose of this work was to investigate the effect of acid and bile salt on the survival and growth of L. reuteri. Five strains (CF 2F, DSM 20016, MM 7, MM 2-3, and SD 2112) of L. reuteri were used in this study. Cultures were inoculated into fresh MRS broth with various concentrations of bile salt (0.0, 0.1, 0.2, 0.3, and 0.4%) and pH values (pH 2.0, 3.0 and 6.5). Samples were then mixed well and incubated at 37 °C for 48 hrs. Bacterial growth was monitored by measuring turbidity at 610 nm in a spectrophotometer at different time intervals during the incubation period. Results showed that a 0.3% bile salt concentration caused a significant reduction in the growth of all tested strains (P < 0.05). The survival of L. reuteri differed significantly among tested strains; MM 2-3 showed significantly higher growth rates than the other tested strains over the 48 hr incubation period. At a 0.2% bile salt concentration, a significant growth reduction (P < 0.01) was observed for strains CF2 F and MM7. None of the tested strains survived low pH (2.00 and 3.00). The results suggest that acid and bile tolerance is an important selection characteristic for the use of L. reuteri cultures as a dietary additive.

Key Words: Lactobacillus reuteri, Acid and bile resistant


The presence of microorganisms in food products has important ramifications for safety, quality, regulations, and public health. Rapid and reliable methods are required for the detection of microorganisms, especially foodborne pathogens. The use of Fourier transform infrared (FTIR) spectroscopy and chemometrics (partial least square (PLS) regression and hierarchical cluster analysis (HCA)) for the rapid detection, identification, and enumeration of bacterial in cultures was investigated. In this study, gram-negative (Escherichia coli O157:H7, H1730, F4546, Cider, E0019) and Salmonella typhimurium (ATCC 14028) and gram-positive (Lactobacillus reuteri SD2112, MM2-3, MM7, CF2-7F, MF14-C) were used. Pathogens were grown in brain heart infusion agar (BHI) whereas lactobacillus strains were grown in MRS broth. All strains were incubated at 37 °C for 24 hr. FTIR spectrometer with attenuated total reflectance (ATR) was used to measure aqueous microbial samples. Fresh broth without microorganism was used as background. The spectral data collection was just taken about 3 minutes. Different spectral regions (3700 - 2800 cm⁻¹ and 1800 - 1000 cm⁻¹) were used to identify and classify. Bacteria were clustered into negative ((E. coli O157:H7, S. typhimurium) and positive (L. reuteri) groups while the rate of correct classifications is 100%. HCA even demonstrated the differences among H1730, F4546, Cider, E0019 strains of E. coli and SD2112, MM2-3, MM7, CF2-7F, MF14-C strains of L. reuteri, separately. A dendrogram indicated that CF2-7F was different from the rest of L. reuteri because it was found in the infant sample while the other were from adults. PLS regression was used for enumeration of bacteria. A R-square value was 0.999 from PLS model based on spectral data and cell numbers. Our results indicated that FTIR spectroscopy could be used as a rapid method for the identification and enumeration of bacteria in foods.

Key Words: Fourier transform infrared (FTIR), Dairy foods, Pathogens

W266 Encapsulation of Lactobacillus reuteri with sodium alginate for continuous production of lactic acid, S. A. Ibrahim*, C. W. Seo, S. Phetsomphou, and G. Shahbazi, North Carolina A&T State University.

Lactic acid fermentation is a well-known process used to preserve food products. The most common approach in lactic acid fermentation is the use of batch system. However with this process several factors limit efficiency of the production of lactic acid. For example, the end products may cause an inhibitory effect on the lactic acid bacteria (LAB). Consequently an alternative method, one that does not have inhibitory effects on LAB is needed. A possible method that meets these challenges involves immobilization of LAB with sodium alginate. The objective of this research was to determine the ability of encapsulated Lactobacillus reuteri (L. reuteri) in sodium alginate to produce lactic acid. In this study, the production of lactic acid was compared using two types of fermentation methods: Batch and batch bead fermentation. Six strains of L. reuteri, CF 2-F, DSM 20016, SD2112, MM 7, MF 14-C and MM 2-3 were used. These strains were grown in lactobacillus MRS at 37°C for 24 hrs. The cells were then washed and suspended in 10-ml peptone water. Sodium alginate beads were prepared by resuspending the 10-mL culture in 7% sodium alginate solution. Beads were manufactured by dropping sodium alginate culture into ice-cold (2°C) 0.4M calcium chloride using a separatory funnel. Under comparable conditions the sodium alginate encapsulated cells were allowed to ferment in 500-mL lactobacillus MRS and whey based medium at 37°C for 24 hrs. Samples were withdrawn at two-hour intervals during storage period and analyzed for pH value, lactic acid, glucose, and lactic acid. Results showed that the pH reached 4.00 within 15 hrs with beads fermentation and reached 5.40 using conventional batch. This indicates that higher acid yields can be produced using bead fermentation. Strain MM 2-3 produced the highest lactic acid yield as measured by pH value (pH 3.70) and lactic acid (8.0%) while strain SD2112 produced the lowest acid yield as measured by pH value (pH 4.18) and lactic acid (2.0%) levels. Our results suggest that using immobilized cells of L. reuteri could have potential use to produce lactic acid for commercial applications in food and pharmaceutical industries.

Key Words: Lactobacillus reuteri, immobilization


Lactobacillus reuteri (L. reuteri) is known to produce a broad-spectrum of antimicrobial compound, reuterin. The antimicrobial spectrum of reuterin includes Gram-positive and Gram-negative bacteria. The purpose of this study was to determine the antimicrobial activity of L. reuteri against the foodborne pathogen, Escherichia coli O157:H7 (E. coli O157:H7). Six different strains of L. reuteri (CF2-F, DSM 20016, MF14-6, MM2-3, MM-7) were incubated at 37°C for 24 hrs in two different growth media (MRS without glycerol, and MRS with 0.2 M glycerol solution). Samples were centrifuged (5,000g/15 min) to obtain supernatants (200μl) which were then tested against five strains of E. coli.

A comprehensive risk assessment of the microbial quality of milk powder should include information about endospores as well as viable bacteria. Bacillus endospores are present in raw milk, used in milk powder production, in numbers ranging from less than 10 to greater than 100 per g of solid content. However, in the finished product they range from less than 100 to 1x10^7 per gram, meaning that endospore-forming bacteria will have the most significant effect on the microbial quality of the powder. Molecular methods offer a unique and sensitive tool for rapid microbial detection. Our focus is to apply polymerase chain reaction (PCR) methods to detect early germination of endospores in milk products. We have studied the germination gene, GerC3, from endospore-forming members of the family Bacillus. This led to the development of specific primers for PCR detection. In the Dairy Products Technology Center (DPTC) endospore library, we have been able to detect five specific strains that contribute to the lipolysis, casein hydrolysis, starch hydrolysis, and acid production of milk products using our primers. The primers designed in this work identified either a 100bp or a 500bp in a conserved region of the GerC3 gene found in the five DPTC target strains. These bands have been detected during germination activity in all five of these Bacillus strains. Spore germination has been difficult to study because it involves extremely rapid physiological responses in a spore whose structure is biochemically intractable. We have evaluated the developed primers in Reverse Transcriptase-PCR (RT-PCR) in the early detection of specific endospores present in skim milk powder resulting in the ability to document the presence or absence of endospore forming bacteria. Results indicate that the rapid growth of endospore forming bacteria can be monitored using RT-PCR.

Key Words: Endospore detection, PCR, Milk powder

W269 The effect of the incorporation of lactobacilli and whey protein isolate on the level of cell glutathion and immunoglobulin M (Ig M). Y. H. Yoon*1 and J. R. Byun, 1Department of Animal Science and Technology, Chung-Ang University.

The effect of the incorporation of whey protein isolates and Lactobacillus spp.in the mouse diet on the level of cell glutathion and Immunoglobulin M (Ig M) in the germ free ICR mouse feeding system. The study was conducted to find out the effect of incorporation of Lactobacillus spp. on the cell glutathione level and Ig M level in the spleen,liver and erythrocyte cells. The highest and statistically significant level of glutathione in spleen cell has been shown in L.casei YIT 9018 cell fed group by feeding 20% whey protein isolate and with L. casei YIT 9018 or L. casei CU 001(p<0.05). Feeding L. casei YIT 9018 with whey protein isolate or L. acidophilus NCFM increased the Ig M level in the splenocyte significantly which was determined by the method of plaque forming unit counting.

Key Words: Glutathione, Immunoglobulin M, Lactobacillus spp.


The objective of the project was to evaluate efficacy of Elliker agar medium as a general purpose enumeration medium for lactic acid bacteria. International Dairy Federation (IDF) recommends M17 agar for starter lactococci and streptococci and MRS agar (DeMan Rogosa Sharpe) for starter lactobacilli enumeration. Current IDF protocol requires specific pH, incubation temperature and incubation conditions (e.g. anaerobic incubation) typical for specific starter bacteria. In light of this the Elliker agar medium with specific modifications was utilized to enumerate selected lactic acid bacteria as a convenient medium that can be used easily by the industry in a routine fashion. Lactic acid bacteria, namely Streptococcus thermophilus (ST), Lactobacillus delbrueckii subsp. bulgaricus Y (LB), Lactococcus lactis sub sp. lactis ATCC 11454 (LL) and Lactobacillus acidophilus NCK 1070 (LA) were utilized. All lactic acid bacteria were subcultured in sterile skim milk. Experiments were repeated 3 times. Appropriate dilutions of skim milk cultures were poured as plates using Stat IDF scheme. Additionally, Elliker medium was used in pour plating at comparable pH and a general pH 6.8 for all the comparisons. Elliker agar modifications utilized alternative nitrogen sources such as casein hydrolysate and 3 per cent sterile skim milk. Based on the statistical analysis of data it was found that modified Elliker medium gave similar recovery with regards to LA, LL, LB and ST when compared to M17 and MRS agar. It was also found that LB can be enumerated without anaerobic incubation when the purpose is general enumeration. pH had no significant influence in Elliker medium in regard to enumeration. Modified Elliker medium appears to be a good candidate for general purpose enumeration media for lactic acid bacteria.

Key Words: Lactic acid bacteria, International Dairy Federation, Fermented dairy foods

W271 Effects of co-culturing EPS and non-EPS starter cultures and supplementation with WPC on syneresis, textural and rheological properties of set yoghurt. T. Amatayakul*, 1, B. Ziu1, F. Sherkat1, and N. P. Shah1, 1Victoria University, Melbourne, Australia, 2RMIT University, Melbourne, Australia.

Exopolysaccharide (EPS) producing starter cultures are becoming increasingly popular for use in the dairy industry. In our earlier study, EPS producing Streptococcus thermophilus 1275 when co-cultured with non-EPS S. thermophilus produced higher levels of EPS. Sterilisation with WPC increased EPS production and reduced the rate of lactic acid production. The objective was to assess if these approaches could improve syneresis, textural and rheological properties of yoghurt. Six batches of yoghurts were made in triplicate using 12% reconstituted skim milk (RSM) with or without replacement of RSM with 0.5% WPC and co-culturing with EPS and non-EPS starter culture (75:25). Syneresis was determined as a percentage of whey expelled after centrifugation. A TA-XT2 texture analyser was used to measure textural properties and gel firmness, and rheological properties were determined by using a Haake Rheostress 50 rheometer. HPLC was used to measure the amount of lactic acid produced. EPS was quantified using the phenol-sulphuric method. Yoghurts made using EPS starters cultures showed reduced syneresis. Control yoghurts made with non-EPS starter and without WPC showed 65.20% syneresis, and those made using co-cultures 60.26%. Co-culturing and partial replacement with 0.5% WPC showed the highest yield stress at 363.367 Pa. Co-culturing and WPC showed the highest yield stress at 363.367 Pa.
Supplementation with WPC and co-culturing with EPS starters has a significant effect (p<0.05) on reduction of syneresis, textural and rheological properties of set yoghurt, and may provide an alternative means of improving functional characteristics of yoghurts without incorporating the use of stabilizers.

**Key Words:** Exopolysaccharides, Rheological properties, Yoghurt

**W274 Effect of c2 phage peptide on acid development in milk inoculated with Lactococcus lactis spp lactis C2 with and without c2 phage infection.** J. Surjawan and C. L. Hicks*, University of Kentucky, Lexington, KY 40546.

Peptides from c2 phage were prepared by hydrolyzing c2 bacteriophage(Φ) with ficin (0.2% at 26°C for 6 h). Inhibition of phage proliferation tests were conducted in milk following a rennet cheese schedule (1 h ripening at 31°C, rennet, cooking to 37°C, and holding at 37°C) by measuring change in pH during fermentation. Six sterilized pint jars were filled with 96 ml of pasteurized milk. Milks were inoculated (4%) with C2 culture that was grown in medium with (2 jars) and without (3 jars) phage peptides (2%) added. One jar was inoculated with culture grown in medium containing 1% c2 peptide. The milk in this jar also contained 1 % added c2 peptide. One of the milks that was inoculated with culture grown in medium without c2 peptide contained 2% added c2 peptide. Four of the milks were infected with c2 phage (10^6 phu/ml). The pH decreased fastest in milk inoculated with C2 culture grown in medium without added c2 peptide then in milk inoculated with culture grown in medium containing c2 peptide. These 2 milks had significantly better acid production (pH 5.63 and 5.71, respectively after 4.5 h of fermentation) than the other 4 milks. However, milks that were inoculated with culture grown in c2 peptide (both the 2% peptide medium and 1 % peptide medium with 1% peptide added to the milk) and infected with (Φ)c2 did continue to produce acid (pH 6.01) throughout the fermentation period. When 2% c2 peptide was added to the milk and inoculated with culture grown in medium without peptide, acid production stopped (pH 6.25) after 200 min. Acid production in milk inoculated with culture grown in medium without peptide and infected with (Φ)c2 stopped (pH 6.25) after 120 min of fermentation. These results suggest the culture growth in media containing c2 peptide were protected from c2 phage proliferation and lysis during the fermentation period better than when the peptide was added to the milk, or when no peptide was present.

**Key Words:** Lactococcus lactis, c2 Bacteriophage inhibition, pH Milk

**W275 Inhibition of Salmonella and Escherichia coli phage with c2 phage peptide.** C. L. Hicks, J. Tang, and I. Surjawan, University of Kentucky, Lexington, KY 40546.

Peptides from Lactococcus lactis Φc2 (phage) were prepared by hydrolyzing Φc2 (10^6 phu/ml) with ficin (0.2% at 26°C for 6 h). Hydrolyzed peptides were partially purified by ultrafiltration (3000 mwco). Ultrafiltration permeate was dialyzed (500 mwco) and freeze dried, then used to formulate growth media. *Salmonella choleraesuis* ssp. *cholerasuis* (Smith) Weilin serotype Typhimurium deposited as *Salmonella typhimurium* (Loofter) Castellani and Chalmers ATCC 14028 and *Escherichia coli* (Migula) Castellani and Chalmers ATCC 47076 were grown in 1558 medium and 1065LB medium, respectively, with and without Φc2 peptide present (various concentrations) and, with and without their respective phage (*S. cholerae suis* ssp. *cholerae suis* serotype Typhimurium phage ATCC 40282 and *E. coli* lambda 97538 ). *S. cholerae suis* ssp. *cholerae suis* grew faster when c2 peptide (1.5 and 2.5% concentrations) was added to the 1558 growth medium (incubated at 37°C for 6 h). However, when ATCC 40282 phage was added to the growth medium (infected after 130 min incubation) with and without peptides the media that contained 1.5 and 2.5% peptide had an extended growth period of 21 and 28 min, respectively, before lysis occurred suggesting that c2 peptide had a minor inhibition effect on ATCC 40282 phage. *E. coli* also grew faster when the c2 peptide (2 and 4% concentration) was added to the 1065LB growth medium. However the most rapid growth was present in the medium containing 2% peptide suggesting that peptide in the 4% medium was starting to block metabolic transport. When the lambda 97538 phage was added to the growth medium (infected after 90 min of incubation) only a slight inhibition of phage proliferation occurred in the 2% c2 peptide medium (20 min) whereas in the 4% peptide medium phage proliferation was suppressed by 120 min suggesting that c2 peptide was an effective inhibitor of lambda 97538 phage proliferation.

**Key Words:** Salmonella, Bacteriophage inhibition, c2 phage-peptide

**W272 Thermophilin 110: a broad spectrum bacteriocin of Streptococcus Thermophilus.** G. A. Somkuti* and D. H. Steinberg, Eastern Regional Research Center, ARS-USDA.

A survey of thermophilic lactic starter cultures for bacteriocin production identified the broad spectrum antimicrobial peptide thermophilin 110 of *Streptococcus thermophilus*ST110, a strain used in yogurt and cheese fermentations. The range of bacteria inhibited by the bacteriocin included lactococci, lactobacilli and pediococci, in addition to related thermophilic streptococci. Production of thermophilin 110 at 37°C paralleled growth of *S. thermophilus* ST110 in a tryptone-yeast extract-lactose medium. After 16 h of growth, bacteriocin titers reached 320 units/ml by an agar well diffusion assay with *Pedococcus acidilactici* as the indicator strain. Thermophilin 110 was sensitive to digestion by proteolytic enzymes and lost its activity after a 60 min exposure to pepsin, pronase and papain. It was also inactivated by amylase treatment indicating glycosylation as a prerequisite for activity. Antimicrobial activity was fully retained after heating crude thermophilin 110 preparations at 80°C for 60 min. Thermophilin 110 was acid resistant and remained stable at pH 3 and 7 but lost its activity after exposure to pH 10. Plasmid analysis of *S. thermophilus* ST110 indicated the absence of plasmids, suggesting that the genetic determinant for thermophilin 110 production is probably located on the chromosome. Inhibition of several species of pediococci is a unique feature of thermophilin 110, implying a potential for applications in controlling the growth of spoilage bacteria in wine and beer fermentations.

**Key Words:** Bacteriocin, Thermophilin 110, *Streptococcus thermophilus*

**W273 The influence of cold adaptation on cryotolerance of Bifidobacterium infantis.** A. Gevorgyan* and R. F. Roberts, 1 The Pennsylvania State University.

The purpose of this study was to determine the influence of cold adaptation on cryotolerance in *Bifidobacterium infantis* strain ATCC 15697 and commercial strain BI-4. Growth of ATCC 15697 and BI-4 in 1 reinforced Clostridial Broth (RCB) was determined at 20°C, 25°C, and 37°C by measuring OD600. Overall BI-4 grew faster than ATCC 15697 in RCB incubated at 37°C. Neither strain grew in RCB when incubated at 20°C or 25°C for up to 7 days. For cold shock experiments and freeze-thaw challenge, cells were grown in 100 ml RCB at 37°C until mid-log phase (OD600= 0.5) then 25 ml of culture was harvested and resuspended in the same volume of tempered medium (20°C, 25°C, 37°C). Ten ml of resuspended inoculum was transferred into two sterile tubes and incubated at the designated temperatures for 240 min. One ml samples were taken at 0, 30, 60, 120 and 240 min and frozen at -20°C for 24 hours, thawed for 10 min at 30°C, sampled for viable counts and then re-frozen. The population of survivors was determined before freezing and after 1, 3, 6 and 9 freeze-thaw cycles by spread plating decimal dilutions on RCA plates and incubating anaerobically at 37°C for 72h. Survivor data were normalized to the initial population (before freezing). Experiments were replicated three times. When BI-4 was incubated at 20°C or 25°C prior to freezing there was no change in population after 9 freeze-thaw cycles. However when BI-4 was incubated at 37°C for 60, 120, and 240 min the strain exhibited 0.5 log decrease in viability at the designated temperatures for 240 min. Viability of both strains after 9 freeze-thaw cycles decreased when incubated at 37°C for longer time (120 and 240 min) suggesting cells in stationary phase are less cryotolerant. Incubation at suboptimal temperatures did not increase cryotolerance of *B. infantis* and the effect of freeze-thaw challenge was strain dependent.

**Key Words:** Probiotics, Bifidobacterium, Cryotolerance
A correlation between the USU stretch test and the pizza fork test would allow the stretch properties of Mozzarella cheese to be measured in an objective manner. The USU Stretch Test uses a modified texture-profile analyzer to pull strands of cheese from a melted reservoir, measuring the load exerted on the probe during stretching. Fifty grams of shredded cheese was melted for 45 min at 65, 70, 75, 80, and 85°C and a three-pronged hook was used to lift the strands of cheese for 3 cm at a rate of 100 cm per min. The load exerted on the probe was recorded and the following parameters were used to search for a correlation with values obtained from the pizza fork test. Pizzazz fork test values were provided by an industrial partner. Melt Strength was defined as the maximum load obtained during stretching, and the probe extension at Melt Strength was termed the Stretch Extension (SE). Stretch Load (SL) was defined as the load exerted on the probe at any point following Melt Strength. These SL values were also used to calculate the slope of the curve formed as the load decreased after Melt Strength was obtained. In general, greater correlation was found at higher temperatures. At 85°C, Melt Strength, slope from 10 to 15 cm, SL from 5 to 10 cm, SL from 15 to 20 cm, and SE obtained from the USU Stretch Test were 0.71, -0.80, 0.84, 0.69, and -0.36 respectively. The correlation coefficient for the same parameters were 0.61, -0.68, 0.71, 0.83, and -0.84 at 80°C; 0.61, -0.41, 0.43, 0.60, and 0.54 and 75°C; 0.73, -0.46, 0.61, 0.69, and -0.85 at 70°C; and 0.73, -0.66, 0.72, 0.67, and -0.29 at 65°C.

Key Words: Mozzarella, Stretch testing, Functionality

W277 Impact of cheese defects on U.S. graded cheeses. M Smukowski1, W. L. Wendtorf2, Y. Ping1, and R. D. Rao2. 1WI Center for Dairy Research, Madison, WI, USA, 2University of Wisconsin-Madison, Madison, WI, USA.

Grading records for over 40,000 metric tonne of Cheddar, Colby, Monterey Jack, and Swiss cheese were obtained from ten national cheese manufacturers or processors. Licensed graders recorded defects and established grades for each lot of cheese. Major defects identified in Cheddar cheese were acid flavor, curdy, short and weak body and open texture. Major defects for Colby and Monterey Jack cheeses were weak body and acid and whey flavor (r) between 10% of the Swiss cheese was downgraded due to defective eye formation or utensil flavor. Potential texture. Major defects for Colby and Monterey Jack cheeses were weak body and acid and whey flavor (r) between 10% of the Swiss cheese was downgraded due to defective eye formation or utensil flavor. Potential economic impacts of the major cheese defects are reported. Trained panelists evaluated Cheddar cheese obtained from the retail market and found less than 10% of the cheese would have been graded as Grade A. Major defects noted were acid, flat, whey, and bitter flavors. Other defects included short, pasty, and weak body and open texture. It is suggested that cheesemakers must continuously evaluate cheeses throughout the aging process, distribution and marketing of cheeses to effectively assess their cheesemaking procedures and practices.

Key Words: Cheese, Defects


This study was designed to examine the effect of microencapsulated iron-fortified Cheddar cheese and vitamin C as a bioavailable helper of iron on chemical and sensory aspects. Coating material was PGMS, and ferric ammonium sulfate and vitamin C were selected as core materials. The highest efficiency of microencapsulation of iron and vitamin C were 72 and 94%, respectively, with 5:1.50 ratio (w/w) as coating to core material to distilled water. TBA absorbance was significantly lower in microencapsulated treatments than those in unencapsulated treatments during ripening. The productions of short-chain free fatty acid and neutral volatile compound were not significantly different between microencapsulated and unencapsulated Cheddar cheese during ripening periods. In sensory aspects, bitterness, astringency, and sourness were higher in Cheddar cheese fortified with microencapsulated iron and unencapsulated vitamin C than others. The present study indicated that fortification of iron as well as vitamin C did not show any defect problem to Cheddar cheese, and suggested the possibility of iron fortification of Cheddar cheese.

Key Words: Iron fortification, Microencapsulation, Cheddar cheese

W279 Comparison of microbial populations of un-frozen and frozen control goat cheeses with those of 3 month frozen-stored ones. J. H. Lee*, S. J. Lee, A. Kalantari, and Y. W. Park, Fort Valley State University, Fort Valley, GA.

Few scientific studies have been reported on microbial profiles of commercial caprine cheeses in relation to food safety and shelf life of the products. A commercial soft goat cheese was manufactured and Monterey Jack (MJ) cheese was manufactured at the pilot plant of Fort Valley State University. Both varieties were prepared in 3 batches, and divided into three equal portions. One portion was stored as un-frozen control (UFC) at 4°C for 4 weeks (0, 14, 28 days), and the other two subsamples were frozen at -20°C and stored for 0 and 3 months (FZC and 3FZ), then immediately thawed at 4°C, followed by aging at 4°C as was done for UFC. Changes in microbial populations were enumerated for total aerobic plate count (TPC), E. coli and coliform, and yeast and mold. Staphylococcus aureus using 3M Petrifilm techniques, pH and acid degree values (ADV) for all cheeses were determined. The pooled data of the respective TPC (log cfu/g) for UFC, FZC, and 3FZ groups of soft and MJ cheeses were: 6.93, 6.67 and 5.51; 8.44, 8.34 and 8.09, indicating that there were significant (P<0.05) reduction in TPC with storage treatments in soft cheeses, whereas no difference in MJ cheeses. The TPCs of 0, 14 and 28 days aging at 4°C for corresponding cheeses were: 8.01, 5.07 and 5.32; 8.57, 8.17 and 8.15, revealing that there were significant (P<0.05) decrease in TPC with aging times in both cheeses. Low levels of coliforms and E. coli were found in MJ, but not in soft cheeses, and these cells were significantly declined by freezing and aging. The main defects (storage and aging) were not significant for the pooled data of yeast counts of MJ, whereas those were significant (P<0.05) for the soft cheeses. Yeast counts tended to increase with aging in UFC and FZC groups of both cheeses, but significantly decreased in 3FZ group. Mold counts in both soft and MJ cheeses were similar at 3.0 (log cfu/g) for all storage groups. E. coli, coliform, and Staphylococcus aureus in soft cheeses were non-detectable <1.0 (log cfu/g), suggesting that no food safety hazard was in the cheese.

Key Words: Microbial population, Goat cheese, Frozen-storage

W280 Quantitative analysis of water-soluble volatile free fatty acids in commercial Swiss-type cheeses. T. Ji, W. Harper, and V. Alvarez, The Ohio State University, Columbus, Ohio.

Short chain (≤C12) water-soluble volatile free fatty acids (FFAs) contribute to the final flavor characteristics of cheese. Quantification of FFAs is a key to understanding the ripening processes. The objective of this study was to compare the concentrations of FFAs in varying aged Swiss-type cheeses as an indirect parameter of flavor development. Twelve commercial domestic, imported Gruyere, Emmental and Jarlsberg Swiss-type cheeses of varying ages were analyzed in duplicate. A capillary gas chromatograph equipped with a flame ionization detector was used for the analysis of FFAs. Each standard curve of fatty acids was made using authentic fatty acids by diluting in double purified distilled water except higher volatile non-branched fatty acids with even carbon numbers such as octanoic, decanoic and dodecanoic due to low water solubility. Predominant FFAs in all cheeses were ethanoic (99-196 mg/kg, cheese), propanoic (81-281 mg) and butanoic (40-131 mg) acids. Ethanoic acid (C2) exceeded the propanoic acid (C3) in 6 cheeses in which C3 was less than 100 mg. Butanoic acid (C4) was greater than C2 and C3 in only two cheeses. In four cheeses, C4 was greater than C3 and all of these cheeses had more C2 than C3. 3-methylbutanoic acid was present in only 5 of 12 cheeses. Gruyere only showed all of even carbon numbered (≤C12), C3 and branched fatty acids such as 2-methylpropanoic, 3-methylbutanoic and 4-methylpentanoic acids. Some domestics and Gruyere cheeses containing low C4 (99-129 mg) and C3 (81-98 mg) had high concentrations of decanoic acid. Domestic cheese (3 mo age) and Gruyere (>6 mo) showed higher volatile non-branched fatty acids with even carbon numbers (C6, C10 and C12). Emmental and Jarlsburg had high level of ethanoic (≥150 mg/kg) and propanoic (243 and 245 mg/kg). The commercial cheeses generally showed two patterns of lower molecular weight fatty acids: (a) those cheeses where C2 is greater than 100 mg.
and C<sub>3</sub> is greater than 175 mg (6 cheeses) and (b) those that showed less than 100 mg of C<sub>3</sub> (6 cheeses). High concentrations of Cs, C<sub>10</sub> and C<sub>12</sub> correlated to low C<sub>3</sub> in most cases.

Key Words: Swiss cheese, Volatile free fatty acid

W281 Compositional differences between whey, salty whey, and press whey from commercial manufacture of cheddar cheese, R. D. Rao* and W. L. Wendhoff, University of Wisconsin-Madison, Madison, WI, USA.

Salty and press whey streams are currently underutilized in the dairy industry because of difficult, costly processing and high salt content. In addition, relatively little information is available on the composition of these whey streams. In Wisconsin alone, over two million gallons of salty whey are produced in a year, most of which is landsapped or disposed of into waste treatment systems. This study investigated compositional differences between whey, salty whey, and press whey streams derived from Cheddar cheese. Differences between individual whey protein composition were also studied. Individual proteins were quantified using SDS-PAGE and digital imaging. Solids, ash, fat, and chloride content were significantly greater in the salty and press whey as compared to standard Cheddar cheese whey. Individual whey proteins analyzed include lactoferrin, β-lactoglobulin, bovine serum albumin (BSA), immunoglobulin G (IgG), β-lactoglobulin (β-LG), and α-lactalbumin (α-LA). Salty and press whey showed slightly decreased proportions of IgG compared to that of the standard Cheddar whey. Amounts of BSA (wt. %) were comparable in all samples. The percentage of α-LA in the salty and press whey streams were roughly half of that found in the standard Cheddar whey, and α-LA concentrations decreased by about 20% from the standard Cheddar whey to the salty and press whey streams. The percentage of LF increased from less than 1% to greater than 30% in both the salty and press whey. Differences in gross composition between standard Cheddar whey and salty and press whey can be used to determine modifications needed in whey processing. Salty and press whey may be good sources of lactoferrin, making processing of these whey sources a more profitable and viable option for whey processors.

Key Words: Salty whey, Press whey, Lactoferrin

W282 Physico-chemical and microbiological characteristics of Cheddar cheese manufactured with a cholesterol lowering spread and oil high in omega-3 fatty acids. K. J. Aryana* and R. Gough, Louisiana State University Agricultural Center.

Milk fat is high in saturated fatty acids. Replacing milk fat in Cheddar cheese with health beneficial lipids could improve consumer appeal and demand for the product. The objective was to study the impact of a gradual replacement of milk fat by a cholesterol lowering spread, Benecol<sup>®</sup> and oil high in omega-3 fatty acids, Omega Pure<sup>TM</sup> on the physico-chemical and microbiological characteristics of full and low fat Cheddar cheeses. Cheddar cheese was manufactured by replacing milk fat with Omega Pure<sup>TM</sup> and Benecol<sup>®</sup> in the following ratios: milk fat : Omega Pure<sup>TM</sup> / Benecol<sup>®</sup> 100:0; 75:25; 50:50; 25:75; 0:100. The attributes studied were color, pH, proteolysis and microbiological profile. Color was measured in L<sup>*</sup>, a<sup>*</sup> and b<sup>*</sup> values using a hand held colorimeter; proteolysis was studied by gel electrophoresis; and the microbiological profile was determined by standard plate counts, coliform counts, yeasts and mold counts. The pH was significantly (P<0.05) lower with Omega Pure<sup>TM</sup> / Benecol<sup>®</sup> (100% fat) at 100% fat level in full fat Cheddar cheese compared to the full fat control. Lower usage levels of Omega Pure<sup>TM</sup> / Benecol<sup>®</sup> in full and low fat Cheddar cheeses did not result in significant (P>0.05) differences when compared to full and low fat Cheddar cheese controls, respectively. The full fat control was lower (P<0.05) in b<sup>*</sup> (yellowness) values compared to the full fat cheeses with Benecol<sup>®</sup>. There was a significant (P<0.05) and steady decline in α<sub>2</sub>-values of full fat cheeses made with decreasing amounts of Benecol<sup>®</sup>. There were slight changes in the gel electrophoretic patterns of the treated cheeses. Coliforms in the controls and the treated samples were estimated at < 10 cfu/ml. The low fat samples appeared to have a higher standard plate count than the full fat samples. Use of the health beneficial lipids altered some characteristics of low fat and full fat Cheddar cheeses.

Key Words: Fermented, Health, Lipids

W283 RAPID method of cheese sample preparation for microstructural studies by electron microscopy. K. J. Aryana* and M. C. Henk†, Louisiana State University Agricultural Center, Louisiana State University.

Cheese sample processing for electron microscopy involves several days. A quicker method that processes cheese samples without altering its microstructure would be desirable. The objective was to identify such a suitable, rapid method. The rapid method involved an initial fixation of cheese in a solution of 2% glutaraldehyde and 1% OsO<sub>4</sub> in 0.05M cacodylate buffer for 10 min. This was followed by a second fixation in 2% glutaraldehyde and 2% OsO<sub>4</sub> in 0.05M buffer for an additional 20 min. Both of these solutions were mixed from stock solutions immediately before use, as components would react with each other in the absence of any sample. Sample fixation by the rapid method was attained in a total of 30 minutes compared to 17 hours in the control, i.e.: 15 hours (overnight) fixation in 1% glutaraldehyde and 2 hours fixation in 1% OsO<sub>4</sub>. After fixation, en bloc staining with aqueous uranyl acetate was conducted for 30 minutes. This was followed by ethanol dehydration and infiltration in resin. En bloc staining provided uniform staining, ultimately saving time and reducing grid handling and contamination encountered when staining sections with alcoholic uranyl acetate. Additionally, the rapid method was conducted with LR White resin compared to Spurr’s epoxy resin in the control. The former is used directly while the latter has to be freshly prepared and involves precise weighing and orderly mixing of four toxic chemicals. The microstructure of cheese processed by the rapid method appeared unaltered when compared to the control. The protein matrices in both the control and the rapid method processed samples picked up the heavy metal stain and were easily seen. The dispersed fat globules were also clearly visible in both the control and treated samples. This rapid method of cheese sample preparation did not alter cheese microstructure and can be recommended for accelerated sample processing for electron microscopy.

Key Words: Structure, Fermented, Fixation

W284 Effect of setting pH on the properties of mozzarella cheese made from whole milk and dry milk protein concentrate by direct acidification. S. Rehman, N. Farkye, and Y. Boorus, California Poly technic State University, San Luis Obispo, CA.

The pH of milk at setting affects the properties of mozzarella cheese. Milk protein concentrate (MPC) containing 64.0% protein, 20% lactose and 2% calcium was used to standardize whole milk to a protein to fat ratio of 1.4 for Mozzarella cheese manufacture. Our objective was to compare the effect of pre-acidification of whole milk standardized with MPC to different pH values in Mozzarella cheese made by direct acidification. Standardized, pasteurized (72°C 16 s) was divided into three lots, A, B and C and respectively adjusted to pH 5.6, 5.8 and 6.0 with 2% citric acid prior to setting (5 mL chymosin / 100 kg milk). The coagulum was cut and the curds were cooked (36°C) and stretched (82°C). Cheesemaking was repeated thrice. All cheeses were stored at 4°C for 5 weeks. Composition, yield, meltability, baking properties and hardness in the cheeses were determined by standard methods, while primary proteolysis was assessed by urea-polyacrylamide gel electrophoresis and determination of water-soluble N contents of the cheeses. Significant differences (P<0.05) in the % moisture (51.54 ± 2.09, 50.87 ± 2.32, 47.94 ± 1.85) and calcium contents (mg/kg cheese, 36.75 ± 1.183, 45.76 ± 4.24, 53.75 ± 2.05) were observed for vats, A, B, C respectively showing that decreasing milk pH caused increase in moisture and decrease in calcium. No significant (P>0.05) differences were observed in lactose, protein, fat and yield of the cheeses, % fat or protein recoveries. The % total solids recoveries increased significantly with increase in setting pH of milk. The milks pre-acidiﬁed to pH 5.6 gave the cheeses with best meltability, least hardness, minimum browning while baking on pizza and highest levels of proteolysis. The results of this study suggest that if Mozzarella cheese with better functional properties is to be manufactured by using MPC, then the milk should be pre-acidiﬁed to pH of 5.6.

Key Words: Milk protein concentrate, Mozzarella cheese, Direct acidification
W285 Effect of calcium on functionality of fat free Mozzarella cheese. N. S. Joshi, R. I. Dave, and K. Muthukumarappan, South Dakota State University, Brookings, SD.

Mozzarella cheese consumption has increased steadily for many years. Calcium plays significant role in functional properties of Mozzarella cheese. Fat free Mozzarella cheese has not become popular because it has poor melt properties. Our recent research on part skim Mozzarella cheese indicated that cheeses with reduced calcium possess better melting properties, particularly softening, melting and flow. Therefore a study was planned with an objective to examine effects of altering calcium levels on functionality of fat free Mozzarella cheeses.

Skin milk was preacidified to four pH levels (control = no treatment, T1 = pH 6.2, T2 = pH 5.9 and T3 = pH 5.6) using citric and acetic acids to alter calcium content in cheeses. The cheeses were made by direct acidification method using glucono-delta-lactone and were analyzed for composition (moisture, protein, fat, salt, ash, and calcium), melt area (modified Schreiber test), melt profile (softening and melting time-temperatures, extent and rate of flow), color (L*), and proteolysis (soluble nitrogen). The data were analyzed using PROC GLM and PROC MIXED procedures of SAS®.

Preacidification of skim milk significantly (P < 0.05) reduced the ash and calcium contents, whereas, rest of the components remained at par in all the cheeses. As the calcium in the cheeses reduced from 0.79 % in control to 0.66 % in T1, 0.59 % in T2 and 0.50 % in T3 cheeses flowed faster (P < 0.001) with higher flow rate and required significantly (P < 0.001) less time to melt. The control cheese had higher (P < 0.05) post melt whiteness (L*) as compared to experimental cheeses (90 vs. 88.9, 88.5 and 88.7 in T1, T2 and T3 respectively). Soluble nitrogen was the highest in T3 (1.80 %) followed by T2 (1.13 %), T1 (0.82 %) and control (0.60 %) on d30. Refrigerated storage of all the cheeses resulted in increase in melt area (P < 0.01), flow rate (P < 0.001), extent of flow (P < 0.01), and soluble nitrogen (P < 0.001) along with decrease in melting time (P < 0.05) and melting temperature (P < 0.001). The post melt whiteness of the cheeses was not affected by refrigerated storage.

Key Words: Fat free Mozzarella, Calcium, Functionality

W286 Changes in microstructure of part skim Mozzarella cheese as a function of calcium. N. S. Joshi, K. Muthukumarappan, and R. I. Dave, South Dakota State University, Brookings, SD.

Mozzarella cheese has unique functional characteristics that are not available in other cheese varieties. Cheese made from reduced calcium curd must be emulsified to achieve functionality and quality. The role of calcium in microstructure of part skim Mozzarella cheese is not clear. Calcium content of part skim Mozzarella cheeses was altered by manufacturing cheese from milk preacidified to four pH levels (control = no treatment, T1 = pH 6.2, T2 = pH 5.9 and T3 = pH 5.6) using citric and acetic acid. Direct acidification method using glucono-delta-lactone was followed for cheese making. Cooking and draining time were adjusted for cheese making. Cooking and draining time were adjusted for cheese making. Cooking and draining time were adjusted for cheese making. Cheese containing reduced calcium curd better emulsifies the fat and its subsequent distribution within the continuous protein matrix decides rheological and functional properties of Mozzarella cheese. Thus calcium is a key factor in determining the basic structure of Mozzarella cheese. Our objective was to understand the role of calcium in microstructure of part skim Mozzarella cheese.

Calcium content of part skim Mozzarella cheeses was altered by manufacturing cheese from milk preacidified to four pH levels (control = no treatment, T1 = pH 6.2, T2 = pH 5.9 and T3 = pH 5.6) using citric and acetic acid. Direct acidification method using glucono-delta-lactone was followed for cheese making. Cooking and draining time were adjusted to obtain uniform moisture content in all the cheeses. Structure of the cheeses was evaluated by scanning electron microscopy (SEM) as well as confocal laser scanning microscopy (CLSM) techniques. Information obtained from both the microscopic analyses was quantified in terms of numbers, area and size of the fat globules using software HL Image ++. Calcium content of the cheeses was significantly different (control = 0.65, T1 = 0.48, T2 = 0.42 and T3 = 0.35 %), whereas rests of the compositional parameters were similar (P > 0.05). The microstructure study using both SEM and CLSM revealed that reduced calcium cheeses had greater number of round fat particles (control = 125, T1 = 193, T2 = 184, and T3 = 215 in SEM and control = 86, T1 = 87, T2 = 125, and T3 = 140 in CLSM), and their distribution in reduced calcium cheeses was also more uniform. The above findings support our hypothesis that casein in the reduced calcium cheese better emulsifies the fat globules and significantly improve the melting of Mozzarella cheese.

Key Words: Mozzarella, Microstructure, Calcium
increasing, freezing of the fresh curd could allow US goat producers to supply soft cheeses throughout the year. In this study, the effects of freezing and long term frozen storage on the proteolysis and texture of soft goat cheese was evaluated. Plain soft cheeses were obtained from a grade A goat dairy in Georgia and received three storage treatments: fresh curd (FC) at 4°C for up to 4 wks, frozen (-20°C) and thawed after 2 d (FTC) or 3 mo (3MF), then stored as FC group. Although all frozen samples showed minute ice crystal formation throughout the body of the cheese, no free liquid was noted when samples were thawed. Proteolysis was monitored using SDS-PAGE and rheological properties were measured using a universal testing machine and a dynamic analyzer. At the start of refrigerated storage, all samples that had been frozen (regardless of length of frozen storage) had 1 to 2% less beta-casein than the fresh cheeses. After 4 wk of refrigerated storage, all cheeses showed 2 to 3% proteolytic breakdown of beta-casein. FC cheese had a fragile texture with values of 10.6 N for hardness, 10.1 mm for springiness, 0.10 for cohesiveness, 9.3 mJ for chewiness, 15.9 kPa for elastic modulus, 5.28 kPa for viscous modulus, and 1.75 kPa.s for complex viscosity. The FTC cheese had slightly lower values for hardness (7.36 N), cohesiveness (0.08), and chewiness (5.2 mL) and elastic and viscous moduli decreased from d1 to d28 (11.3 kPa and 3.60 kPa, respectively). However, the 3MF cheeses were slightly harder and chewier than the FC cheese and the viscoelastic properties were similar to those of the FC cheese. Frozen storage of soft goat cheese affects its textural quality through the creation and removal of ice crystals in addition to the proteolytic breakdown of caseins in the casein matrix.

Key Words: Goat milk cheese, Proteolysis, Rheology

W290 Effect of sodium chloride and acid on rennet coagulation and curd firmness of high heat-treated milk. M. R. Acharya* and V. V. Mistry, MN-SD Dairy Foods Research Center, South Dakota State University.

Raw whole milk was pasteurized at 62.8, 68.3, 73.9 and 79.4°C for 30 min and divided into ten portions. Five levels of sodium chloride, 0 (S0), 0.5 (S1), 1.0 (S2), 1.5 (S3) or 2.0% (S4) or five levels of 2% lactic acid, 0 (A0), 0.1%, 0.5% (A1), 3.0% (A2), 4.5% (A3) or 6.0% (A4) were added to formulate a total of 10 treatments. There were three replications. From each treatment, 100 mL sample was inoculated with 1.0 mL of 2:10 diluted rennet solution and incubated in a water bath at 32°C. Curd firmness was judged at intervals using a knife to determine cutting time. A Formagraph was used to measure the curd formation characteristics. Ten mL milk from each treatment was inoculated with 200 μL of 2:100 diluted rennet solution and incubated in a water bath at 32°C. Rennet coagulation time was determined at intervals of 180 min. Formagraph plots were used to determine rennet coagulation time (t, min), time to reach firmness of 20 mm (k20, min) and firmness (mm) at 30, 60, 90 and 120 min as a30, a60, a90 and a120, respectively. Only treatments A2, A3 and A4 could reach cutting strength at 79.4 and 77.0°C (C-AcT). All treatments except controls reached cutting strength. Rennet coagulation time by both subjective (knife) test and Formagraph reduced from control (S0) to S1 and then increased with increase in sodium chloride content and reduced with increase in level of acidification. Values of k20, a30, a60, a90 and a120 indicated similar trends as rennet coagulation time. It is concluded that desired cutting time and curd firmness, suitable for cheese making can be obtained from high heat treated milk with added sodium chloride or acid.

Key Words: Sodium chloride, Lactic acid, Rennet


This study was carried out to find whether cheese ripening process was accelerated in cholesterol-reduced Cheddar cheese or not, which may be made by cream separation following by 10% β-CD treatment. The cholesterol removal rate of the cholesterol-reduced cheese was 91.9%. The production of short chain free fatty acid (FFA) increased with ripening time in both control and experimental cheeses. The short-chain FFA data showed that cholesterol-reduced cheese ripened for 2 and 4 wk released a similar amount of FFA in control cheese ripened for 16 wk (4 mJ) and 24 wk (6 mJ). With ripening period, the increase of neutral volatile compounds, especially, acetdehyde, acetone, ethanol and 2-heptanol. β-Cyclodextrin was more profud in the control group. In addition, cholesterol-reduced Cheddar cheese produced much higher total free amino acid and bitter amino acids than control during all ripening periods. In sensory analysis, texture score of control Cheddar cheese showed an increasing trend with 32 wk ripening, however, that in β-CD treatment group decreased during a ripening period (8 wk). Above results indicated that the cholesterol-reduced cheese made by β-CD treated cream resulted additionally in an accelerated ripening means.

Key Words: Acceleration of ripening and cholesterol removal, β-cyclodextrin, Cheddar cheese

W292 Influence of feeding strategy (pasture vs TMR) on proteolysis in Ragusano cheese during ripening. V. Fallico*, L. Chiavese, J. Horne1, S. Carpino1, and G. Licitra1, 1CorFiliCa, Regione Siciliana, 97100 Ragusa, Italy, 2Food Science Department, Napels University, Portici, Italy.

Pasture contributes to aromatic profiles of milk and derived-products providing odor compounds that the animal can transfer to milk via the rumen. Aromatic substances were found in the milk and cheese of grazing ewes, but not in those of sheep fed TMR (Total Mix Ration). Proteolysis also contributes to cheese flavour, producing low molecular weight aromatic compounds and amino acids that may act as flavour precursors. The aim of this study was to evaluate the effect of feeding strategy (pasture vs TMR) on proteolysis of Ragusano, a brine-salted pasta filata cheese made from raw cow’s milk without starter, during ripening (1, 120 and 210 d). Primary proteolysis was monitored by urea-PAGE, isoelectric focusing (IEF) and immunostaining with polyclonal antibodies against αs1- and β-caseins. Reversed phase-HPLC was used to assess secondary proteolysis by fractioning 12% TCA-soluble peptides. Both urea-PAGE and IEF profiles of pasture and TMR cheeses showed similar proteolytic patterns at each level of ripening, indicating that diet had no effect on primary proteolysis. Denaturation of urea-PAGE profiles of cheeses aged 120 and 210 days revealed slightly higher proteolysis levels in TMR cheeses. Similar but not significant (P>0.05) trends were found in chemical analyses (15.72 vs 14.23 at 120 d, 15.22 vs 14.16 at 210 d, SN/TN%). Immunoelectrophoretic patterns were useful in identifying the origin of main primary peptides. In vitro hydrolysis reactions with chymosin and plasmin helped to elucidate the potential role of these enzymes in primary proteolysis. Different feeds had a qualitative impact on secondary proteolysis. Peptide patterns resolved better in pasture HPLC profiles suggesting a more defined and balanced action of microbial peptidases involved in oligopeptide and amino acid production. Chemical analyses revealed a nonsignificant (P>0.05) trend showing larger 12% TCA-soluble peptide fractions in TMR profiles at each level of ripening.

Key Words: Ragusano cheese, Feed, Proteolysis

W293 Effect of sodium citrate on structure-function relationships of Cheddar cheese. A. J. Pastorino*, C. L. Hansen, and D. J. McMahon, Western Dairy Center, Nutrition and Food Science Dept. Utah State University.

The objective of this study was to determine the effect of sodium citrate on the structure and functionality of Cheddar cheese. The hypothesis was that citrate (sodium citrate) injection would affect cheese properties mainly through its effect on insoluble calcium (measured as the difference between total calcium and water-soluble calcium of a cheese extract). A 9-kg block of Cheddar was made, vacuum-packaged, and then stored for 2 wk at 4°C. After storage, the cheese was cut into 0.5- to 0.6-kg blocks that were vacuum-packaged and stored for 1 wk at 4°C. Cheese blocks were then high-pressure injected with a buffer solution (pH 5.27) containing 40% (wt/wt) citric acid trisodium dihydrate and 6.25% (wt/wt) anhydrous citric acid, from zero (control) to five times (successive injections performed 24 h apart). Increased citric acid content of cheese from 0.22 (uninjected) to 1.39% (after five injections) caused phosphate solubilization. Thus, the insoluble phosphate content of cheese decreased from 0.54 to 0.45 mmol/g protein. However, unexpectedly, the soluble calcium content decreased from 0.34 (control) to 0.28 mmol/g protein (after five injections), whereas the insoluble calcium content remained unchanged (0.42 mmol/g protein). The decrease in soluble calcium probably resulted from the formation and concentration of crystals in the cheese surface, which was not included in samples for analysis, and from serum expulsion. Higher concentration of soluble calcium in the water phase would increase the volume of serum, but the cheese had limited holding capacity and serum was expelled. Citrate injection increased the sodium content of cheese from 0.63 to 0.93%, but
it had no effect on cheese pH (5.2). After five injections, the protein matrix occupied increased area of cheese matrix (83 versus 78%). Even though citrate injection had no effect on insoluble calcium, and thus the rate and extent of cheese flow were unaffected, increased phosphate solubilization, and possibly decreased ionic calcium content, resulted in expansion of the protein matrix and increased cheese hardness.

Key Words: Calcium, Phosphate, Protein matrix


The objective was to develop a continuous cheese-making process, which uses concentration factor (CF) 8-9, pH 6.0 skim milk microfiltration (MF) retentate to produce low-moisture part-skim (LMPs) Mozzarella cheese. Pasteurized skim milk was microfiltered to a concentration factor of 8-9 at 50°C using a 0.1μm nominal pore diameter microfiltration membrane microfiltration membrane unit with a total area of 0.72 m². The system was equipped to maintain a uniform transmembrane pressure (UTMP) in the range of 68.9 KPa to 172.4 KPa. The milk was gradually acidified during microfiltration to pH 6.0 using glucono-d-lactone (GDL) at a concentration of 1.6g/l skim milk to adjust the calcium to protein ratio in the final retentate. Experiments were conducted to test the effect of four different cross flow velocities (CFV): 2.5, 3.5, 4.5 and 5.5 m.s⁻¹ on permeate flux, which allowed the determination of fouling of the membrane. Furthermore, flux decay was evaluated at four different transmembrane pressure levels (68.9 KPa, 103.4 KPa, 137.2 KPa and 172.4 KPa). The process was scaled-up to a membrane unit with a total area of 9.1 m² for the continuous production of cheese. The obtained retentate was subsequently standardized with heavy cream to a casein to fat ratio of 0.85 and converted into LMPs Mozzarella cheese curd in an Alcurd continuous cheese coagulator using single strength rennet (80μl/Kg retentate). The resulting curd was then cooked and stretched. The analyses performed on skim milk, retentate, permeate and cheeses included total solids, protein (Total N, non-protein N and non-casein N), fat and ash. The fat, moisture and protein contents of the cheese produced by the process as well as its textural characteristics were within the normal ranges for LMPs.

Key Words: Microfiltration mozzarella, Microfiltration retentate cheese, Whey protein depletion of milk

W295 Lexicon development of appearance and texture descriptors for melted cheddar cheese. K. M. Asato*, I. M. Tsai, and M. R. McDaniel, Oregon State University, Corvallis, OR.

A lexicon to define the sensory properties of melted cheddar cheese was created using a trained descriptive panel. The lexicon characterizes appearance (surface rupture, meltedness, oiliness, and edge browning) and texture (stringiness, stretchiness, springiness, firmness, toothpull, smoothness, cohesiveness, denseness, and chewiness). The newly developed lexicon was used to evaluate seven samples consisting of three commercial brands of shredded cheddar cheese at different ages (sharp, medium and mild) in order to determine how heat treatment (oven and microwave) affected the sensory perception of melted cheese. Microwave treated cheese was higher in oiliness and lower in all texture descriptors than melted medium and mild cheddar.

Key Words: Melted cheese, Cheddar, Sensory

W296 Monitoring spores and spore-forming bacteria populations in commercial skim milk powder production plants using conventional and molecular methods. C. Murillo*, C. Kitts2, and R. Jimenez-Flores. 1 Cal Poly Dairy Products Technology Center, 2 Cal Poly Biological Sciences Department.

The microflora of milk powder consists of a wide array of microorganisms of which special attention is given to Bacillus spp. spores and spore formers. Bacillus spp. spores survive well in all processing stages and inhabit the milk powder in the dormant state indefinitely. Upon reconstitution, spores may germinate, and through their enzymatic activity become detrimental to quality. The objectives of this study are to 1) enumerate total aerobes, mesophilic, and thermophilic spore populations in commercial, low-heat skim milk powder production plants; 2) characterize the microbial ecology of this process using Terminal Restriction Fragment Patterns (TRFPs) and 3) compare technology during this process. Fluid and powder skim milk was collected from 3 commercial facilities during April, summer, and fall ‘01-‘02. Sampling points included the raw milk silo, separator, evaporator, and spray dryer. Samples were normalized based on total solids. Every sample was evaluated for total aerobes, mesophilic, and thermophilic spores. For TRFPs community DNA was extracted, amplified by 16S PCR, and digested with HaeIII and DpnII. Spore formers were predominant in condensed and powdered milk, and tend to increase in the powder with increasing processing time. In raw milk mesophilic and thermophilic spores ranged from 25CFU/g to 70CFU/g and 25CFU/g to 10⁵ CFU/g, respectively. In powder they ranged from 25CFU/g to 10⁵ CFU/g and 25CFU/g to 10⁴ CFU/g, respectively. Both spore counts from skim milk showed an increasing trend with run time and rendered the powder out of the 10³ CFU/g limit. In the ecology TRF patterns successfully described microbial populations, and an overall decrease in microbial diversity between raw and powdered milk was observed. Overall, Bacillus spp. were found in 92 important organisms included Clostridium spp. (57Staphylococcus spp. (29Streptococcus spp. (9Bacillus spp. were present in 100% from all 3 plants.

Key Words: Milk powder, Terminal restriction fragment patterns, Quality

W297 Enterotoxigenic Bacillus spp. DNA fingerprints revealed in powdered milk products using rep-PCR. R. M. Cooper* and J. L. McKllip, Ball State University, Muncie, IN.

As a staple food, milk powders and other dry functional dairy ingredients must reflect strict quality control and a long shelf life. As a means of assessing the microbiological quality of a battery of dry dairy products, the technique of repetitive element palindromic polymerase chain reaction (rep-PCR) was used as a screening tool to detect DNA fingerprinting profiles from potentially enterotoxigenic Bacillus spp. in five industrial formulations of lecithin, soy fiber, whey protein concentrate, and nonfat dry milk powder. Following a nonselective enrichment protocol (11-13 h) in tryptone phosphate glucose yeast extract (TPGY) broth to induce spore germination and vegetative cell growth to densities of 10⁶ CFU/ml, each dry product was subjected to a commercial DNA extraction procedure and rep-PCR to generate distinct amplicon banding patterns that were analyzed using agarose gel electrophoresis. A distinct 1,230bp diagnostic band consistent with that of previously characterized enterotoxigenic Bacillus cereus was demonstrated in rep-PCR from nonfat dry milk, lecithin, and soy powders. The identity of the diagnostic band was confirmed by restriction enzyme analysis, and in each case generated the same digest pattern as the rep-PCR amplified from the positive control B. cereus. These data validate the method of rep-PCR as a viable means of screening powdered dairy ingredients (and perhaps many other foods) for enterotoxigenic Bacillus spp. with the need for plating and enumeration using selective and differential media.

Key Words: Enterotoxigenic Bacillus spp., rep-PCR, Detection

Food Safety: Food safety; Methods, prevalence and control

W298 Detection of viable Enterobacteriaceae in milk by using real-time broad-range RT-PCR. S. H. Choi* and S. B. Lee, Sangji University, Wonju, Korea.

This study was carried out to develop real-time broad-range RT-PCR which could detect viable Enterobacteriaceae in milk. The threshold cycle (Ct) of the RT-PCR was determined by using Multiscribe reverse transcriptase and SYBR Green PCR Master mix(Applied Biosystem) and iCycler iQ(Bio-Rad). Following the RT-PCR, the synthesized DNA was confirmed in agarose gel electrophoresis. The nucleotide sequences of primers were designed based on the ribosomal protein genes, S11
coli bacteria were more than 40. The limit of bacterial number to detect
Salmonella
togenes

Twenty-four milk samples identified as positive for
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PCR for the detection of pathogenic microbes in raw milk could help to minimize
risks associated with consumption of raw milk. The objective of this study was to examine the usefulness of real-time PCR for the detection of
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in bulk-tank milk. Twenty-four milk samples identified as
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positive by traditional culture techniques and 176 that were
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negative based on culture techniques were chosen for PCR analysis. DNA was isolated from the same tetrathionate enrichments used for culture identification and subjected to real-time PCR analysis using a commercially available reagent kit. Fifty-three samples were identified as
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Salmonella. Eighty-one samples of bulk-tank milk shown to be
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Listeria sp. by traditional culture were chosen for analysis with a published TaqMan primer/probe set specific for
Listeria monocytogenes.
DNA was isolated from the same Modified Listeria Enrichment broth cultures used for culture identification. Of these 81 samples 42 were clearly positive by real-time PCR, 8 were tentatively positive, and 31 were shown not to contain
Listeria monocytogenes,
indicating that the
Listeria isolated from them were non-pathogenic species. This study suggests that real-time PCR techniques can be used to detect pathogenic microorganisms in bulk-tank milk with a sensitivity as good or better than traditional culture methods. In addition, these methods yield results within 24 h for
Salmonella and 48 h for
Listeria,
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Swine can become rapidly infected with
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during lairage at the abattoir and during transport; suggesting a need for intervention. The goal of this research was to determine the efficacy of lactic acid to reduce rapid
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were available to pigs for 7 d prior to euthanasia. Animals were placed in a pen contaminated with nalidixic-acid resistant strain of
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The consumption of raw milk and raw milk products has led to periodic disease outbreaks in the United States and more information is needed to assess the incidence of food-borne pathogens in bulk tank milk. The objective of this study was to determine the prevalence of
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in bulk tank milk in the United States. As part of the NAHMS Dairy 2002 survey, 861 bulk tank milk samples were collected from farms in 21 states and, when possible, shipped overnight on ice to the USDA-ARS laboratories in Beltsville, MD. Milk was directly plated on selective agars (MacConkey, Sorbitol MacConkey, XLT4, and Modified Oxford media) for direct bacterial enumeration and was enriched in selective broths (EC, tetrathionate, and modified Listeria enrichment broth) to increase detection sensitivity. After enrichment, cultures were streaked on selective media as above. Coliforms are often used as a general indicator of fecal contamination and coliforms were detected in 798 (92.7%) of the milk samples. Twenty two samples (2.6%) were culture-positive for
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Recent reports suggest an increase in consumption of raw milk and products made from raw milk in the United States. Several outbreaks of food-borne disease have been associated with the consumption of these products. Traditional culture methods for detection of pathogens in foods are generally time-consuming and labor intensive, often requiring more than 96 hours for positive identification. Methods for the rapid detection of pathogenic microbes in raw milk could help to minimize risks associated with consumption of raw milk. The objective of this study was to examine the usefulness of real-time PCR for the detection of
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Key Words: Salmonella, Listeria, TaqMan

W301 Efficacy of lactic acid to prevent rapid
Salmonella
infection in market weight swine. M. D. Howard1, H. S. Hurd2, and J. K. Gailey2, 1National Swine Research and Information Center, 2National Animal Disease Center, Ames, IA.

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Key Words: Lactic acid, Salmonella typhimurium, Market swine
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