2005 Joint Annual Meeting

American Dairy Science Association - Canadian Society of Animal Science - American Society of Animal Science

July 24-28, 2005

Cincinnati, Ohio

Cinergy Center

www.fass.org/2005

ABSTRACTS

AMERICAN DAIRY SCIENCE ASSOCIATION

Journal of Dairy Science

Volume 88, Supplement 1

AMERICAN SOCIETY OF ANIMAL SCIENCE

Journal of Animal Science

Volume 83, Supplement 1

Application for membership in the American Society of Animal Science is invited from persons with interest in animal science and livestock production. In 2005, annual dues including access to the electronic version of the *Journal of Animal Science* are $110 in U.S.A., Canada, and Mexico and in other countries. For those in the U.S.A., Canada, or Mexico who wish to receive a paper copy of the *Journal*, the additional fee is $50; for those in other countries, the additional fee is $75. Student Affiliate Membership to those who are certified by a professional member as a regularly enrolled college student who does not hold a full-time position at the time of application for, or annual renewal of, affiliate membership, $20 annually, which includes access to the electronic version of the *Journal of Animal Science*. Postdoctoral fellows' membership dues are $55; with receipt of a paper copy of the *Journal*, the cost is an additional $50 per year. Institutional members (including receipt of a paper copy of the *Journal*), $450 per year in U.S.A., Canada, and Mexico or $500 per year in other countries. Individual sustaining membership, $350 per year. Applications for membership with remittance should be mailed to the ASAS Business Office.

Jerome F. Baker, Executive Director, 1111 N. Dunlap Ave., Savoy, IL 61874
Telephone: 217-356-9050; Fax: 217-398-4119; E-mail: asas@assochq.org Office hours: 8:00 a.m.–5:00 p.m.

American Society of Animal Science World Wide Web address: http://www.asas.org

Calendar of American Society of Animal Science Upcoming Meetings

National Annual Meeting, with ADSA	July 24–28, 2005	Cincinnati, OH

Manuscript Submission. Information about manuscript submission is given in *Style and Form* published in the January issue of the *Journal* (available at http://jas.fass.org). All manuscripts submitted to the *Journal of Animal Science* must be accompanied by the JAS manuscript submission form certifying that any research that involves animals has followed established standards for the humane care and use of animals. Manuscripts should be submitted online via http://mc.manuscriptcentral.com/jas; for assistance, contact Jeremy Holzner at 217-356-2426, ext. 38; e-mail: jeremyh@assochq.org.

Address Change and Missing Copies. Notice of change in address should be received by the ASAS Business Office 60 days in advance of change. Claims for missing copies should be received within 30 days (90 days foreign) of publication date to ensure replacement copies at no charge.

Airmail Postage to Foreign Addresses. An additional $200.00 is charged annually to those in foreign countries who wish the *Journal* to be sent to them via air mail.

Journal of Animal Science (ISSN 0021-8812) is published monthly (bimonthly in August) by the American Society of Animal Science. Form 3579 to be returned to the ASAS Business Office Printed at The Sheridan Press, 450 Frame Ave., Hanover, PA 17331.

JOURNAL
Since 1917

JOURNAL OF DAIRY SCIENCE

1111 N. DUNLAP AVE., SAVOY, IL 61874 217/356-5146 FAX 217/398-4119 E-MAIL ADSA@ASSOCHQ.ORG HOME PAGE HTTP://WWW.ADSA.ORG

Manuscripts offered for consideration should be submitted electronically at http://jds.manuscriptcentral.com in accordance with the Instructions for Authors, J. Dairy Sci. 87:232–247. Reprints of instructions are available from ADSA and at http://jds.fass.org.

Mention of any trademark or proprietary product in works published in the *Journal of Dairy Science* does not constitute a guarantee or warranty of the product by The American Dairy Science Association and does not imply its approval to the exclusion of other products that may also be suitable.

Membership: $110 per year, includes electronic version of the *Journal of Dairy Science* (additional $50 for paper copy in US, Canada, and Mexico; additional $75 for paper copy in all other countries). Undergraduate student affiliate membership $5.00, graduate student membership, $10.00, includes electronic version of the *Journal of Dairy Science* (additional $50 for paper copy in US, Canada, and Mexico; additional $75 for paper copy in all other countries). Membership in the Association is on a calendar year basis from January through December. Dues should be sent to the ADSA office.

Institutional Members: $450 US, Canada, and Mexico, $500 elsewhere, per volume, one volume per year, January through December. New memberships and renewals begin with the first issue of the current volume and should be sent to the ADSA office.

Change of address. All matters pertaining to the receipt of the Journal and changes in the mailing list should be sent to the ADSA office.

Claims: Claims for copies lost in the mail must be received within 60 days (120 days international) of the date of issue to ensure free replacement.

Journal of Dairy Science (ISSN 0022-0302) is published monthly by the American Dairy Science Association, 1111 N. Dunlap Avenue, Savoy, IL 61874. Journal of Dairy Science electronic edition (ISSN 1525–3198) is published on the World Wide Web at http: // jds.fass.org/.

Printed at The Sheridan Press, 450 Fame Ave., Hanover, PA 17331.

Table of Contents

Sunday, July 24, 2005

Symposia and Oral Sessions

Monday, July 25, 2005

Poster Presentations

Symposia and Oral Sessions

Tuesday, July 26, 2005

Poster Presentations

Symposia and Oral Sessions

Wednesday, July 27, 2005

Poster Presentations

Symposia and Oral Sessions

Thursday, July 28, 2005

Symposia and Oral Sessions

ABSTRACTS
AMERICAN DAIRY SCIENCE ASSOCIATON
AMERICAN SOCIETY OF ANIMAL SCIENCE
CANADIAN SOCIETY OF ANIMAL SCIENCE

July 24–28, 2005
Cincinnati, Ohio

*Author Presenting Paper

Sunday, July 24, 2005

SYMPOSIA AND ORAL SESSIONS

CSAS Mastitis: Udder Health Management—A Canadian Perspective

1 Research networks: The Canadian mastitis research experience. D. Scholl*, *University of Montreal*, *Saint-Hyacinthe, Quebec, Canada*.

Innovative partnerships infuse new energy into research on commonplace problems. Funding priority for bovine mastitis research has diminished in the face of competing problems but mastitis remains an important animal and public health issue. In response, Canadian dairy industry and mastitis research leaders have created a unique partnership in the form of a research network. The Canadian Bovine Mastitis Research Network (CBMRN) joins national and provincial industry organizations and 42 researchers in ten institutions. The CBMRN program comprises coordinated mastitis research, student training, and knowledge and technology transfer. The mastitis monitoring and mastitis control research themes integrate applied and fundamental research techniques together. They are supported by a core platform that optimizes data collection through a national cohort of dairy farms, a pathogen strain bank and networked mastitis diagnostic laboratories. The monitoring theme aims to develop and transfer monitoring knowledge and technologies by benchmarking pathogen-specific mastitis incidence, devising efficient monitoring strategies, identifying virulence factors, and testing rapid diagnosis methods. The control theme aims to develop and transfer knowledge and technologies with research on host-pathogen interaction, therapy strategies and antibiotic resistance. The dairy industry contributes management and planning leadership and collaboration. Industry involvement stimulates a sense of program ownership and expectation of transferable results. A national scale network presents challenges related to its size and diversity but advantages include an infrastructure that fosters national and international collaboration and coordination, promotion of trust and mutual-ownership among diverse partners, and an increasing profile for Canadian mastitis research.

Acknowledgements: Valorisation Recherche Québec, Dairy Farmers of Canada, Novalait Inc., Dairy producers organizations of Québec, Ontario, Alberta, Prince Edward Island, New Brunswick, Nova Scotia, and Saskatchewan, Alberta Agriculture Research Institute, Action Concertée, Pfizer Animal Health, Health Canada, Dairy Gen.

Key Words: Mastitis, Research Partnerships

2 Epidemiology of mastitis: Changes in distribution of pathogens, bulk milk somatic cell count and preventative practices in the last decade. H. W. Barkema*[1], R. G. M. Olde Riekerink[1], R .N. Zadoks[2], and Y. H. Schukken[2], [1]*University of Prince Edward Island*, *Charlottetown, PEI, Canada*, [2]*Quality Milk Promotion Services, Cornell University*, *Ithaca, NY*.

Since the introduction of the standard mastitis prevention program in the 1960s much progress has been made in reducing the prevalence of intramammary infection and mean bulk milk SCC (BMSCC). Standard control methods have been adopted in the majority of dairy herds. In 2004, 96% of Canadian dairy farms applied post-milking teat disinfection, 71% used dry cow treatment on all cows, and 89% used one towel per cow for udder preparation. As a result, Canadian mean BMSCC has decreased from 340,000 in 1989 to 230,000 cells/ml in 2003, an improvement that was stimulated by a stepwise decrease of the regulatory limit from 800,000 to 500,000 cells/ml from 1989 to 1995.

As a result of this program, *Streptococcus agalactiae* is nearly at the point of extinction, although in some low BMSCC herds human strains occur sporadically. *Staphylococcus aureus*, a predominantly contagious pathogen, has become the most prevalent subclinical pathogen. The predominantly environmental pathogen *Streptococcus uberis* is now isolated from an increasing proportion of subclinical cases and has shown to be contagious in some instances. The importance of *Streptococcus dysgalactiae* has decreased. Because of differences in epidemiology and control, grouping of *S. uberis* and *S. dysgalactiae* as environmental streptococci should be avoided. In clinical mastitis samples, *Escherichia coli* has become the most common pathogen, competing for that disputable honor with *Staph. aureus* and, in some countries, *S. uberis*. Approx. 4% of the clinical *E. coli* mastitis cases are recurrent flare-ups of chronic subclinical *E. coli* infections. The importance of coagulase-negative staphylococci in udder health remains to be defined. In conclusion: 1) the effort that farmers are willing to make and the resulting reduction in BMSCC depend on incentive rather than on the current state of knowledge and technology, and 2) we observe an evolution from a black-and-white distinction in environmental and contagious pathogens, or chronic and transient infections, to more omni-potent bacterial species with diverse strains that do not follow these paradigms.

Key Words: Mastitis, Somatic Cell Count, Pathogens

3 Mastitis vaccines: Past, present, and future. G. M. Tomita*[1], B. G. Talbot[2], P Lacasse[3], A. A. Potter[4], X Zhao[5], J Lee[5], and D. T. Scholl[1], [1]*University of Montreal*, *Saint Hyacinthe, Quebec, Canada*, [2]*University of Sherbrooke*, *Sherbrooke, Quebec, Canada*, [3]*AAFC-Dairy and Swine R&D*, *Lennoxville, Quebec, Canada*, [4]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*, [5]*McGill University*, *Montreal, Quebec, Canada*.

Recommended mastitis control practices are at times inadequate in coping with the complex epidemiology of this disease. Therefore, the concept of immunization to enhance resistance to mastitis is a logical approach to augment existing mastitis control procedures. Mastitis vaccine research in the past has led to the commercialization of several products. Cows vaccinated with coliform mastitis vaccines are reported to have a lower incidence and duration of clinical mastitis. However, vaccinated cows are still infected at the same rate as nonvaccinated cows. The administration of vaccines against *Staphylococcus aureus* mastitis has been shown to enhance spontaneous cure rates, but vaccination did not prevent new infections. Therefore, improvements are needed. Advancements in the field of microbial pathogenesis, genomics, and bovine immunology have made the identification of protective antigens a relatively straightforward task. The challenge has been to incorporate these antigens into an effective product. Researchers are currently formulating the next generation of mastitis vaccines which are based on cross-protective antigens from coliform bacteria, *S. aureus*, and *Streptococcus* species. Most vaccines in use today are still formulated and delivered in the same manner as those produced 30 years ago and this will likely be the rate limiting step in the improvement of mastitis vaccine efficacy. The incorporation of novel immunomodulators such as CpG oligodeoxynucleotides, and the employment of alternative vaccine delivery methods such as antigen microencapsulation have the potential to increase the magnitude and quality of the immune response. A successful mastitis vaccine will serve as an additional mastitis control tool in a comprehensive udder health management program. Immunization will complement, but not replace management practices that promote reduction of teat end exposure to pathogens.

Key Words: Mastitis, Vaccines, Immunization

4 Management strategies to maintain udder health. D. Kelton*, *University of Guelph*, *Guelph, ON, Cananda*.

Management strategies employed by Canadian dairy producers to maintain udder health are based on the National Mastitis Council's Ten-Point Plan, encompassing the three broad areas of monitoring, prevention and therapy. The adoption of this plan is supported by an informal network of dairy veterinarians, extension workers and regulatory personnel, who together with the research community are in the process of formalizing a national mastitis network.

Prevention of mastitis is encouraged through the enforcement of somatic cell count (SCC) regulatory limits and the staged implementation of the Canadian Quality Milk (CQM) program. A key component to the CQM is the establishment of standard operating procedures on every farm to ensure that milk is harvested in a manner that safeguards the health of the cow and the product. Current emphasis on providing each cow with a clean and comfortable environment, and on reducing peri-partum disease, are also key components of this effort. A recent study involving over 300 Ontario tie-stall dairy farms confirms the relationship between inadequate stall size and increased SCC at the herd level.

Treatment of sub-clinical mastitis is based on sound dry cow management, which includes the standard recommendation of treating every quarter of every cow. The strategic use of teat sealers/sealants plays a role in preventing new infections during the dry period in some herds. Clinical cases must be appropriately identified, etiologically classified and where appropriate treated based on clearly defined protocols which are consistent with the guidelines established in the CQM program.

Monitoring of udder health is critical to the process, and with approximately 75% of Canadian dairy producers enrolled in milk recording and subscribing to monthly SCC services, there is a strong foundation for this process. Current and future efforts to link diagnostic laboratory culture results to on-farm herd management systems containing clinical case records and SCC data will greatly enhance the monitoring capacity.

5 Mammary tissue damage during mastitis: causes and controls. X. Zhao*[1] and P. Lacasse[2], [1]*McGill University*, *Ste Anne de Bellevue, Quebec, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lennoxville, Quebec, Canada*.

It is well known that mastitis reduces milk production. However, exact underlining mechanisms are not fully understood. Mammary tissue damage causes a reduction of the number and activity of epithelial cells and consequently contributes to decreased milk production. There are two distinct types of cell death, apoptosis and necrosis. Both have been reported to occur during mastitis. Various factors contribute to epithelial tissue damage. Certain bacteria produce toxins that destroy cell membranes and damage milk producing tissue, while other bacteria are able to invade and multiply within the bovine mammary epithelial cells before causing the damage. Breakdown of the extracellular matrix by the plasmin/plasmingen system can also lead to death of epithelial cells. Probably more important but less obvious players are somatic cells, in particular neutrophiles. They are predominant cells in the mammary gland during infection. Their major function is to phagocytose and destroy infectious agents. In addition, they limit the growth of some microbes. At the same time, they can potential harm the mammary tissue by releasing reactive oxygen intermediates and proteolytic enzymes. Different signaling and biochemical pathways leading to tissue damage are being delineated. An *in vitro* co-culture system with activated neutrophils and mammary epithelial cells has been adopted by us to study the potential value of various antioxidant, chelators and enzyme compounds for reducing the damage. The promising compounds were further evaluated using *in vivo* challenge studies. The future challenge is to find economical feed containing active compounds for field study and application. Understanding the biochemical and cellular changes in the mammary gland during mastitis will ultimately lead to means of manipulating mammary function to alleviate the loss of milk production during mastitis.

Key Words: Bovine, Mammary Gland, Mastitis

CSAS Vitamin: Vitamin Nutrition of Livestock Animals

6 Vitamin nutrition of livestock animals: Overview from vitamin discovery to today. L. McDowell*, *University of Florida*, *Gainesville*.

There are 15 vitamins that are of significance to livestock. The term vitamin(e) was first used in 1911-1912. What were later to be known as vitamin deficiency diseases, such as scurvy, beriberi, night blindness and xeropthalmia had plagued the world from antiquity. Around the turn of the 20th century laboratory animals were found not to survive on purified diets containing only fat, protein, carbohydrate, salts and water. Natural foods (e.g. milk) was found to contain small quantities of ?unknown substances essential to life?. Experiments with animals contributed greatly from 1900 through the 1930s to the discovery of vitamins. The development of the concept of vitamins can be roughly divided into four (broadly overlapping) periods. 1) Empirical healing of some diseases by administration of certain foods. 2) Development of analytical capabilities to identify classes of nutrients in foods. 3) Experimental induction of dietary diseases in animals; and 4) Administration of synthetic diets to discover essential nutritional factors. In the 1950s to the present, vitamin deficiencies became more common place when livestock were denied pasture and moved into confinement. Today typical grain-oilseed meal (e.g. corn-soybean meal) monagastric diets are generally supplemented with most vitamins, thiamin and vitamin B_6 seem to be less likely deficient. A number of factors influence vitamin requirements and vitamin utilization and include: physiological make-up and production function; confinement rearing without pasture; stress, disease and adverse environmental conditions; vitamin antagonist, use of antimicrobial drugs, and

body vitamin reserves. Under commercial livestock and poultry production conditions, vitamin allowances higher than NRC requirements may be needed to allow optimum performance. Generally, the optimum vitamin supplementation level is the quantity that achieves the best growth rate, feed utilization, health (including immune competency), and provides adequate body reserves.

Key Words: Vitamins, History, Requirements

7 Enhancing the vitamin content of meat and eggs: Implications for the human diet. A. Sahlin and J. D. House*, *University of Manitoba*, *Winnipeg, MB, Canada*.

Enhancing the vitamin content of meat and eggs provides an opportunity to increase the level of key nutrients, especially those deemed to be at marginal or insufficient levels in the human diet for optimal health and well-being. In general, enhancement efforts have focused on the development of feeding strategies to achieve optimal vitamin levels in meat and eggs. The definition of an optimal strategy however is influenced by such factors as: 1) the efficiency of transfer of the vitamin into the final product, 2) the impact on animal performance or health, 3) the impact on the quality characteristics of the final product, and 4) economic considerations. Vitamins are an extremely diverse class of nutrient, in terms of chemical and physical properties. Each vitamin differs with respect to stability during processing, susceptibility to bioconversion within the intestinal tract, digestibility, transport and storage within tissues. Therefore, the development of vitamin-enriched meat and eggs will be highly dependent on the interaction of multiple factors. Ultimately, the success of such strategies must be judged against the contribution the enriched products make to the human diet, in terms of vitamin intake, and in the acceptance of the products by the consumer.

Key Words: Vitamin, Meat, Eggs

8 Impact of B-vitamin supply on major metabolic pathways of lactating dairy cows. C. L. Girard* and J. J. Matte, *Agriculture et Agroalimentaire Canada*, *Lennoxville, Québec, Canada*.

Knowledge on dairy cow requirements for major nutrients increased substantially during the last decade and they have been extensively applied in dairy cow nutrition. However, little is known on the importance and the roles of B-vitamins. Most of those vitamins act as essential cofactors in energy, protein and lipid metabolism, it is likely that as milk yield increases, the demand for these cofactors also increases. In dairy cows, the supply in those vitamins from synthesis by the ruminal microflora is generally sufficient to avoid deficiency symptoms but could be suboptimal when it comes to optimize metabolic efficiency, production, composition and nutritional quality of milk. Results from recent experiments highlight how the supply in B-vitamins, especially folic acid, biotin and vitamin B_{12}, impacts on the major metabolic pathways. For example, supplemental biotin given during the first 100 days of lactation increased milk and true protein yield without effect on feed intake, plasma concentrations of glucose, insulin or non-esterified fatty acids (NEFA) nor on molar percentages of acetate, propionate and butyrate in ruminal fluid. Supplementary vitamin B_{12} and biotin given between 118 and 174 days of lactation increased the amount of glucose and decreased the amounts of volatile fatty acids and ammonia from the gastrointestinal tract and increased milk, milk protein and casein yields without changes in dry matter intake. Vitamin B_{12} utilization was increased in cows fed simultaneously supplementary folic acid and possibly, more so in extra-hepatic tissues. Moreover, in those cows fed supplementary folic acid, plasma glucose was increased by vitamin B_{12} supplementation while plasma biotin tended to be decreased. Vitamin B_{12} also reduced accumulation of lipids in liver that was observed when folic acid was given alone. In conclusion, it appears from those results that there is a need to review the paradigm according to which synthesis of B-vitamins by ruminal microflora is sufficient to meet dairy cow requirements under all circumstances.

Key Words: Dairy Cow, B-Vitamins, Metabolism

9 Fat-soluble vitamins in reproducing animals: physiological and nutritional basis. F. J. Schweigert*, *University of Potsdam*, *Potsdam, Germany*.

The general importance of fat-soluble vitamins especially vitamin E, vitamin A and its nutritional precursor b-carotene in reproducing animals has been characterized based on response variables such as the prevalence of overt signs of deficiency, reproductive performance and milk production rate. The substantially increase in performance in farm animals such as milk production in cows has substantially changed the feeding and management e.g. for cows (less pasture, less forage, and more total confinement) and thus resulted in changed (increased) vitamin requirements. The review will focus on the importance of fat-soluble vitamins (especially vitamin E, vitamin A and its precursor b-carotene) in reproducing animals under these changed variables. Both, vitamin E and ß-carotene might exert their function due to their antioxidant properties. Especially vitamin A through its active metabolite retinoic acid but possibly also b-carotene as molecule per se or by products of its metabolism as well as vitamin E can modulate gene expression through interaction with nuclear receptors. This aspect is of specific importance in ovulation, embryonic development and mammary gland development. Additionally an optimal supply of the mother is of importance for an early and efficient supplementation of the newborn through milk.

Key Words: Nutrition, Fat-Soluble vitamins, Reproduction

10 Choline metabolism for high-producing dairy cows: metabolic and nutritional basis. A. Baldi* and L. Pinotti, *University of Milan*, *Via Celoria, Milano, Italy*.

Choline, the beta-hydroxyethyltrimethylammonium ion, is a strong base containing a trimethylated quaternary nitrogen. Choline occurs widely in biological materials as the compound itself, as acetylcholine and as various phospholipids. In feed ingredients and crude unprocessed fat sources most choline is present as phosphatidylcholine (lecithin). Relatively rich sources of choline are soyabean, soyabean meal, rapeseed meal, fish meal and dried yeast. However in these feedstuffs, the dietary bioavailability of choline is considered "moderate". In dairy ruminants, choline is extensively degraded in the rumen; for this reason dietary choline contributes insignificantly to the choline body pool and methyl group metabolism is generally conservative with a relatively low rate of methyl catabolism and an elevated rate of de novo synthesis of methyl groups via the tetrahydrofolate system. The primary source of methylneogenesis, via the tetrahydrofolate system, is derived from gluconeogenic precursors, which depending of the energy balance and of physiological state, can be deficient in ruminants. Consequently, in time of glucose imbalance, for instance at the onset of lactation in dairy cows, the extra demand for methyl groups may have a negative impact on milk production, making reasonable to hypothesize that choline could be limiting nutrient for lactating dairy cows. Moreover, choline as a lipotropic substance may optimise the balance between the fat retained and metabolized by the liver, and hence improve lipid metabolism in general. Our findings herein presented are in line with these assumptions indicating that supplementation of choline, which can escape degradation in the rumen, may help to improve not only methyl groups metabolism but also other nutrient status (e.g. vitamin E).

Key Words: Dairy Cow, Choline, Metabolism

11 Folic acid and vitamin B_{12} in reproducing sows: New concepts. J. J. Matte* and C. L. Girard, *Dairy and Swine R & D Centre, Agriculture and Agri-Food Canada*, *Lennoxville, QC, Canada*.

In pig nutrition, the lack of and/or the outdated information on B-complex vitamins is an important factor for empiricism and disparities in dietary recommendations. This is particularly the case for folic acid (B_9) and vitamin B_{12}. Recent studies suggest that the beneficial effects of B_9 on sow prolificacy would be due to enhanced embryo development and survival. Embryo synthesis of oestrogens and uterine secretions of prostanoids and cytokines during attachment appears to be key factors involved in this B_9 regulation of embryo devel-

opment. Nevertheless, those embryo and uterine responses to B_9 are often more pronounced in multiparous sows than in gilts. This parity effect on B_9 responses could be attributed to the metabolic interaction with another vitamin, B_{12}. Those two vitamins are essential to modulate the transfer of one-carbon groups for protein and DNA synthesis, methylation and gene expression. The metabolic pathway involved is the remethylation of methionine from an intermediary metabolite, homocysteine (Hcy). A deficiency in B_9 or B_{12} may induce a local or systemic accumulation of Hcy, a powerful pro-oxidant known to impair embryo development. It appears that the B_{12} status, which is about 2 times lower in gilts than in multiparous sows, could be a limiting factor to the B_9 action on uterus and embryo metabolisms during the first pregnancy. This B_{12} status is particularly critical since the sow uterus drained in early gestation massive amounts of B_{12}, representing 2 to 3 times the B_{12} plasma pool. Dietary B_{12}, at levels 10 times higher than recommended, maximized B_{12} status and minimized Hcy accumulation in first parity sows. It appears that an optimum ratio B_9:B_{12}, yet to be estimated, would allow the full beneficial response of B_9 on sow prolificacy. In the future, it is likely that the need for updated information on requirements for B-complex vitamins will be enhanced taking into account the "dietary fine tuning" required with the highly producing pigs selected during the last decades.

Key Words: Folic Acid, Vitamin B_{12}, Sow

Genomics: Functional Genomics for Livestock Improvement

12 What is functional genomics? J. Pérez Laspiur* and T. Ferris, *Michigan State University*, *East Lansing*.

In the past, we have attempted to understand the physiological responses of livestock to stressors, such as environmental conditions and husbandry practices, and their impact on performance traits. Further, we have selected livestock using quantitative approaches that involve estimating the effects of all genes affecting these traits without knowing the specific role of any of these genes. Evident phenotypic traits are a combination of internal (genetics) and external (environment) factors working jointly. Although we have advanced in our understanding of the role that external factors play on the occurrence of important phenotypic traits, we lag behind in our understanding of the genetic factors that affect these same traits. With the recent completion of the bovine genome sequence and availability of high-throughout technology, a functional genomics approach can now be used to simultaneously investigate disturbances in expression of thousands of genes in relation to environmental and physiological challenges. This approach allows us to determine what groups of genes and pathways are responsible for, or correlated with, - metabolic changes and how these may be manipulated to improve performance and well-being of cattle. Functional genomics therefore has the potential to highlight significant new candidate genes to improve genetic selection programs and to evaluate the effect of various practices on multiple systems within an animal. A vital contribution of these studies is the integration of physiological, nutritional, and genetic data to develop public resources for cattle. These resources will help answer questions concerning genes involved in milk production, milk quality and composition, and response to husbandry stressors. Eventually, this knowledge will further aid in selection and management of livestock.

Key Words: Functional Genomics, Genetic Improvement

13 Implications of functional genomics for animal breeding programs. J. C. M. Dekkers*, *Iowa State University*, *Ames*.

Current selection programs in livestock are primarily based on selection on EBV for traits of economic importance, that are estimated from phenotypic records. These EBV provide an estimate the collective effects of all genes that affect the trait, without knowing where the genes that control the trait are located in the genome or what their individual effects are. Thus, although this quantitative genetic approach to selection has been effective for many traits, it is essentially a black-box approach. In the past decade, much research has been conducted to locate so-called Quantitative Trait Loci (QTL), which are regions in the genome that contain genes that affect the trait and which can be identified using molecular markers that are linked to the QTL. In most cases, however, the actual location, identity, and functional role of the QTL remains unknown. Thus, QTL mapping has essentially subdivided the black box of quantitative genetics into multiple smaller black boxes. Examples where the causative gene for the QTL has been identified are limited. Although markers that are linked to QTL can be used to enhance genetic progress through marker-assisted selection, there are limitations to such selection. In addition, the ability to identify QTL is limited for traits that are difficult or expensive to record. The purpose of this presentation is to describe and discuss how functional genomics can enhance the discovery of genes that control traits of importance and how the knowledge functional genomics promises to provide on gene function could be used in the future to enhance selection programs, management programs, and the integration of selection and management programs.

Key Words: Functional Genomics, Selection, Marker-Assisted Selection

14 Use of functional genomics in genetic selection programs for environmental stress tolerance in dairy cattle. R. Collier*[1], C. Stiening[1], B. Pollard[1], M. VanBaale[1], and P. Coussens[2], [1]*University of Arizona*, *Tucson*, [2]*Michigan State University*, *East Lansing*.

Selection for tolerance to environmental stress has traditionally been counterproductive in domestic animal production. As animals acclimatize to environmental stressors they reduce or divert metabolizable energy from production to balance heat gain and loss. Thus, it has generally been faster and easier to obtain production increases by altering the environment around animals. However, environmental modification comes at a high cost and in some cases these costs cannot be economically justified. Ideally, one would like to simultaneously select for increased production and thermal resistance to increased thermal load In order to do this the genes associated with acclimatizationon need to be identified. In acclimatization, the body's response to the environment is coordinated in two phases (acute and chronic) over a several week period at the structural, organ, cellular and molecular level to respond the stress or stressors with alterations in the organism's capacity to tolerate the stress. These changes include alteration in gene expression, enzyme activity, cell receptor populations, body organ size, fat deposition, energy consumption and a wide variety of other possible effector mechanisms depending on the stressors. Targets of potential genetic manipulation would include increased efficiency and capacity of thermal effectors and delayed onset of temperature threshold for thermal injury. We have identified a group of genes associated with the heat shock response in bovine mammary tissue. We have also identified factors associated with altered sweating rate in cattle. Presentation will focus on strategies to improve heat shock response and sweating rate to improve thermal tolerance in dairy cattle.

Acknowledgements: National Functional Bovine Genomics Consortium (NBFGC) IFAFS/USDA

Key Words: Acclimation, Heat Stress, Functional Genomics

15 Functional genomics of reproductive tissues: Creating new knowledge that can be used to solve infertility in farm animals. M. C. Lucy*, *University of Missouri*, *Columbia*.

Reproductive tissues express mRNA for a large number of genes. The full complement of expressed mRNA is unknown and sequencing projects typically find a large number of unique mRNA within the reproductive tract. The function of the proteins that arise from the expressed mRNA is either unknown or poorly understood. Furthermore, genes with recognized functions may have alterna-

tive functions that may be poorly characterized or completely unknown. Functional genomics is a scientific discipline that links gene expression (manifested at the genome level) to gene product (i.e., protein) function and cellular phenotype. Reproductive tissues are similar to other tissues where tissue and developmental patterns of gene expression is incompletely characterized and the functional annotation of expressed genes is poor. Nonetheless, characterizing changes in gene expression for known genes is a powerful tool that can be used to understand the underlying mechanisms controlling fertility in farm animals. Previously unknown control points are revealed when gene expression patterns are examined globally. These control points can act as avenues to ameliorate mechanisms that lead to infertility.

Key Words: Genomics, Ovary, Fertility

16 What has functional genomics taught us about Johne's disease in cattle? P. Coussens*[1], K. Skovgaard[2], and P. Heegaard[2], [1]*Michigan State University*, *East Lansing*, [2]*Danish Institute of Food and Veterinary Research*, *Copenhagen, Denmark*.

Infection of cattle with Mycobacterium avium supspecies paratuberculosis (MAP) leads to a chronic granulomatous enteritis commonly known as Johnes disease. Once established, infections with MAP typically exist in a subclinical state for several years and are difficult to detect during much of this period. We have used functional genomics to understand more about how the host immune system reacts to MAP, and how this response changes over time. During the course of these studies, our cDNA microarray analyses suggested that inherent gene expression profiles in peripheral blood mononuclear cells (PBMCs) from MAP infected cattle may be different those in PBMCs from uninfected controls, providing a possible gene expression signature indicative of Johnes disease. In collaboration with scientists from the Danish Institute of Food and Veterinary Research we have conducted studies aimed at testing this hypothesis. Our novel results indicate that expression profiles of at least 42 genes are inherently different in freshly isolated PBMCs from MAP infected cattle when compared to similar cells from uninfected controls. Major classes of genes differentially expressed include those encoding cytokines and their receptors (IL-5, TGFb, and GM-CSF), matrix metalloproteinases (MMPs) and their inhibitors (TIMPs) (TIMP1, TIMP2, MMP14, and MMP15), and proteins regulating apoptosis (Bad, CIDE-A, and MCL1). Gene expression differences in each of these categories were verified and expanded upon by Q-RT-PCR. Our results not only provide new information on immune responses to MAP, but confirm that infection with MAP may be diagnosed using the tools of functional genomics. With collaborators from University College Dublin, we have further applied these same findings to infections with M. bovis (bovine TB) and to infections with Brucella abortus.

Acknowledgements: USDA-APHIS-VS Grant Number 03-9100-0794-GR, USDA-IFAFS Grant Number 2001-52100-11211, Michigan Agriculture Experiment Station, Michigan State University Foundation, The Natl Research Agency of Denmark Grant 23-01-0163

Key Words: Functional Genomics, Johnes Disease, Gene Expression

17 Immunogenomics and the transition dairy cow: physiological insights and future possibilities for improving animal health. J. L. Burton*[1], S. A. Madsen[1], L-C. Chang[1], P. S. D. Weber[1], P. M. Coussens[1], G. J. M. Rosa[1], L. K. Matukumalli[2], T. S. Sonstegard[2], and T. P. Smith[3], [1]*Michigan State University*, *East Lansing*, [2]*USDA, ARS, BARC, Bovine Functional Genomics Laboratory*, *Beltsville, MD*, [3]*USDA, ARS, MARC*, *Clay Center, NE*.

Neutrophils are sensitive biomarkers of physiological status and are the main line of immune defense against bacteria that cause mastitis in dairy cows. Neutrophils become defective in some anti-bacterial activities as parturition approaches, but little is known about the gene products responsible for these defects. This reduces our ability to make improvements in postpartum cow health. Development of functional genomics tools for cattle provided the opportunity to rapidly investigate how the expression of thousands of genes in bovine neutrophils is affected by parturition. In our recent studies we used BOTL cDNA microarrays (see http://www.nbfgc.msu.edu) to examine gene expression in neutrophils collected from periparturient cows. Of 302 genes we identified to be induced or repressed around parturition, we revealed 3 key functional categories that were responsive to two blood factors of parturition, glucocorticoid and G-CSF. Phenotyping of the cells subjected directly to these factors painted a picture of neutrophil physiology not previously recognized, showing extended life span and induction of tissue degrading and phagocytic activities. Tissue degrading and phagocytic activities of neutrophils are critical for successful parturition and uterine involution in humans, and our results extend this by suggesting that parturient steroids and cytokines reprogram neutrophils so they can take part in parturition, perhaps at the expense of mammary defense. Because we now know the actual molecules involved in these important neutrophil phenotypic changes, our next steps are to: (1) identify which molecules are suitable drug targets for mastitis prevention; (2) test hormone/cytokine regimes as strategies for timed parturition; and (3) identify useful gene polymorphisms to aid genetic selection decisions for improved calving behavior and mammary health.

Acknowledgements: This work was supported by funds from USDA-IFAFS grant 2001-52100-11211 and the Michigan Agricultural Experiment Station project number MICL02035 (for JLBs participation in USDA Multistate Research Project NC-1010).

Key Words: Functional Genomics, Immunity, Parturition

Monday, July 25, 2005

POSTER PRESENTATIONS

Animal Health I

M1 Influence of the mycotoxin fumonisin B_1 on intestinal physiology and immune function in piglets. M. Lessard*[1], J.-P. Lallés[2], G. Boudry[2], B. Séve[2], and I. P. Oswald[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre*, *Lennoxville, Qc, Canada,*, [2]*INRA Systémes d'Élevage, Nutrition Animale et Humaine*, *St-Gilles, France*, [3]*INRA Pharmacologie-Toxicologie*, *Toulouse, France*.

In this study, a fungal extract enriched in fumonisin B_1 (FB_1) was orally administered to piglets to determine the influence of this mycotoxin on intestinal morphology and function and on systemic immunity. At weaning, 18 pairs of male piglets within litters were conducted in three replicates and allocated to the control (CTR) and FB_1 groups. Ten days after weaning (d 0), pigs of the FB_1 group received 1.5 mg/kg BW of the FB_1 extract (2.3 mg/ml) diluted in glucose solution for 9 days. CTR group received only glucose solution. On d -5 and d +2, all piglets were injected with 2 mg of emulsified ovalbumin (OVA) and blood samples were taken on d -5, +2 and +9 to evaluate antibody to OVA and mitogen-induced lymphocyte responses. On d +9, piglets were slaughtered and organs weighed. Samples from the small intestine were taken for morphometry and enzyme activities and to examine physiology in Ussing chambers. Mesenteric lymph nodes were also taken to determine bacterial translocation. Feed intake was slightly restricted during the oral treatment in both groups. Growth of pigs and feed consumption were similar in both groups but liver weight was higher ($P \leq 0.01$) in FB_1 group. FB_1 did not affect small intestinal villous and crypt morphometry but it tended ($P \leq 0.10$) to increase jejunal Na^+-dependent glucose absorption and vasoactive intestinal peptide (VIP) -induced secretion in vitro. Jejunal aminopeptidase N activity was lower with FB_1 ($P \leq 0.01$). FB_1 treatment did not influence secondary antibody response to OVA, specific lymphocyte proliferation response and bacterial translocation. In conclusion, FB_1 consumption alters functions of the small intestine without effect on its architecture or systemic immunity in this trial. Increased VIP-induced jejunal secretion suggests that FB_1 may aggravate secretory diarrhea caused by gut bacterial toxins.

Key Words: Fumonisin B_1, Intestine, Pigs

M2 Effects of age and nutrition on proliferation and activation of mitogen stimulated T cell subsets from neonatal calves. M. Foote*[1], B. Nonnecke[2], M. Fowler[3], B. Miller[3], D. Beitz[1], and W. Waters[2], [1]*Iowa State University*, *Ames*, [2]*USDA, ARS, National Animal Disease Center*, *Ames, IA*, [3]*Land O'Lakes, Inc.*, *St. Paul, MN*, [4]*Land O'Lakes, Inc.*, *Webster City, IA*.

Effects of nutrition and age on mitogen-induced (i.e. in vitro) proliferation and activation of lymphocyte subsets from milk replacer-fed calves were investigated. Calves were fed standard (0.45 kg/d of a 20% crude protein, 20% fat milk replacer, n=4) or intensified (1.14 kg/d of a 28% crude protein, 20% fat milk replacer, n=4) diets from 1 to 8 wk of age. Average daily weight-gain of intensified-diet (0.66 kg/d) calves was greater (P<.05) than standard-diet (0.27 kg/d) calves. When compared to responses of pokeweed mitogen-stimulated CD4 cells from juvenile steers (5-6 m of age), CD4 cells from 1-wk old calves displayed decreased (P<.05) proliferation, delayed CD25 expression and no increase (P>.10) in CD44 expression or decrease (P>.10) in CD62L expression in response to mitogenic stimulation. The mitogen-induced decrease (P<.05) in CD62L expression by steer CD8 and γδ T cells was not seen in stimulated CD8 and γδ T cell populations from 1-wk old calves. Similarly, the mitogen-induced increase (P<.05) in CD44 expression by adult γδ T cells was not observed (P>.10) in stimulated γδ T cell populations from 1-wk old calves. At wk 8 of age, however, mitogen-induced responses (i.e. proliferation and expression of activation antigens) by T cell subsets from standard-fed calves were comparable to responses of T cell subsets from juvenile steers. Feeding an intensified diet was associated with decreased (P<.05) proliferation of stimulated CD4, CD8, and γδ T cells; CD25 expression on stimulated CD4 and CD8 cells; and CD44 expression on stimulated CD8 cells. These results indicate that the functional capacity of the calf's T cell population matures rapidly during the first weeks of life and suggest that nutrition influences maturation of T cell function during the neonatal period.

Key Words: Milk-fed calf, Neonatal immunology, T lymphocyte

M3 Gastrointestinal leukocyte and peripheral blood mononuclear cell populations within piglets nursing sows supplemented with phosphorylated mannan oligosaccharides during gestation and lactation. C. L. Bradley*[1], D. C. Brown[1], M. E. Davis[1], C. V. Maxwell[1], E. A. Halbrook[1], Z. B. Johnson[1], R. Dvorak[2], and B. Lawrence[3], [1]*University of Arkansas*, *Fayetteville*, [2]*Alltech, Inc.*, *Nicholasville, KY*, [3]*Hubbard Feeds, Inc.*, *Mankato, MN*.

Three weeks prior to farrowing, 36 gestating sows were allotted to two dietary treatments to determine the effects of mannan oligosaccharide (MOS) supplementation on peripheral blood mononuclear cell (PBMC) and enteric leukocyte populations within their offspring. Diets consisted of a control or the control with 0.3% MOS fed to sows for 3 wk of gestation and throughout lactation. Dietary treatments were assigned to individual sows in a completely randomized design with sows stratified for equal parity and genotype representation. At an average of 16 d of age, 12 pigs (6 pigs per treatment) were randomly selected, and blood samples were obtained for the isolation of PBMC for flow cytometric analysis. Twenty-four hours later, the same 12 pigs were euthanized and jejunal intraepithelial (IEL) and lamina propria (LP) leukocytes were isolated for flow cytometric analysis. Myeloid cell lineage was affected in pigs nursing MOS-supplemented sows, which was evident by a reduction ($P < 0.04$) in monocytes (SWC1+CD14+ and CD14+SWC9-), intermediate monocytic cells (SWC1+SWC9+ and SWC1+MHCII+), activated macrophages (CD14+SWC1-, SWC9+MHCII+, SWC9+CD14+, and MHCII+CD14+) and antigen presenting cells (MHCII+CD14-) within the PBMC population. In addition, cellular immunity in nursing pigs was altered by MOS supplementation to the sow, with a reduction ($P < 0.02$) of CD3+ (T cells), CD4+ (T helper cells), CD21+ (B cells), CD25+ (activated T and/or B cells), CD4-CD8-CD25+ (activated immature T cells), TCR1+ (T cells with the gamma/delta T cell receptor), and CD4-CD8-TCR1+ (immature T cells with the gamma/delta T cell receptor) leukocytes within the PBMC population. However, there were no differences ($P > 0.10$) in populations of LP leukocytes or IEL between the two treatment groups. This study suggests that MOS supplementation to the sow may alter innate and cellular immunity in developing piglets, creating a quiescent immune response in the nursing offspring.

Key Words: Leukocytes, Mannan oligosaccharide, Swine

M4 Gene identification in bovine neutrophils. M. Worku*, T. Harris, and P. Matterson, *North Carolina A&T State University*, *Greensboro*.

Polymorphonuclear leukocytes (PMN) are key cells in the inflammatory response to bacterial products such as endotoxin. Endotoxins (LPS) are components of the outer cell wall of gram negative bacteria. Few studies have addressed the effect of LPS on gene expression in bovine blood PMN. The objective of this study was to investigate the expression of 5′-lipoxygenase (5′-LOX), cylcooxygenase 1 and 2 (COX-1 and COX-2), ubiquitin, tumor necrosis factor alpha (TNF-A), lactoferrin (Lf), and c-kit in PMN before and after exposure to LPS. Bovine PMN were isolated by differential centrifugation and hypotonic lysis of red blood cells. Cells were exposed to E. coli LPS (10ng/ 1x 10^6cells, 30 minutes, @ 37°C) and unexposed cells were used as control. RNA from control and endotoxin exposed PMN was isolated using TRI-REAGENT® (Sigma). RNA was reverse transcribed to cDNA and gene specific primers were used to amplify COX-1, COX-2, TNF-A, Lf, ubiquitin, 5′-LOX, and c-kit using RT-PCR. Bands observed on a 2% agarose gel were documented. The genes for 5′-LOX, COX-2, ubiquitin, and c-kit were expressed following LPS exposure. The genes for COX-2 and c-kit were expressed in the control samples. There was no expression for genes encoding COX-1, TNF-A, and Lf in bovine PMN. The expression of the gene encoding ubiquitin following LPS exposure may reflect its role in the regulation of the immune responses. Further studies are needed to elucidate the implications for inhibition of TNF-A-mRNA expression. The interplay between these genes and the levels of gene expression may contribute to the resolution of inflammation in response to LPS in bovine PMN.

Key Words: Bovine, PMN, Genes

M5 Use of PCR to amplify RNA in bovine neutrophils. M. Worku* and P. L. Matterson, *North Carolina A&T State University*, *Greensboro*.

Mature neutrophils (PMN) are post-mitotic cells that synthesize lower levels of protein and RNA than do dividing cells. Further, they contain endogenous RNases complicating RNA isolation. Neutrophils are critically important for determining the outcome of acute infections and serve as indicators of inflammation. Bacteria and their products such as endotoxin (LPS) evoke several functional responses in PMN that contribute to innate immunity. With the availability of the draft bovine genome sequence and the development of specific microarrays it is possible to conduct genome level expression studies to decipher key mechanisms of innate immunity. Gene expression studies using microarray analysis require sufficient quantities of good quality RNA. Studies were conducted to isolate sufficient quantities of good quality RNA from bovine blood PMN which was isolated from two cows using TRI-REAGENT®(Sigma). RNA quantity was measured using a spectrophotometer (OD 260), evaluations and concentrations calculated by multiplying OD x dilution factor (200) x 40 (extinction factor). Quality was assessed from the OD 260/280 ratio and using electrophoretic documentation. RNA was amplified by PCR using the cDNA Synthesis System (Roche) and purified using the High Pure RNA Tissue Kit (Roche). A concentration of 0.108 µg/µl RNA was isolated from LPS treated and 0.100 µg/µl from untreated samples. The purity was 1.07 and 1.1 respectively. PCR amplification yielded 0.348µg/µl of RNA from treated and 0.212 µg/µl from untreated samples to conduct microarray experiments. Endotoxin treated amplified samples showed an increased amount of RNA over untreated. Additionally, PCR amplification resulted in a 61% overall increase in the amount of RNA. Amplification of RNA with PCR using poly(A) primers may be a feasible approach to overcome the low concentration of RNA in bovine PMN in order to facilitate studies on gene expression at the transcriptional level.

Key Words: PCR, Bovine, Microarray

M6 In vitro effects of leptin on bovine immune cells. H. Florez-Diaz* and E. B. Kegley, *University of Arkansas*, *Fayetteville*.

Leptin is a 16 kDa protein that regulates feed intake and energy expenditure and has been proposed to act as a link between nutritional status and immune function. However, the role of leptin as a regulator of immune function in cattle has not been studied. Therefore, the objective of this study was to investigate the effect of leptin on in vitro lymphocyte proliferation and macrophage phagocytosis in beef cattle. Blood samples were collected from steers (n = 4) for peripheral blood mononuclear cells isolation. Recombinant ovine leptin was added to cell cultures at concentrations of 0, 1, 5, 10, 50, 100, 500, and 1000 ng/mL for lymphocyte proliferation without (unstimulated) or with mitogens phytohemagglutinin (PHA), pokeweed mitogen (PWM), concanavalin A (ConA), and lipopolysaccharide (LPS), and at concentrations of 0, 1, 10, 100, and 1000 ng/mL for macrophage phagocytosis. To discard endotoxin contamination of leptin, unstimulated and LPS stimulated cell cultures, in the absence or presence of leptin, were cultured for lymphocyte proliferation with or without the addition of polymyxin B sulfate. Linear, quadratic, and cubic effects of leptin were tested by GLM and ORTHOREG procedures of SAS. No evidence of endotoxin contamination was detected ($P \geq 0.06$). Leptin increased (linear effect, $P < 0.0001$) lymphocyte proliferation in PHA stimulated cells and maximum lymphocyte proliferation was obtained at leptin concentrations of 1000 ng/mL. Leptin increased stimulation index in cells cultured with PHA (cubic effect, $P < 0.01$). In ConA stimulated cells leptin increased (cubic effect, $P < 0.05$) stimulation index and maximum proliferation was obtained at leptin concentrations of 500 and 1000 ng/mL. Leptin did not affect ($P \geq 0.06$) lymphocyte proliferation in unstimulated, or PWM and LPS stimulated cells. Macrophage phagocytosis was affected by leptin (cubic effect, ($P < 0.05$). Maximum phagocytosis was obtained at leptin concentrations of 10 ng/mL. These results provide some evidence of the possible role of leptin in the immune response of cattle.

Key Words: Cattle, Leptin, Immune Response

M7 Tumor necrosis factor-α (TNF-α), nitric oxide (NO), and xanthine oxidase (XO) responses to endotoxin (LPS) challenge in heifers: effect of estrous cycle phase. S. Kahl* and T. H. Elsasser, *USDA, Agricultural Research Service*, *Beltsville, MD*.

The severity of host response in some diseases differs between sexes and this dimorphism has been attributed to the immunomodulating effects of steroid hormones. In females, puberty, pregnancy, menopause, and age have been shown to affect the immune response to a disease stress through the prevailing sex steroid milieu. Our objective was to determine in heifers whether the phase of estrous cycle affected the plasma concentration changes of immune response mediators after LPS challenge (2.5 µg/kg BW, i.v., *E. coli* 055:B5). Sixteen beef heifers (426 ± 9 kg) were synchronized to a similar stage of the estrous cycle with the two-injection protocol of dinoprost tromethamine (Lutalyse, Pfizer). Heifers were challenged with LPS 3 d (E, estrus; n = 8) or 10 d (D, diestrus) after the last i.m. injection of Lutalyse. Blood samples were collected at 0, 1, 2, 3, 4, 7, and 24 h after LPS injection. Plasma progesterone (P4) concentrations before LPS challenge (0 h) were 0.3 ± 0.1 and 4.2 ± 0.6 ng/mL in E and D, respectively. In all heifers, plasma TNF-α peaked 2 h after LPS ($P < 0.01$) and returned to basal level by 7 h. With TNF-α concentrations higher ($P < 0.01$) in E than D at the 1, 2, and 3 h samplings, the integrated TNF-α response (area under the time × concentration curve, AUC) was greater in E than in D (27.1 vs. 16.8 ng/mL × h, $P < 0.05$). Plasma concentrations of nitrate+nitrite (NO_x), an estimate of NO production, and XO activity, a mediator of superoxide production, were measured. NO_x increased ($P < 0.01$) in all heifers at 7 and 24 h after LPS; plasma NO_x AUC after LPS was greater in E than D (146 vs. 65 µM × h, $P < 0.01$). Plasma XO responses were also greater in E than D (235 vs. 150 mU/mL × h, $P < 0.05$). Results indicate that the estrous cycle phase is a major source of variability in the magnitude of immune response to bacterial toxins like LPS. The discrimination in responses between cycle phases may reside in the prevailing P4 concentrations at the time of challenge encounter.

Key Words: Endotoxin, Estrous cycle, Tumor necrosis factor-α

M8 Microarray analysis of LPS-induced mastitis in a mouse model. J. Zheng*, A. Watson, and D. Kerr, *University of Vermont*, *Burlington*.

Bovine mastitis is an inflammation of the mammary gland that is usually due to bacterial infection. In order to better understand the acute host response to mas-

titis, we have taken a microarray approach to study the genomic response to an intramammary infusion of LPS in a mouse model. On day 10 of lactation, LPS (1ug/gland) or saline (control) was infused into two glands/mouse (n=3/treatment). Mice were euthanasized 4h post-infusion and glands were recovered for analysis. Expression levels of approximately 23,000 genes were then examined by microarray (Affymetrix genechip; Moe430A). Microarray data was background corrected, normalized, and expression indexing was performed using RMA. Statistical analysis was performed using the R statistics programming environment (www.r-project.org). We found that a total of 299 genes were significantly ($p<0.005$) affected (≥2-fold change) of which 260 were induced and 39 were repressed. Northern blot analysis with phosphoimager quantification of band intensity (pixel intensity) confirmed induction ($P<0.01$) of CXCL1 (64,158 ± 16,063 vs 1,761 ± 52), serum amyloid A3 (74,629 ± 24,258 vs 397 ± 90), CD14 (245,893 ± 58,744 vs 4,354 ± 491), and IL-6 (3,459 ± 483 vs 614 ± 141). The fold changes in expression of these genes obtained by northern blot analysis were 36, 188, 56, and 6, respectively, and were of similar magnitude to those obtained by microarray analysis, 70, 93, 13, and 8, respectively. Overall, the importance of chemotaxis signals in the acute response was indicated by the induction of numerous chemokines including CXCL1, CXCL2, CXCL10, S100A8, and S100A9. Microarray analysis indicated that the fold induction of these genes was 70, 114, 21, 169, and 71 respectively. Immunohistological techniques are being used to determine if the epithelial cells are the source of these acute infection response signals.

Key Words: Innate, Chemotaxis, Chemokine

M9 Temporal response of signal transduction elements during endotoxin (LPS) challenge in cattle liver cells: effects of growth hormone treatment. C. Li*, T. Elsasser, S. Kahl, and D. Carbaugh, *Agricultural Research Service, USDA*, *Beltsville, MD*.

Exogenous GH treatment has been explored as a potential adjunct for management of catabolic processes that further challenge the host response to infection stress. Few definitive studies in cattle, if any, have addressed NO production as affected by GH treatment prior to the onset of immune challenge as well as signal transduction pathways after the challenge. Using Western blot, we examined the protein expression level of inducible nitric oxide synthase (iNOS) and the activities of potential signal transduction pathway elements in cattle liver cells in response to LPS challenge and the modification of these responses by daily treatment with recombinant GH prior to LPS challenge (3.0 μg/kg BW, *i.v*. bolus, *E. coli* 055:B5). Animals (n = 24) were divided into GH- and non-GH-treatment groups (n = 12/group, GH-treated: recombinant bovine GH, Monsanto Inc., St. Louis, MO; 0.1 mg/kg BW, i.m., daily for 12 d) in a factorial arrangement of GH treatment (+/-) and biopsy sampling time. In responses to LPS challenge, the protein level of iNOS increased significantly ($P < 0.001$) after 3 h and remained higher until 24 h. In GH treaded animals, the level of iNOS protein increased at 0, 3, and 6 h and was significantly higher than that in non-GH treated animals ($P < 0.001$). GH treatment stimulated the phosphorylation of Akt/Protein kinase B (PKB). Family of mitogen-activated protein kinases (MAPK), Erk, SAPK/JUK and p38 showed different patterns of response. While the temporal profile of phospho-Erk only responded to LPS in GH-treated animals ($P < 0.001$), phospho-SAPK/JUN responded to LPS in both GH-treated and non-GH-treated animals with significant higher level of phosphorylation ($P < 0.001$) in GH treated group. P38 showed no temporal response to LPS in both groups. These data support the notion that GH is able to activate signaling pathways similar to those used by cytokines and protect or enhance immune cell's function during stress conditions.

Key Words: GH, LPS, Signal transduction

M10 The effects of anti-inflammatory agents on gene expression of bovine neutrophils. N. Cunningham, M. Worku*, and P. Matterson, *North Carolina A&T State University*, *Greensboro*.

The objective of this study was to evaluate the effect of commonly used NSAIDS on COX-2 gene expression in resting and LPS (E. coli) stimulated bovine neutrophils (PMN). Blood PMN were isolated by differential centrifugation and red blood cells lysis. Cell viability was determined by Trypan blue dye exclusion, purity by differential cell counts and concentration by hemacytometer. Isolated PMN ($5x10^6$) were incubated in the presence or absence of $10ng/1x10^6$ cells LPS or NSAIDS (Naproxen Sodium, Flunixin Meglumine, Ibuprofen, Acetametophen, Dexamethosone, Sodium Salicylate, Nordihydroguaiaretic acid, Indomethosone, and NS-398 (30 minutes at 37°C, 5% CO2, and 88% humidity). Supernatants were collected and assayed for PGE_2 using a PGE_2 enzyme immunoassay kit (Cayman). COX-2 expression in cells was assessed using a simple dot blot assay. Bovine PMN express COX-2 following isolation and on exposure to LPS. This expression was inhibited by the presence of NS-398. With the exception of Indomethasone, all NSAIDS tested inhibited PGE_2 production. Initial studies indicate that common NSAIDS inhibit PGE_2 production. NS-398 has been reported to temporarily block the attachment site for arachidonic acid on the cyclooxygenase enzyme, preventing it from converting arachidonic acid to prostaglandin. On bovine PMN the expression of COX-2 at the protein level may also be inhibited by NS-398.

Key Words: COX-2, Bovine, NSAIDS

M11 Microarray analysis of immunorelevant gene expression in LPS-challenged bovine mammary epithelial cells. R. S. Pareek*[1], O. Wellnitz[2], J. Burton[3], and D. Kerr[1], [1]*University of Vermont*, *Burlington*, [2]*Technical University of Munich*, *Munich, Germany*, [3]*Michigan State University*, *East Lansing*.

The mammary epithelial cell plays a role in the host response to bacterial invasion of the gland by alerting the immune system of the presence and location of the infection. To better understand this process a cDNA microarray approach was used to search for potential signals produced by mammary epithelial cells in response to exposure to Escherichia coli LPS. Total RNA from separate cultures of epithelial cells from four Holstein cows was harvested 6 h after LPS challenge or control conditions. For each cow, RNA from control or LPS exposed cells was transcribed to cDNA, then labelled with Cy3 or Cy5, and then equal quantities applied to a bovine total leukocyte (BOTL) microarray slide containing 1278 unique transcripts. Dye reversal was used so that RNA from two of the control cultures was labelled with Cy3 while RNA from the other two control cultures was labelled with Cy5. From the resulting microarray data we selected four of the eleven genes significantly ($p<0.02$) induced (>1.2 fold) in response to LPS exposure for more detailed analysis. Two genes, RANTES/CCL5 and T-PA, were validated by quantitative real-time RT-PCR (Q-RT-PCR) analysis and revealed that they were induced by 208-fold and 3-fold, respectively. Two other genes, IL-6 and CXCL5, were detected by northern blot analysis that indicated inductions of 9-fold and 10-fold, respectively. This model system provides evidence for an important role of the mammary epithelial cell in the acute phase of the innate response to infection.

Key Words: Bovine total leukocyte (BOTL) microarray, Lipopolysaccharide (LPS), Mammary gland

M12 Parenteral administration of glutamine modulates acute phase response in postparturient dairy cows. A. Jafari*[2,1], D. Emmanuel[1], J. Bell[1], R. Christopherson[1], G. Murdoch[1], J. Woodward[1], C. Field[1], and B. Ametaj[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Isfahan University of Technology*, *Isfahan, Iran*.

The transition period is characterized by immune suppression and increased incidence of infectious diseases in dairy cows. Glutamine, the most abundant free amino acid in circulation that plays a key role in immune cell division and proliferation, has been shown to decrease (25%) immediately after parturition. The goal of this study was to investigate effects of parenteral administration of glutamine on mediators of acute phase response in transition dairy cows. Three groups (n = 8/group) of multiparous Holstein cows were randomly assigned to the following 3 treatments: intravenous infusion of 10 L of 0.85% NaCl (control), or intravenous infusion of 106 or 212 g/d of L-glutamine mixed with 10 L of 0.85% NaCl for 8 h for 7 consecutive days starting on the day of parturition.

Blood samples were drawn from the jugular vein 1-2 wk before the expected day of parturition as well as on days 0, 7, 14, and 21 after parturition and plasma concentrations of serum amyloid A (SAA) and haptoglobin (Hp) were measured by ELISA. Concentrations of SAA and Hp in plasma of control cows increased on the day of parturition as well as at 7 days postpartum and declined thereafter. Cows infused with 212 g/d of L-glutamine had greater concentrations of SAA and lower concentrations of Hp on days 7 ($P<0.05$) and 21 ($P<0.05$) postpartum compared to controls. Cows infused with 106 g/d of L-glutamine also had greater concentrations of SAA in plasma on day 21 ($P<0.05$) postpartum compared to controls. In conclusion our data indicate that parenteral administration of glutamine modulates acute phase response in dairy cows immediately after parturition. Further research is warranted to understand the mechanism by which glutamine affects immune response in transition dairy cows.

Key Words: Glutamine, Acute Phase Response, Dairy Cows

M13 Evaluation of two simple tests for the detection of cryptosporidium parvum oocysts in calf feces. L. Trotz-Williams[1], S. Martin[1], D. Martin[2], T. Duffield[1], K. Leslie*[1], D. Nydam[3], and A. Peregrine[4], [1]*University of Guelph, Guelph, ON, Canada*, [2]*Ontario Ministry of Health and Long-Term Care, Etobicoke, ON, Canada*, [3]*Cornell University, Ithaca, NY*, [4]*University of Guelph, Guelph, ON, Canada*.

A sucrose wet mount test developed at the Ontario Veterinary College (OVC) for the detection of Cryptosporidium parvum oocysts in calf feces, and a lateral immunochromatography test (BioX Diagnostics, Jemelle, Belgium) for C. parvum in feces, were evaluated in terms of epidemiological sensitivity and specificity, cost, and utility. Polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) targeting the Cryptosporidium oocyst wall protein (COWP) gene locus was used as the gold standard for evaluation of the tests.

One hundred and ninety-nine fecal samples from naturally infected Holstein calves under 21 days old were used for the study. All samples were analyzed in a blinded manner. Cohen's kappa statistic of agreement (κ) between the OVC sucrose wet mount test and COWP PCR-RFLP was 0.82, showing good agreement, and the sensitivity and specificity of the OVC sucrose wet mount test were 88.6% and 93.8%, respectively. The sensitivity and specificity of the lateral immunochromatography test were 78.3% and 93.3% respectively, and agreement between this test and PCR-RFLP was also good ($\kappa = 0.73$). There was also substantial agreement between the OVC sucrose wet mount test and the lateral immunochromatography test ($\kappa = 0.84$). Both tests were inexpensive and easy to use. However, the lateral immunochromatography test was faster and simpler to perform than the sucrose wet mount test, and was generally more user-friendly. Both of these tests provide practitioners and researchers with cheap, quick and accurate methods of detecting C. parvum infection in young calves.

Acknowledgements: Thanks to Grazyna Adamska-Jarecka for diagnostic support, and to Dr. Frances Jamieson and Billy Yu, Laboratories Branch of the Ontario Ministry of Health and Long-Term Care, for collaborative assistance with this research. The lateral immunochromatography test kits used for this project were kindly supplied by BioX Diagnostics.

This study was funded by the Ontario Ministry of Agriculture and Food, the National Sciences and Engineering Research Council of Canada, Dairy Farmers of Ontario and Dairy Farmers of Canada.

Key Words: Cryptosporidium parvum, Diagnostic tests, Calves

Breeding and Genetics I

M14 Estimatives of heritability to time in different distances of race in Quarter Horse. S. Oliveira, M. Correa, and M. Mota*, *Unesp, Botucatu, SP, Brazil*.

The Quarter Horse are known by their versatility, they can be used for conformation, work and race modalities. This way, this work objectived to estimate the heritabilities to race time in distances of 301m (2,770 observations), 320m (2,039), 365m (3,739) and 402m (5,366), in Quarter horse races. The components of variance needed to the obtation of the heritabilities were estimated by MTGSAM program, under animal model. The Gibbs sampling considered 2,005,000 samples, excluding the first 5,000 and after these, one in each 1,000 samples were stored for inference, totalizing 2,000 samples for studying. The linear model used to information analise included the random effects of animal and permanent environment and the fixed effects of age (2, 3 and 4 years-old or more), sex (male and female) and race. The estimatives of heritability were, in average, 0.26, 0.15, 0.40 and 0.35, respectively to the distances of 301, 320, 365 and 402m. The biggest density intermission "a posteriori", with 90% of probability, following the previous presentation order were 0.25 to 0.34, 0.09 to 0.33, 0.33 to 0.58 and 0.34 to 0.38. The results indicate that longer distances present bigger heritability and, in consequence, they shall possible good replies to the masal selection.

Key Words: Heritability, Quarter horse, Race

M15 Estimatives of repeatibility to time in different distances of race in Quarter horse. M. Correa, S. Oliveira, and M. Mota*, *Unesp, Botucatu, SP, Brazil*.

The Quarter horse are admired by their versatility, they can be used for conformation, work and race modalities. Based on this, this work objected to estimate the repeatibilities to race time in distances of 301m (2,770 observations), 320m (2,039), 365m (3,739) and 402m (5,366) in Quarter horse races. The components of variance needed to obtain the repeatibilities were estimated by MTGSAM program, under the animal model. The Gibbs sampling considered 2,005,000 samples, excluding the first 5,000 and after them, one in each 1,000 samples were stored for inference, totalizing 2,000 samples for studying. The linear model used to information analise included the random effects of animal and permanent environment and the fixed effects of age (2, 3 and 4 years-old or more), sex (male and female) and race. The setimatives of repeatibility were, for 301m, in average, 0.36, with 90% of probability of the information appear between 0.29 and 0.36, for 320m, 0.27, with the informatinos between 0.19 and 0.45, for 365m, 0.48, between 0.43 and 0.61, and for 402m, 0.68, between 0.65 and 0.68. The estimated results suggest that for longer distances, just a result of performance can be enough to rule out the animal, while for shorter distances, more than one result of performance shall be done.

Key Words: Repeatibility, Quarter horse, Race

M16 Simulation model of cashmere goat production system: I. A dynamic herd simulation model & breeding strategies for fiber quality. B. Tseveenjav*[1,2], D. J. Garrick[1], S. LeValley[1], and Z. Yondon[2], [1]*Colorado State University, Fort Collins*, [2]*Cashmere Goat Association of Mongolia, Ulaanbaatar, Mongolia*.

Fiber diameter is the most important factor determining the value per unit weight of cashmere fleece. The need to consider fiber diameter in selection programs in addition to cashmere fleece weight has increased in the last decade, because fiber diameter in many Cashmere populations has deteriorated as a result of intensive selection on fleece weight. The objective of this study was to quantify the superiority of an economic selection index applied to simultaneously decrease fiber diameter and increase cashmere fleece weight in indigenous Cashmere goats. Throughout computer modeling the effects of different breeding

schemes applied to a hierarchical integrated cashmere production system, involving purebred goats, were investigated. The study simulated cashmere production based on traditional cashmere herd management practices in Mongolia and utilized the published genetic parameters with heritabilities of .28 for cashmere fleece weight (CFWT), .10 for live weight (LWT), .32 for fiber diameter (FD)and .23 for fiber length FL. Simulation program of cashmere production was developed using AWK and JAVA programming languages. Using multitrait animal model, individual animal breeding values were predicted and deterministic procedures were applied to develop a model for cashmere production system. Using different selection criteria and their combinations of FD, CFWT, FL and LWT effects were tested for 20 years and the accuracy of prediction and economic responses each of breeding schemes in long term were compared. Genetic trends for each economically relevant trait were calculated for 20 years. Using economic selection indexes likely to be the most profitable in an integrated cashmere production system. The main conclusion of this study were (i) new estimated breeding values (EBV) should be developed for FD, a major determinant of cashmere price, for every breeding does and bucks in those indigenous goats (ii) economic selection indexes could simultaneously improve genetically antagonistic two economically relevant traits- FD and CFWT.

Key Words: Economic Selection Index, Cashmere Goats, Fiber Characteristics

M17 Bayesian inference of the genetic trend for litter size in the Ripollesa breed of sheep in Spain. J. Casellas*, G. Caja, A. Ferret, and J. Piedrafita, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

The Ripollesa is an autochthonous sheep breed managed under semi-intensive conditions for the production of light lambs (24 kg BW at slaughter) in Catalonia (Spain). The ewes used (n = 365) came from a flock naturally mated for fall lambing (Christmas harvesting) and selected under a phenotypic breeding program for litter size since 19 yr ago. Replacement ewes and rams were chosen from the progeny of the most prolific ewes which have had at least three recorded lambings. A total of 1,590 litter sizes (single, 54.0%; twins, 44.2%; triplets, 1.8%; and quadruplets, 0.1%) were recorded from 1986 to 2004 for which annual litter size ranged between 1.23 and 1.70 lambs/ewe, showing a positive phenotypic trend. The dataset was analyzed using the Bayesian threshold methodology. The model included the additive genetic effect, as well as age of the ewe, year of lambing and ewe's permanent environmental effect, as the non-genetic sources of variation. Response to selection was analyzed as the change in average breeding value (ABV) per year of the replacement ewe-lambs and as the ABV of all ewes present in the flock. Estimated heritability was 0.13, with the highest posterior density at 95% ranging between 0.05 and 0.37. The ABV values was 0.01 in 1986, and peaked to 0.39 (1997) and 0.29 (2004) residual variance units (RVU) for ewe-lambs and ewes, respectively. A significant increase of multiple lambing (≥2 lambs) was observed with a mode of approximately 10 percentage units. Litter size also varied according to year of lambing (estimates ranging from 0 to 0.85 RVU, for 1986 and 2000, respectively) although there was no significant trend. Despite the small population size, our results show that litter size was effectively improved through phenotypic selection, with a low amount of triplets and quadruplets.

Acknowledgements: Conveni DARP-ANCRI-UAB

Key Words: Bayesian Inference, Litter Size, Ripollesa Breed

M18 Estimation of genetic parameters for body weight in Rambouillet and Targhee lambs. J. M. Rumph*, K. C. Davis, P. G. Hatfield, and R. W. Kott, *Montana State University*, *Bozeman*.

Weights were analyzed using records from 8055 Rambouillet and 6604 Targhee lambs collected at Montana State University's Red Bluff Research Ranch from 1970 through 2004. Records included birth weight (BW), turnout weight (TW) when lambs were turned out to summer range at an average age of 50 d, and weaning weight (WW) at an average age of 125 d. All traits were analyzed with fixed effects of year, line, age of dam, number born, and sex. BW and TW were analyzed in a multiple trait model. Analyses of BW with WW and TW with WW could not reach convergence, so WW was analyzed in a single trait analysis. Estimates of heritability for BW were 0.35 and 0.42 for Rambouillet and Targhee, respectively. Estimates of heritability for TW were 0.14 and 0.13, respectively. The direct genetic correlation between BW and TW was estimated to be 0.32 and 0.64, respectively. Estimates of heritability for WW were 0.02 and 0.46, respectively. For unknown reasons, there are distinct differences in estimates of genetic parameters for these two breeds in the Montana State University flock.

Key Words: Weaning Weight, Birth Weight, Sheep

M19 Genetic polymorphism of β-Lactoglobulin gene in Iranian Karakul sheep by DNA test. A. Javadmanesh*, M. R. Nassiry, H. Ghiasi, A. Samei, and A. Norouzy, *University of Mashhad*, *Mashhad, Khorasan, Iran*.

β-Lactoglobulin is the major milk whey protein in ruminants. Studies have shown that this protein is polymorphic in many breeds and the allele B is associated with higher milk yield than allele A. This is the result of single base pair substitution in the β-Lactoglobulin gene which also rises to an RsaI restriction fragment length polymorphism (RFLP). The genotype BB of β-Lactoglobulin seems to be associated with higher milk yield; on the other hand genotypes AA and AB seem to be superior in protein and casein content of milk. The aim of the present study was to identify two genetic variants (A and B) and three genotypes (AA, AB and BB) of β-Lactoglobulin gene in Iranian Karakul sheep by PCR-RFLP. 83 blood samples were supplied from Karakul sheep station located in Sarakhs, Khorasan. Total DNA was extracted from 100 uL blood according to Boom R. et al. (1989). 25 ng DNA was used to amplification in a total volume of 25 uL. Samples were amplified for 34 cycles at the following steps: denaturation at 94°C for 50 sec, annealing at 59°C for 30 sec and extension at 72°C for 40 sec. Primers amplified a 301 bp fragment from the exon II of the ovine β-Lactoglobulin gene. PCR products were recognized by electrophoresis on 1% agarose gel stained with etithium bromide. 5 uL of each PCR products were incubated for 5 h at 37°C with 4 units of *RsaI* enzyme. Digestion products were separated by electrophoresis on 8% polyacrylamid gel and visualized with silver staining. The frequency of genotypes in co-dominant locus was analyzed by PopGen32 software ver 1.31. The allelic frequencies were 88% and 12% for A and B respectively. The genotype distributions were 76%, 24% and 0% for AA, AB and BB. G test did not confirm the H-W equilibrium. According to Vltaka et al. (2002) BB genotype of ovine β-Lactoglobulin not found in Russian Karakul sheep so this experiment confirmed the previous study. Since the allele B is more important in milk production and allele A is more responsible for protein content of milk and cheese quality, we can result that these Karakul sheep are suitable for cheese production.

Key Words: β-Lactoglobulin, Polymorphism, Karakul

M20 Comparison of maturity rate for bull daughters in the United States and Canada. H. D. Norman[1], J. R. Wright*[1], R. L. Powell[1], P. M. VanRaden[1], and F. Miglior[2,3], [1]*Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*, [2]*Agriculture and Agri-Food Canada - Dairy and Swine Research and Development Centre*, *Lennoxville, QC, Canada*, [3]*Canadian Dairy Network*, *Guelph, ON, Canada*.

Maturity rate of bull daughters in the United States and Canada were compared based on parity-specific predicted transmitting abilities (PTA) of sires. For US daughters, 305-d milk records for Holsteins with first-parity calving dates between 1960 and 1998 were used to calculate sire PTA based on first-parity daughter records (PTA_1), first- and second-parity daughter records (PTA_{1-2}), and first- through third-parity daughter records (PTA_{1-3}). Sire evaluations with contributions only from second- (PTA_2) or third-parity (PTA_3) daughter records were approximated by weighting based on numbers of daughters with first, second, and third parities. For Canadian daughters, parity-specific estimated breeding values (EBV_1, EBV_2, and EBV_3) of sires were those derived for November 2004 national evaluations. Correlations among parity-specific sire evaluations were calculated within birth year of bulls. Correlations for 101 bulls with ≥500 daughters in both countries were 0.87 between PTA_1 and PTA_2, 0.86 be-

tween PTA_1 and PTA_3, and 0.97 between PTA_2 and PTA_3 for US daughters; corresponding correlations were 0.90, 0.88, and 0.98 for Canadian daughters. Correlations between PTA_2 - PTA_1 and EBV_2 - EBV_1 were 0.63 for 599 bulls with ≥20 daughters, 0.82 for 311 bulls with ≥100 daughters, and 0.89 for bulls with ≥500 daughters in both countries; corresponding correlations were 0.54, 0.76, and 0.85 for differences between third- and first-parity sire evaluations. Corresponding correlations for differences between third- and second-parity sire evaluations were considerably lower at 0.14, 0.27, and 0.52, probably because differences between second- and third-parity evaluations were small. Differences in maturity rate of bull daughters were reasonably consistent across countries. Modeling genetic evaluations to account for those differences would increase accuracy for bulls with daughters that deviate substantially from population mean.

Key Words: Maturity Rate, Milk Yield, Parity

M21 Factors affecting heifer fertility in US Holsteins. M. Kuhn* and J. Hutchison, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*.

Heifer breedings from January 2003 to October 2004 were used to investigate factors affecting heifer fertility. There were 331,469 breedings on 220,624 Holstein heifers. Only artificial inseminations were analyzed. Age at breeding was required to be between 8 months and 3 years. Only 0.33% of breedings occurred at ages > 2.5 years; 98.2% of all breedings were at ages < 2 years. The dependent variable for analysis was 0 (no conception) or 1 (conception). A heifer's last recorded service was considered a success. Breedings were included only if there was at least 2 months for a repeated service to be reported. The linear model for analysis included the fixed effects of herd, year, month, and age-at-breeding, and the covariates of parent average predicted breeding value for milk, SCS, and daughter pregnancy rate (DPR). The overall arithmetic mean conception rate was 0.64 with a 0.48 standard deviation. The only factors that did not have a significant effect on heifer conception were parent average breeding values for milk and SCS. Year accounted for the most variation in heifer conception rate. Year 2004 had a 6% higher conception rate than 2003. This may be a realistic difference between years or it may indicate that additional editing needs to be investigated. Perhaps 2 months is not an adequate amount of time to wait for a reported service in the case of heifers. Month of breeding accounted for the second largest amount of variation with January and February having the poorest conception rates and September and October having the best. Parent average breeding value for DPR accounted for the third most variation with conception rate increasing as DPR increased. Selection on DPR will improve fertility in heifers as well. Age at breeding accounted for more variation than herd; conception rates increased with age. Further research will investigate appropriate edits for heifer breedings and also compare linear model results to results from logistic and probit models.

Key Words: Heifer Bbreedings, Daughter Pregnancy Rate, Fertility

M22 Effectiveness of estimating individual herd heritabilities using regression techniques. C. D. Dechow*[1] and H. D. Norman[2], [1]*Penn State University*, *University Park*, [2]*Animal Improvement Programs Laboratory*, *Beltsville, MD*.

The objectives of this study were to estimate heritabilities for individual herds using regression techniques and determine if incorporating individual herd heritability would increase accuracy of genetic evaluations. First lactation mature equivalent milk (MEM) was obtained from 64,350 first lactation cows in 45 herds with 500 or more cows. Individual herd heritability was estimated using REML (h^2_{RML}), daughter-dam regression (h^2_{DD}), and daughter-sire estimated breeding value regression (h^2_{DS}). Regression coefficients were estimated for each herd with the MIXED procedure of SAS. The model included fixed year-season and age at calving effects, either dam MEM (DM) or sire estimated breeding value (SEBV) as a random covariable, and random error. Animal models were also used to estimate heritability for each herd with ASREML. Heritability from daughter-dam regression was twice the regression of MEM on DM. Twice the regression of MEM on SEBV was multiplied by genetic variance of the US Holstein population and divided by herd phenotypic variance to estimate h^2_{DS}. Sex averaged heritability (h^2_{SA}) was the mean of h^2_{DD} and h^2_{DS}. Heritability estimates were constrained to range from 0.25 to 0.35 and were used to standardize records to a constant genetic variance across herds. Estimated breeding values (EBV) were generated with the adjusted records, which were weighted by the ratio of base error variance to herd error variance. Average individual herd heritability estimates ranged from 0.28 for h^2_{RML} to 0.31 for h^2_{DD}. Correlations of h^2_{RML} with h^2_{DD}, h^2_{DS}, and h^2_{SA} were 0.53, 0.42 and 0.61, respectively. Correlations among sire EBV generated with the adjusted records and official sire PTAM from November 2004 national genetic evaluations ranged from 0.007 to 0.012 higher than the correlation when using non-adjusted records. Correlations between yield deviations and parent averages were lower (range -0.026 to -0.002) after adjustment for heritability, except adjustments for h^2_{DD} (0.006 higher). Individual herd heritability estimates may improve accuracy of national genetic evaluations, or help identify progeny test herds with poor parent identification.

Key Words: Heritability, Yield, Accuracy

M23 Accounting for heterogeneous variances in multi-trait evaluation of Jersey type traits. N. Gengler[1], G. Wiggans[2], L. Thornton*[2], J. Wright[2], and T. Druet[1], [1]*National Fund for Scientific Research, B-1000*, *Brussels, Belgium*, [2]*Animal Improvement Programs Laboratory*, *Beltsville, MD*.

The multi-trait genetic evaluation system for type traits was modified to estimate adjustments for heterogeneous variance (HV) simultaneously with estimated breeding values (EBV) for final score and 14 linear traits. Heterogeneity, estimated for transformed traits, was regressed within parity toward the population variance means by fitting a model with fixed effects of mean final score for herd, size of contemporary group, appraisal month, and appraisal year-season and a random effect for interaction between herd and appraisal date. Method R was used to estimate variances for the heterogeneity model in each EBV iteration. Data was from the 766,725 appraisals included in the official November 2004 evaluation. Parent averages were calculated from evaluations with recent appraisals removed. Annual trends for cow EBV were lower with HV adjustment than for unadjusted EBV for all traits. The SD of Mendelian sampling (evaluation minus mean of parent evaluations) declined less over time for HV adjusted than for unadjusted evaluations. The slope at year 2000 of Mendelian-sampling SD from HV adjusted evaluations was only 22% for udder depth to 48% for teat length of the slope of that for unadjusted evaluations. This adjustment for HV was implemented in May 2001 and should make selection decisions more accurate by using these proposed integrated HV adjustments.

Key Words: Heterogeneous Variance Adjustment, Type Evaluation

M24 Comparison of lifetime relative net income with and without adjustment for opportunity cost. E. Yook, R. Pearson*, and B. Cassell, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The purpose of this study was to compare relationship of lifetime relative net income (RNI) and RNI adjusted for opportunity cost (RNIOC) for 6 herd life opportunity lengths based on 305d or complete milk records. RNI and RNIOC were calculated on 70,167 cows born in 1988, 1990, and 1992 from IN, FL, NC, TX, VA, and VT using the milk pricing assumed in Net Merit calculations and based on either 305d or complete lactation records for periods of herd life from 5 to 10 years. Opportunity cost was estimated for each cow by multiplying her total days of productive life in herd times the mean herd RNI divided by mean herd days of productive life. RNIOC for 10yr herd life opportunity estimated from complete lactations was regressed on 5, 6, 7, 8, and 9yr herd life opportunity (β= 1.2, 1.13, 1.07, 1.04, 1.01; R^2 =.74, .87, .94, .98, and .99). Similarly regressions predicting RNI for 10 yr herd life opportunity were run (β = 1.45, 1.26, 1.14, 1.06, 1.02; R^2 =.72, .86, .94, .98, and .99). RNIOC for 10yr herd life opportunity estimated from complete lactations was regressed on 5 to 10 yr herd life opportunity based on 305d lactations (β = 1.12, 1.05, 1.01, .97,

.95, and .94; R^2 =.62, .73, .79, .82, .84, and .84). Similar regressions for RNI 10yr opportunity based on 305d lactations were calculated (β = 1.57, 1.38, 1.26, 1.19, 1.15, and 1.13; R^2 =.66, .79, .87, .91, .93, and .93). Shorter herd life opportunities underestimate 10yr opportunities much less for RNIOC than for RNI. However, R^2 for RNI and RNIOC using complete lactations are nearly identical. Use of 305d records to predict RNIOC 10yr opportunity have substantially lower R^2 than for the same comparison with RNI. The simple regression of RNIOC 10yr opportunity on the PTA in the merit index was less for all of the PTA than for the similar simple regressions RNI on the PTA. The largest reduction (75%) was for PTA DPR and the smallest was for PTA FAT. Use of RNIOC based on complete lactations is recommended.

Key Words: Lifetime Net Income, Relative Net Income, Herd Life Opportunity

M25 A stochastic simulation study on validation of an approximate multitrait model for prediction of breeding values. J. Lassen*[1,2], M. K. Sorensen[1], and P. Madsen[1], [1]*Danish Institue of Agricultural Sciences*, *Foulum, Denmark*, [2]*The Royal Veterinary and Agricultural University*, *Frederiksberg, Denmark*.

The aim of this study was to develop and validate an approximate multitrait model for prediction of breeding values. A population resembling Danish Holstein with 300,000 cows and a herd size of 100 was simulated. The simulation included the following eight traits: milk yield, mastitis, SCS, days open, non return rate, udder depth and dairy character. A 15 year breeding scheme with selection on an index of milk, mastitis and udder depth was simulated. The simulation was repeated 35 times.

For each replicate, univariate BLUP was performed to estimate fixed and predict random effects. Records were adjusted for all effects except the animal effect using the BLUP solutions. Variance components were estimated on preadjusted data using a simplified model with a mean, an animal effect and a residual. Two multivariate BLUP were conducted: 1) on preadjusted data using the estimated variance components and the simplified model. 2) on raw data using the true variance components and the complete model. Correlations between true and predicted breeding values were computed for both sets of BLUP breeding values.

The variance components estimated on preadjusted data were in close agreement with the true parameters and never with more than 10 % difference in absolute value. The correlations between true and predicted breeding values were from 1 to 8 % lower for BLUP based on preadjusted data compared to the BLUP from raw data. The largest differences were for traits with low heritability.

A full multitrait BLUP would be the optimal method, but computer power is a limiting factor when handling the large number of traits in the total merit index of today. Therefore, using multivariate BLUP on subsets of the traits and then combine the resulting breeding values using approximate methods to the total merit index is of interest.

Key Words: Multitrait Model, Variance Components, Simulation Study

M26 Genetic correlations between reproductive traits in swine. S.-H. Oh* and M. T. See, *North Carolina State University*, *Raleigh*.

The objective of this study was to estimate genetic parameters among reproductive traits in swine. Traits analyzed included weaning to first service interval (WTE), litter birth weight (LBW), number of pigs born alive (NBA), number of pigs weaned (NW), and adjusted 21 day litter weight (LWT). The National Swine Registry provided reproductive records of Duroc sows. Numbers of records were 3,850 for WTE, LBW and NBA and 3,836 for NW and LWT. Genetic parameters were estimated using a five-trait model and the MTDFREML software program. The statistical model included fixed effects of contemporary group, farm and parity and random effects of animal and permanent environment. For LBW and LWT, NBA and number of pigs at transfer (NAT), respectively, were added as a fixed effect in the model. Heritability estimates for WTE, LBW, NBA, NW and LWT were 0.09, 0.14, 0.10, 0.15, 0.17, respectively. Weaning to first service interval was genetically correlated with LBW (.13) but not NBA (-0.02), NW (0.01) or LWT (0.01). Genetic correlations between LBW and NBA, NW, and LWT were -0.06, 0.07 and 0.39, respectively, and are lower than previously reported estimates. Genetic correlations between NBA and NW and LWT were 0.86 and 0.65, respectively. The genetic correlation between NW and LWT was 0.81. These results indicate that in the Duroc breed response to genetic selection for these traits is possible and that when including WTE and LBW in genetic evaluations a multiple trait model with other reproductive traits should be considered.

Key Words: Pigs, Reproduction, Genetic Parameters

M27 Heritability of daily feed intake in swine. S.-H. Oh*[1], W. O. Herring[2], M. Culbertson[2], and M. T. See[1], [1]*North Carolina State University*, *Raleigh*, [2]*Smithfield Premium Genetics*, *Roanoke Rapids, NC*.

Estimates of genetic parameters for daily feed intake in swine were obtained using a random regression model. Daily feed intake for 581 boars was recorded at two farms using feed intake recording equipment (FIRE®) resulting in 31,689 non-zero feed intake observations. Feed intake records were collected between 70 and 204 days of age. Before analysis, each individual's complete feed intake record was evaluated for outliers by plotting feed intake by day and testing each feed intake observation with the Cook's D test statistic and studentized residuals. After removal of outliers 30,358 feed intake observations were utilized in the subsequent analysis. The statistical model included herd-year-season as a fixed effect, and litter, animal and permanent environmental effects were included as random effects with levels of each effect of 249, 26, 2,236 and 529, respectively. The REMLF90 program was used to analyze the data with third degree Legendre polynomial and assumed homogeneous error variances. The mean additive genetic, litter and permanent environmental variances across all ages were 107.32, 0.23, and 0.11, respectively. Residual variance was 0.848. As a result, heritabilities of daily feed intake were estimated that ranged from 0.10 to 0.99 between 1 and 210 days of age. Between 90 and 150 days of age where most observations were collected, additive genetic, litter and permanent environment variances ranged from 0.120 to 0.708, 0.047 to 0.234, and 0.065 to 0.085, respectively. Heritability of daily feed intake ranged from 0.11 to 0.42 between 90 and 150 days of age where most intake observations were collected. To better understand the observed residual variance further study is needed to evaluate the effect of heterogeneous error variance in these data.

Key Words: Pigs, Feed Intake, Heritability

M28 Genetic parameter estimates for insulin-like growth factor I concentration and growth traits in Angus beef cattle divergently selected for serum insulin-like growth factor I concentration. M. Davis*, *The Ohio State University*, *Columbus*.

Divergent selection for serum insulin-like growth factor I (IGF-I) concentration was initiated in 1989 using 100 spring-calving cows (50 high line and 50 low line) and in 1990 using 100 fall-calving cows (50 high line and 50 low line) at the Eastern Agricultural Research Station. The objective of the present study was to update genetic parameter estimates published in 1997 (J. Anim. Sci. 75:317-324) using data from the IGF-I selection experiment. The updated analysis included 1,761 calves produced from 1989 through 2000. Data were analyzed by multiple-trait, derivative-free, restricted maximum likelihood (MTDFREML) methods. Estimates of direct heritability for serum IGF-I concentration measured at d 28, 42, and 56 of the 140-d postweaning test and for mean IGF-I concentration (average of three IGF-I measurements taken on each calf) were 0.44, 0.51, 0.42, and 0.52, respectively. Heritabilities of maternal genetic effects were 0.18, 0.20, 0.10, and 0.20, respectively. The proportion of phenotypic variance accounted for by permanent environmental effects of dams was zero for all measures of IGF-I. Additive direct correlations with birth weight,

weaning weight, on-test weight, and off-test weight were -0.27, 0.12, 0.09, and 0.29, respectively, when averaged across all four measures of IGF-I. Phenotypic correlations were -0.08, 0.07, 0.10, and 0.16, respectively. The average direct genetic correlation of IGF-I with gain during the 140-d postweaning period was 0.29, whereas the average phenotypic correlation was 0.15. Updated results indicate that serum IGF-I concentration is moderately to highly heritable in beef cattle and that it has small positive genetic and phenotypic correlations with postnatal weight and gain traits. These findings contrast with those published from the same selection experiment in 1997, which indicated negative genetic correlations of IGF-I with weaning and postweaning weights and with postweaning weight gain (correlations ranged from -0.21 to -0.54 and averaged -0.38).

Key Words: Beef Cattle, Genetic Parameters, Insulin-Like Growth Factor

M29 Association of single nucleotide polymorphisms in bovine somatostatin and somatostatin Receptor 2 genes with growth traits in divergent IGF-I selection lines of cattle. W. Huang*, H. Hines, and M. Davis, *The Ohio State University*, *Columbus*.

Somatostatin (SST) plays an important role in inhibiting the secretion of growth hormone. Somatostatin action is mediated through its five G-protein-coupled receptors (SSTR1~5). Polymorphisms in SST and SSTR2 may have an effect on growth traits. The aim of this study was to investigate the associations of three SNPs, SST111 (*Dra* III) in SST, and SSTR339 (*Bcc* I) and SSTR393 (*Hpy*188 I) in SSTR2, with growth traits and IGF-I concentration in Angus cattle from two divergent IGF-I selection lines. Genomic DNA was extracted from 410 Angus cattle born in spring and fall of 2000 to 2002 at the Eastern Agricultural Research Station. The entire region of SST and SSTR2 was amplified by four overlapping primer pairs. The pool and sequence method was used to detect polymorphisms before genotyping. Five cattle, randomly chosen from eight combinations of sex, season, and line, formed the Angus panel. Three restriction enzymes (*Dra* III, *Bcc* I, and *Hpy*188 I) were used to perform the PCR-RFLP. We observed significant differences among SSTR339 polymorphisms for weight gain from d 84 to 112 (GG 24.1 kg, GC 25.2 kg, CC 28.8 kg) of the 140-d postweaning period in the across selection line analysis ($P<0.05$). The transversion (C339G) results in an amino acid substitution (Ile113Met) in SSTR2. Results also showed significant associations of SSTR393 polymorphisms with weight gain from d 28 to 42 (CC 12.7 kg, CT 14.9 kg, TT 16.2 kg) and weight gain from d 56 to 84 (CC 33.9 kg, CT 34.0 kg, TT 38.1 kg) of the 140-d postweaning period in the across selection line analysis ($P<0.05$). The SSTR393 polymorphism was determined to involve a T to C transition in codon 131, which does not change the amino acid cysteine. The SST111 polymorphism, identified in the promoter region of SST, involves an A to C transversion at nucleotide position 111, but significant differences were not found among the genotypes for any of the traits analyzed. Overall, these data indicate that two SNPs in the bovine somatostatin receptor 2 gene can be applied as markers in beef cattle breeding programs.

Key Words: Somatostatin, Single Nucleotide Polymorphism, Beef Cattle

M30 Test duration for growth, feed intake and feed efficiency in beef cattle using the Growsafe® System. Z. Wang*[1], D. Nkrumah[1], C. Li[1], J. Basarab[2], L. Goonewardene[3], E. Okine[1], D. Crews[4], and S. Moore[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Lacombe Research Center, Alberta Agriculture, Food and Rural Development*, *Lacombe, Alberta, Canada*, [3]*Alberta Agriculture, Food and Rural Development*, *Edmonton, Alberta, Canada*, [4]*Lethbridge Research Centre, Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*.

Shortening the duration of tests to reduce the cost of measurement without compromising the data accuracy and reliability would be highly beneficial to beef cattle production. This study was conducted to determine the optimum test duration for the measurement of average daily gain (ADG), dry matter intake (DMI), feed conversion ratio (FCR) and residual feed intake (RFI) using data on 303 beef steers with 3,318 repeated feed intake and growth measurements. Data was collected using the Growsafe® System at the University of Alberta's Kinsella Research Ranch. Daily feed intake and weekly growth data on individual animals were obtained for a total of 84 days. Residual variances and serial correlations (Pearson and Spearman) between data from shortened tests (7, 14, 21, 28, 35, 42, 49, 56, 63, 70, and 77 days) against an 84-d test were used as criteria to determine the optimum test duration. The four traits were analyzed using the MIXED procedure of SAS®, Version 9.1.3 as a repeated measures analysis. Results showed that tests for ADG, DMI, FCR and RFI could be shortened to 56-63 d without significantly reducing the accuracy of the test under the Growsafe® System when growth is measured weekly. These results have valuable practical implications for performance and feed efficiency testing in beef cattle.

Key Words: Feed Intake and Feed Efficiency, Test Duration, Beef Cattle

M31 Full genome scan of quantitative trait loci (QTL) for net feed efficiency in beef cattle. D. Nkrumah[1], C. Li*[1], Z. Wang[1], R. Bartusiak[1], B. Murdoch[1], J. Basarab[2], D Crews[3], and S. Moore[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Lacombe Research Center, Alberta Agriculture, Food and Rural Development*, *Lacombe, Alberta, Canada*, [3]*Lethbridge Research Centre, Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*.

Profitability of the beef industry relies on minimizing inputs while maintaining high levels of production of quality products. The cost of feeding has been shown to be the single largest variable cost in most beef production systems. Studies on feed efficiency have demonstrated considerable genetic and phenotypic variation among individual animals. Thus, the identification and characterization of genes controlling feed efficiency has tremendous implication potentials to the beef industry. In the current study, we attempted to identify and map quantitative trait loci (QTL) for net feed efficiency through a genome scan using animals of the University of Alberta's experimental beef cattle population. Phenotypic data was collected using the Growsafe® System and animals were typed using genetic markers, SSRs and SNPs, spanning the whole genome. Preliminary QTL interval mapping analysis detected seven chromosomal regions for net feed efficiency above suggested significance ($p<0.05$) in the cattle populations examined. The chromosomal regions identified in the present study provides a valuable reference for further fine mapping of the QTL and identification of positional candidate genes for net feed efficiency in beef cattle.

Key Words: Quantitative Trait Loci (QTL), Net Feed Efficiency, Beef Cattle

M32 Using simulation models to predict feed intake: Phenotypic and genetic relationships between observed and predicted values. C. B. Williams*, G. L. Bennett, T. G. Jenkins, L. V. Cundiff, and C. L. Ferrell, *USDA-ARS; U.S. Meat Animal Research Center*, *Clay Center, NE*.

The objectives of this study were to evaluate the accuracy of the Decision Evaluator for the Cattle Industry (DECI) and the Cornell Value Discovery System (CVDS) in predicting individual feed intake, and the feasibility of using predicted feed intake data in genetic evaluations. Observed individual animal data on the average daily feed DMI (OFI) were obtained from postweaning records of feed consumption of 504 steers from 52 sires. The experimental data also contained individual growth performance and carcass measurements. The experimental data, and daily temperature and wind speed data were used as inputs to predict average daily kg feed DMI required for maintenance, cold stress, and ADG with the CVDS model (CFI_{mcg}) and the DECI model (DFI_{mcg}). Average daily feed DMI required for maintenance and ADG (CFI_{mg}, DFI_{mg}) were also predicted with both models. Genetic parameters were estimated by REML, using an animal model with age on test as a covariate, and genotype, age of dam, and year as fixed effects. Regression equations for observed on predicted DMI were: OFI = 1.27 ± 0.27 + 0.83 ± 0.04 * CFI_{mcg} (R^2 = 0.44) and OFI = 1.32 ± 0.22 + 0.8 ± 0.03 * DFI_{mcg} (R^2 = 0.53). Phenotypic correlations between OFI and CFI_{mcg}, CFI_{mg}, DFI_{mcg}, and DFI_{mg} were 0.67, 0.69, 0.73, and 0.77, respec-

tively. Heritabilities for OFI, CFI_{mcg}, CFI_{mg}, DFI_{mcg}, and DFI_{mg} were 0.27, 0.34, 0.34, 0.34, 0.33, respectively with all SE = 0.012. Genetic correlations between OFI and CFI_{mcg}, CFI_{mg}, DFI_{mcg}, and DFI_{mg} were 0.95 ± 0.07, 0.95 ± 0.07, 0.96 ± 0.07, 0.96 ± 0.06, respectively. Genetic correlations between CFI_{mcg} and DFI_{mcg}, and between CFI_{mg} and DFI_{mg} were both 0.99 ± 0.005. The strong genetic relationships between OFI and the predicted DMI data suggest that predicted DMI may be used in genetic evaluations. Genetically, there appears to be little difference between DECI and CVDS predicted feed intakes.

Key Words: Mathematical Models, Feed Intake, Genetic Correlations

M33 Genetic parameters and environmental factors for growth traits in Bali cattle. L. Praharani*[1], D. G. Riley[2], and T. A. Olson[2], [1]*Research Institute of Animal Production*, *Bogor, Indonesia*, [2]*University of Florida*, *Gainesville*.

A genetic evaluation of Bali cattle (Bos javanicus) using data collected from the Bali Cattle Improvement Project on the island of Bali was conducted to determine the non-genetic and genetic parameters influencing growth traits and to evaluate their phenotypic and genetic trends. There were 7,980 calves born from 1985 through 2000. Traits evaluated were weight at 190 days (W-190d) and 350 days (W-350d). A connectedness program was used to evaluate genetic linkages between contemporary groups defined as a location-year-season combination. Variance components were computed by the AsREML using two-trait animal models that included contemporary group (CG), sex of calf, cow age, and the sex of calf by cow age interaction as fixed effects and calf age as a covariate. Genetic trends were plotted as average of estimated breeding values on year of birth. All non-genetic effects including CG, calf age (in W-190d), calf sex (in W-350d), calf age x calf sex (in W-190d), and cow age x calf sex (in W-350d) were found significant ($P<0.05$). Estimates of direct additive heritability were 0.3 and 0.5 for W-190d and W-350d, respectively. The estimated maternal heritabilities were not different from 0. The estimated correlations between W-190d and W-350d were 0.74 (genetic), 0.19 (environmental) and 0.33 (phenotypic). These findings suggest that the genetic progress for W-350d might be expected to be faster than at for W-190d and increasing W-190d can be achieved by selection for W-350d since their genetic correlation was strong and positive. Failure to detect significant maternal effects may have been due to the unique management system (small shareholders with one or a few cattle) or there may have been inadequate pedigree/data structure for estimation. The decline in W-350d ($P<0.01$) might be caused by factors other than genetic due to the observed genetic trend of W-190d and W-350d.

Key Words: Genetic Pparameters, Growth Traits, Bali Cattle

M34 Sire x maternal grandsire interaction for pre-weaning growth traits in Brazilian Nellore cattle. A. de los Reyes[1], M. Elzo*[1], R. Lobo[2], and L. Bezerra[2], [1]*University of Florida*, *Gainesville*, [2]*University of Sao Paulo*, *Ribeirao Preto, SP, Brazil*.

Non-additive genetic effects are currently ignored in the genetic evaluation of beef cattle in Brazil. However, non-additive genetic effects have been found to be important for beef cattle in several studies. The objective was to assess the importance of the sire x maternal grandsire (SMGS) interaction on standardized weights at 120 d (W120) and at 240 d (W240) in a Brazilian Nellore cattle population. Weight records came from 10,302 calves born and raised on pasture in 60 herds, and collected from 1976 to 1998. The single-trait mixed model included: 1) the fixed effects of contemporary group (CG = herd-year-season-sex-management group) and calving age subclass (2, 3, 4, 5 to 9, 10 yr and older), 2) the random effects of animal additive genetic (direct and maternal), maternal permanent environmental, SMGS subclass and residual. Each CG had a minimum of 10 records, two different sires, and two different SMGS subclasses per sire. The REMLF90 program was used to estimate (co)variance components. Direct and maternal heritabilities were 0.31 and 0.12 for W120, and 0.18 and 0.10 for W240. Direct-maternal genetic correlations were -0.23 for W120 and -0.05 for W240. Maternal permanent environmental variance ratios (relative to phenotypic variances) were 0.21 for W120 and 0.20 for W240. The SMGS variance ratios, as a fraction of the phenotypic variance, were 0.09 for W120 and 0.08 for W240. The SMGS variance ratios were comparable to maternal heritabilities. These results indicate that, in this subpopulation of Nellore cattle, SMGS interaction effects may need to be included in genetic evaluation models for W120 and W240. However, this may not be the case in other Nellore subpopulations in Brazil. Thus, this research needs to be repeated within each subpopulation, and, if the objective were the development of a national genetic evaluation, then data from all Nellore subpopulations would be required.

Key Words: Beef Cattle, Growth, Interaction

M35 Gene expression profiling in bovine adipose tissues by serial analysis of gene expression. J. Bong[1], K. Cho[2], and M. Baik*[1], [1]*Chonnam National University*, *Gwangju, South Korea*, [2]*Jinju National University*, *Jinju, South Korea*.

Serial analysis of gene expression (SAGE) was done in subcutaneous and intramuscular adipose tissues of Korean cattle to identify and quantify expressed genes. Sequencing of clones revealed about 11,000 tags in SAGE libraries from subcutaneous and intramuscular adipose tissues. We report here abundantly expressed genes identified in adipose tissues. Included in 50 most abundant tags in the subcutaneous adipose tissues were osteonectin, cyclin-dependent kinase regulatory subunit 1, annexin A2, tumor protein translationally-controlled, ferritin heavy polypeptide, cofilin, diacylglycerol O-acyltransferase, thymosin beta 4, and inositol 1,4,5-triphosphate receptor type 1 genes. Included in 50 most abundant tags in the intramuscular adipose tissues were cyclin-dependent kinase 5 regulatory subunit 1, tumor protein translationally-controlled gene, myosin light polypeptide 1, a transcribed sequence with strong similarity to human troponin C slow, osteonectin, eukaryotic translation elongation factor 1 alpha, and annexin A2 genes. For about 50 genes, the number of tags was over 2 fold higher in subcutaneous adipose tissue compared to intramuscular adipose tissue. In contrast, about 30 genes showed over 2 fold higher tag number in intramuscular adipose tissue. RT-PCR or northern analyses confirmed that expression of osteonectin, annexin A2, ferritin heavy polypeptide 1, and thymosin beta 4 genes was higher in subcutaneous tissues compared to intramuscular adipose tissues. Expression of heat shock 70 kDa protein 1 and N-myristoyltransferase 2 genes were higher in intramuscular tissues compared to subcutaneous adipose tissues. The current SAGE analysis provides overall differential gene expression profile in subcutaneous and intramuscular adipose tissues of Korean cattle. The deposition of intramuscular adipose tissue (marbling) is an important factor for high quality beef, especially in Korean cattle. Understanding the differential gene expression mechanism that regulates the deposition of fat between intramuscular tissues and subcutaneous adipose tissues will lead to develop methods to produce high-marble beef.

Key Words: Expression Profile, SAGE, Bovine Adipose Tissues

M36 Somatic cell banking-an alternative technology for conservation of endangered livestock breeds. N. Gupta*, S. P. S. Ahlawat, and S. C. Gupta, *National Bureau of Animal Genetic Resources*, *Karnal, Haryana, India*.

Each cell of an animal body contains full genetic code for the whole animal and nuclear transfer provides a way of converting a cell to whole animal. Cells from endangered breeds collected by biopsy or from scrapings of soft skin or ear tissue or from hair follicle can be grown and multiplied in laboratory and this would then be stored frozen indefinitely at -196°C in liquid nitrogen. With this principle in consideration, a somatic cell bank has been created at the Bureau for the cryopreseravtion of skin fibroblast cell lines from different breeds of buffalo, camel, sheep and goat species as competent nuclear donor for the revival of the endangered germplasm through nuclear transfer and animal cloning at later stage. Skin samples of 0.25 cm2 from ear pinna of 10 male and 10 female animals keeping effective population size in mind were collected from the main breeding tract of the breeds. The samples were transferred into complete media (DMEM+ HamsF12 with 10% FBS and antibiotic-antimycotic solutions) within 2 hrs and were transported in thermos flask at 4oC to the labora-

tory within 72 hours of collection. The skin fibroblast cells were purified from epithelial contaminations by repeated multiple passaging. All the quality assays like cell viability, mycoplasma, fungal and bacterial contamination detection, cell counts, cell proliferation rates, growth curve, cell senescence, genetic stability (karyological, DNA finger printing and frame shift mutations), replicative aging (telomeric dynamics) were studied in different passages. The cell freezing rates, thawing and different cryoprotectants were also studied. In this paper, details of the indigenously standardized somatic cell banking technology have been described. The present status of cryofrozen germplasm in somatic cell bank at -150°C is given in the table.

Cryopreserved germplasm of different livestock species in somatic cell bank

Species	Breeds	Male cell line	Female cell lines	No of samples
Buffalo	2	19	10	1200
Sheep	4	43	46	3500
Goats	2	24	28	2200
Camel	1	12	–	650

Each sample had 1 million cells per ml

Acknowledgements: Authors thank the World Bank for funding the project under National Agricultural Technology Project, Indian Council of Agricultural Research

Key Words: Somatic Cell Banking, Skin Fibroblast Cell Line, Nuclear Transfer

Dairy Foods: Cheese

M37 Chemical, textural and sensory properties of fresh Turkish Kashar cheese. N. Koca*[1,2], M. Metin[1], and V. B. Alvarez[2], [1]*Ege University*, *Izmir, Turkey*, [2]*The Ohio State University*, *Columbus*.

Kashar cheese is a semi-hard Turkish cheese made by heating and stretching its curd. Kashar is one of the most consumed cheeses in Turkey and is classified as fresh or mature depending on its ripening level. The aims of this study were to characterize the chemical composition, texture and sensory properties of commercial cheeses and to determine how those properties relate to each other. Sixteen full fat cheese samples produced by different manufacturers were obtained from retail stores in Izmir, Turkey. Cheese samples were analyzed for pH, moisture, protein, fat and salt. Textural properties were measured by using an Instron Universal Testing Machine. Sensory properties (appearance, texture, flavor and overall acceptability) were determined by nine trained panelists using a scale of 1 to 5 (1:the worst, 5:the best). All cheese properties varied widely. The moisture, fat, protein and salt value ranges were 38.7-50.9%, 17.0-35.0%, 24.09-29.35% and 1.40-2.58% respectively. Hardness, springiness, cohesiveness, adhesiveness, gumminess and chewiness values were between 16.79-59.12 kg, 0.130-0.323, 0.107-0.249, 0.000-0.072 kgcm, 2.770-8.395 kg and 0.360-2.338 kg respectively. Mean appearance scores ranged from 1.78 to 4.67, texture from 2.78 to 4.22, flavor from 2.44 to 3.78 and overall acceptability from 2.44 to 4.11. As expected, the hardness values had significant correlation with moisture contents ($P<0.01$), because high moisture content weakens the cheese matrix by dissolution of proteins. The cheeses having moisture contents between 54.00-58.5% and hardness values between 23.00-33.45 kg had higher overall acceptability and texture scores. The same trend was observed for cohesiveness and springiness. Texture, flavour as well as apperance significantly affected overall acceptability ($P<0.01$). Properties characterization of fresh Kashar cheese and good understanding of their relationship are very important for manufacturers to make good quality and wholesome cheese products

Key Words: Fresh Kashar, Composition, Texture

M38 Yield enhancement of cottage cheese curd manufacture through milk protein fortification. Methods for quality evaluation. C. Kohen*[1,2], R. Hallab[1], A. Grandison[1], M. Lewis[1], and D. Marriott[2], [1]*The University or Reading*, *Reading, Berkshire, UK*, [2]*Creative Food Systems Limited*, *Marlow, Buckingamshire, UK*.

Cottage cheese curd was prepared using milk fortified with a milk protein powder preparation (92.6 % protein - produced from skimmed milk by co-precipitation and spray drying), and compared to non-fortified controls. Fortification led to significant increases in yield; for example, yield increased by over 10 % when the addition level was 0.4 %.

Methods were developed to assess the quality of curd, based on analysis of firmness, microstructure, total solids content, curd size distribution, and sensory evaluation.

Firmness was assessed on dressed and undressed curd with a TA-XT2i Texture Analyser (Stable Micro Systems Ltd, Godalming, UK). Curd microstructure was observed using scanning electron microscopy. Size distribution of curd particles was estimated using a sieving technique. Sensory evaluation was used to assess differences between the curd samples (with added dressing), with significant differences evaluated through triangle tests.

The curd obtained with fortified milk (0.4% protein addition) retained more water than the control (Total solids values 20.9 ± 0.25 % for control and 19.2 ± 1.3 % for fortified) and was softer than the control (Firmness as maximum force 20.6 ± 3.5 g for control and 14.2 ± 3.5 g for fortified). In addition, electron micrographs of fortified curd displayed many more pores than control curd.

The difference in firmness was not detectable after the addition of dressing (Firmness: control 10.7 ± 2.8 g, fortified 11.2 ± 2.6 g). Also, there were no significant differences detected by sensory evaluation between the samples with added dressing. The dressing had a masking effect on minor differences in the curd quality. Hence, fortification with protein during curd manufacture produced a product with equivalent quality with reduced manufacturing costs/kg of finished product through the increased yield.

Key Words: Cottage Cheese, Fortification, Texture

M39 A one-dimensional dynamic model of curd syneresis based on viscoelastic properties of curd. M. Castillo*, S. Torrealba, and F. Payne, *University of Kentucky*, *Lexington*.

Syneresis is a major process in cheese making. The extent of syneresis during cheese making controls the moisture, mineral and lactose content of curd which affects cheese ripening and subsequently the final cheese sensory attributes. Better curd moisture control would decrease the production of under-grade cheese. Estimated annual losses to the U.S. cheese industry in 2001 due to downgrades for cheese defects were $29 million for cheddar cheese. Alternatively, the appearance of whey on the surface of a gel, or wheying-off, is a common defect during storage of fresh cheeses and fermented dairy products. Very little is known about syneresis. Limited knowledge is available about the mechanisms by which the microstructure and rheological properties of gels influence gel porosity, permeability, endogenous syneresis pressure and whey drain-

age. Despite the importance of the syneresis process, it constitutes one of the least understood phases of cheese making, which causes a lack of suitable models for predicting syneresis kinetics and extent. Casein gels consist of a three-dimensional, porous and elastic matrix of casein micelles saturated with an interstitial and viscous fluid called whey. Rearrangement of casein micelles during syneresis is responsible for the shrinkage of the casein matrix and subsequent expulsion of whey. A one-dimensional gel syneresis dynamic model was developed to determine the stresses and strains induced during the dynamic process of syneresis by combining the mechanics of porous media with the theory of viscoelasticity. Induced strains in the curd body are estimated based on viscoelastic deformations from the different pressures acting on the curd during syneresis. A preliminary validation of the model was made based on values obtained from literature review. The results obtained strongly encourage validating the model using one-dimensional syneresis experiments conducted under different coagulation and syneresis conditions.

Acknowledgements: This research was supported by the USDA/NRI grant USDA-NRI-2005-35503-15390

Key Words: Syneresis, Dynamic Model, Viscoelastic

M40 Study of the aqueous phase of Prato cheese. V. S. Monteiro and M. L. Gigante*, *State University of Campinas*, *Campinas, SP, Brazil*.

The objective of this study was to evaluate the physical-chemical balance between the protein matrix and the aqueous phase of Prato cheese in the early stages of the ripening process. The cheeses were manufactured by the traditional method and had its centesimal composition analyzed. To evaluate the effect of ripening time on the aqueous phase of the cheese, samples were randomly taken every day up to the fifth day of ageing and evaluated for the amount of aqueous phase separated by centrifugation. The aqueous phase was evaluated for the levels of total solids, total nitrogen, nitrogen fractions and electrophoretic profile. The experiment design was a completely randomized design with one primary factor and one blocking factor. A total of 3 complete experiments were performed and the results analyzed by analysis of variance (ANOVA) and Pearson's correlation test. The cheeses manufactured exhibited 44.5±0.3% moisture, 29.0±0.6% fat, 22.5±0.9% total protein, 3.1±0.8% ash and 1.10±0.02% salt. The amount of aqueous phase decreased significantly with ripening time, varying from approximately 27% to 5% of the moisture of the cheese during the first 5 days of ageing, representing a 81% reduction in the amount of aqueous phase separated from the cheese, thereby evidencing a rapid increase of the water holding capacity of the protein matrix. In addition, a significant negative association was found between the amount of water in the aqueous phase and the content of total solids, total protein and protein soluble at pH 4.6. The electrophoretic profile showed an increase in the casein fractions (α_{s1}-I-casein and γ-casein) and intact proteins (β-casein and α_{s1}-casein) in the aqueous phase of the cheese after 5 days ripening. The results suggest that the changes in the chemical-physical balance between the protein matrix and the aqueous phase that occur during the first days of ripening may contribute to improving the functionality of Prato cheese as a result of the effect of the aqueous phase on the degree of hydration of the protein matrix.

Key Words: Prato Cheese, Aqueous Phase, Proteolysis

M41 Proteolysis of Piacentinu Ennese cheese made with different farm technologies. V. Fallico*, C. Pediliggieri, S. Carpino, and G. Licitra, *CoRFiLaC*, *Ragusa, Sicily, Italy*.

Piacentinu Ennese is a pressed ovine cheese of Sicily. It is traditionally made from raw milk, farmhouse rennet and no starters. Recently some producers are using pasteurized milk with commercial rennet and starters. The aim of this survey was to study the impact of different farm technologies on proteolysis of Piacentinu Ennese cheese. Seven batches of cheeses were collected from different farms and five cheeses were produced from each batch to be aged 2, 4, 6, 8 and 10 mo respectively. Protein and S/M contents, along with levels of N soluble in pH 4.6-acetate buffer (pH4.6SN) and in 12% TCA (TCASN), all significantly ($P<0.05$) increased with cheese age. Farm technology had no significant impact on the overall means of cheese chemical composition, mainly due to large variance within treatment, except for the indices of proteolysis. Levels of pH4.6SN and TCASN, expressed as percentages of TN, were significantly higher in industrial than in traditional cheeses. Urea-PAGE profiles of the cheeses showed that farm technology influenced the activities of proteases on caseins. A greater retention of rennet in industrial cheeses produced higher levels of α_s-CN hydrolysis compared to traditional cheeses, whereas plasmin was unaffected by milk treatment. HPLC peptide profiles showed a largest production of soluble compounds in industrial cheeses but also a large variability within treatment among cheeses. PCA of chemical and HPLC data discriminated cheese samples by age and farm technology due to differences in moisture and proteolysis levels, respectively. Proteolysis in Piacentinu Ennese cheese was largely affected by aging time and farm technology. The large variability in peptide profiles was related to different manufacturing conditions at farm level that need to be better defined in order to uniform Piacentinu Ennese cheese quality.

Key Words: Farm Technology, Cheese Proteolysis

M42 Effect of somatic cell count on milk composition and the yield of Prato cheese. G. Mazal[1], M. V. Santos[2], and M. L. Gigante*[1], [1]*State University of Campinas*, *Campinas, SP, Brazil*, [2]*University of São Paulo*, *Pirassununga, SP, Brasil*.

Brazilian Prato cheese is manufactured through rennet coagulation, cooking done by removing part of the whey, replacing it with warm water. The objective of this work was to evaluate the effect of somatic cell count (SCC) in milk on its composition and on the yield of Prato cheese. Initially, two groups of animals were selected to obtain milk with low (< 200,000 cell/ml) and with high (> 600,000 cell/ml) SCC. The milk was submitted to three treatments to obtain Prato cheese: (1) from milk with low SCC and clotting time of 35 minutes; (2) from milk with high SCC and clotting time of 35 minutes; and (3) from milk with high SCC and adjusted clotting time. The milk and whey were evaluated according to pH and total solids, fat, total nitrogen, soluble nitrogen at pH 4.6 and at 12% TCA, ash, lactose, and calcium. The cheeses were evaluated according to the same factors, (except lactose), and also to salt content. The fat, protein and lactose recovery and cheese yield were calculated. A randomized block design was used, with a single factor: SCC (two levels) in the case of milk composition; and treatment (three levels) in the case of fat, protein and lactose recovery and cheese yield. The milk with high SCC showed a significantly smaller concentration of true protein, and a higher concentration of non-protein nitrogen, indicating higher proteolytic activity. The cheeses obtained from the milk with high SCC showed significantly higher soluble nitrogen contents at pH 4.6 and at 12% TCA than the cheeses obtained from milk with low SCC. The protein recovery was significantly higher for the cheeses with low SCC. A significantly higher lactose recovery was observed for the cheeses with high SCC, as well as a tendency for higher moisture. Although with these levels of somatic cells a significant difference in cheese yield was not observed, the cheeses that were obtained from the milk with high SCC showed higher proteolytic activity, which can compromise the ripening development.

Acknowledgements: Fapesp - Fundação de Amparo à Pesquisa do Estado de São Paulo

Key Words: Somatic Cell, Protein and Fat Recovery, Prato Cheese

M43 Standardization of the time and temperature conditions to evaluate the meltability of Cream cheese. R. R. Monteiro, A. S. Salles, and M. L. Gigante*, *State University of Campinas*, *Campinas, SP, Brazil*.

The meltability properties of cheese are controlled by the chemical composition at the moment of heating. This includes parameters such as protein, fat, moisture, pH, calcium protein hydrolysis and principally the extent of hydration of the casein matrix. Different conditions had been used to evaluated the cheeses meltability, with temperatures varying from 100 to 280°C and exposition time from 4 to 60 minutes. Exploratory experiments carried out to evaluate the melt-

ability of cream cheese indicated the lack of an adequate time/temperature condition to evaluate the meltability of a cheese obtained by acid coagulation. Thus, the objective of this study was to standardize the adequate time/temperature condition to evaluate the meltability of cream cheese. Hot pack cultured cream cheese was manufactured and analyzed for chemical composition. The meltability was evaluated using the method of Schreiber after storage at 4°C for 20 days. The Box-Wilson method was used for a 2^2 experimental design, with three central and four axial points, giving a total number of 11 experiments, varying the temperature (110, 126, 190, 254 and 280°C) and the exposition time (4, 10, 25, 40 and 46 minutes). The testes were carried out in quadruplicate. The meltability was expressed as a percentage of the increase in diameter of the cheese after being submitted to the test. The average composition of the cream cheese was 44.6±0.2% total solids, 6.81± 0.05% proteins, 34.2±0.3% fat, 1.7±0.1% ashes and pH 4.8. The most adequate time/temperature binomial for maximum meltability of cream cheese without burning was established as 170°C/15 minutes. The definition of the best condition to evaluate the meltability makes possible future studies on the influence, for example, of variations in the fat, moisture, and pH, on the melting characteristics of the Cream cheese.

Acknowledgements: FAPESP-SP/Brasil

Key Words: Cream Cheese, Melting

M44 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Cryo-scanning electron microscopy observations. A. Hassan* and S. Awad, *South Dakota State University*, *Brookings*.

The microstructure of reduced and full fat cheeses made with exopolysaccharide (EPS)-producing and nonproducing cultures was observed using cryo- scanning electron microscopy. Fully hydrated cheese samples were rapidly frozen in liquid nitrogen slush (-207 C) and observed in their frozen hydrated state without the need for fat extraction. Different EPS-producing cultures were used in making reduced fat Cheddar cheese. Full fat cheese was made with a commercial EPS-nonproducing starter culture. The cryo-scanning electron microscopy micrographs showed that fat globules in the fully hydrated cheese were surrounded by cavities. Serum channels and pores in the protein network were clearly observed. Fresh full fat cheese contained wide and long fat-serum channels which were formed as a result of fat coalescence. Such channels were not observed in the reduced fat types. Fresh reduced fat cheese made with EPS-nonproducing cultures contained fewer and larger pores than did reduced fat cheese made with a ropy strain of *Lactococcus lactis* ssp. *cremoris* (JFR1) which had higher moisture levels. A three dimensional network of EPS was observed in large pores in cheese made with the ropy strain JFR1. Big changes in the size and distribution of pores within the structure of the protein network were observed in reduced fat cheese, except that made with JFR1, as it aged. This indicated that redistribution of the moisture was occurring during ripening. Changes in porosity were less pronounced in both the full fat cheese and the reduced fat type made with the ropy culture JFR1. The changes in moisture distribution seemed to play a major role in the development of the textural and functional properties of cheese during ripening.

Acknowledgements: Authors would like to thank Dr. John Shields, The University of Georgia, for carrying out the microscopy analysis

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Cryo-Scanning Electron Microscopy

M45 Sensory description of fresh Mozzarella cheese. M. Almena*, E. Valentine, P. Kindstedt, and A. Howard, *University of Vermont*, *Burlington*.

Fresh Mozzarella cheese is characterized by a soft and elastic body, pleasant lactic flavor and smooth and juicy appearance. However, specific sensory characteristics may vary depending on initial milk properties, manufacturing and distribution conditions and the *terroir* effect. This study evaluated sensory characteristics of 3 different types of fresh Mozzarella cheese: water buffalo (WB) milk Mozzarella produced in Italy, and 2 cheeses made in the US from cow and WB milk, respectively. The goal was to identify key sensory characteristics that influence acceptability of fresh Mozzarella to American consumers. Commercial samples of each of the 3 Mozzarella types were evaluated by two different groups of subjects: 1) consumers enlisted at a supermarket that specializes in natural and gourmet foods (98 consumer subjects); 2) chefs and specialty cheese retailers (27 professional subjects). Consumers were asked to rate the acceptability of the product using an increasing intensity 9-pt scale. In addition to rating acceptability, the professionals also rated texture and flavor. Both questionnaires included an open section in which subjects were asked to describe the product in terms of sensory characteristics, as well as to provide demographic information. Data were statistically analyzed by paired t-tests, ANOVA and Chi-square tests using SPSS. No significant differences were found in the acceptability ratings of the 3 Mozzarella types. However, preferences within consumer subjects were significantly affected by gender ($P \leq .05$) and professionals preference by age (<40 or ≥ 40). Consumers and professionals identified several sensory attributes that impacted acceptability, including: saltiness (either too salty or too bland), flavor (either too strong or lacking), and texture (either too stringy and dry, too coarse and grainy, or too soft and watery). However, high variability in the acceptability and description of pleasant characteristics of the final product was identified among both consumers and professionals.

Key Words: Mozzarella Cheese, Water Buffalo Milk, Sensory Description

M46 Influence of calcium, phosphorus, residual lactose, and salt-to-moisture ratio (S/M) of Cheddar cheese on glycolysis during ripening. P. Upreti*, L. L. McKay, and L. E. Metzger, *MN-SD Dairy Food Research Center, University of Minnesota*, *St. Paul, MN*.

Glycolysis in Cheddar cheese involves conversion of lactose to glucose and galactose or galactose-6-phosphate by starter and non-starter lactic acid bacteria. Under ideal conditions (i.e., where bacteria grow under no stress of pH, a_w, and salt), these sugars are mainly converted to lactic acid. However, during ripening of cheese, survival and growth of bacteria occurs under the stressed condition of low pH, low aw, and high salt content. This forces bacteria to use alternate biochemical pathways resulting in other different organic acids (viz. citric, orotic, acetic, pyruvic, propanoic, butyric). The objective of this study was to determine if the level and type of organic acids produced during ripening was influenced by the buffering properties (due to Ca and P), amount of substrate (lactose) and bacterial activity (due to S/M) in cheese. Eight cheeses with two levels of Ca and P (0.67 and 0.47% vs 0.53 and 0.39%), lactose at pressing (2.4 vs 0.78%) and S/M (6.4 vs 4.8%) were manufactured. The cheeses were analyzed for organic acids (citric, orotic, pyruvic, lactic, acetic, propanoic, butyric) and residual sugars (lactose, galactose) during 48-wk of ripening by using an ion-exchange HPLC method. Results indicate that there was a significant ($p<0.05$) decrease in lactose and increase in lactic acid between salting and day 1 of ripening, however there was no substantial change subsequently. More lactic acid was produced in low S/M treatments as compared to high S/M treatments ($p<0.05$). Minor changes in the levels of butyric and propanoic acids were observed until 4-mo of ripening. However, by 12-mo of ripening, there was a 7-fold increase in the level of these acids; with low S/M cheeses having higher levels of these acids as compared to high S/M cheeses ($p<0.05$). A gradual decrease ($p<0.05$) in orotic acid and a gradual increase ($p<0.05$) in pyruvic acid content of cheeses were observed during 12-mo of ripening. In contrast, acetic acid did not show a particular trend, indicating its role as an intermediate in a biochemical pathway, as opposed to a final product.

Key Words: Organic Acids, Cheese Ripening

M47 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Textural and melting properties. S. Awad*, A. Hassan, and K. Muthukumarappan, *South Dakota State University*, *Brookings*.

Texture development and meltability of reduced fat cheeses made with exopolysaccharide (EPS)-producing cultures was monitored during ripening. Results showed that texture profile analysis (TPA) parameters such as hardness, gumminess, springiness, and chewiness increased as the fat content decreased.

Cheeses made with EPS-producing cultures were the least affected by fat reduction. No significant differences in hardness, springiness and chewiness were found between young reduced fat cheese made with a ropy strain of *Lactococcus lactis* ssp. *cremoris* (JFR1; the culture that produced cheese with the highest moisture level) and its full fat counterpart. During ripening, whereas hardness of full fat cheese and reduced fat cheese made with JFR1 increased, a significant decrease in its value was observed in all other cheeses. After 6 months of ripening, reduced fat cheeses made with EPS-producing cultures maintained lower values of all TPA parameters than did those made with no EPS. Fat reduction decreased cheese meltability. However, no significant differences in meltability were found between the young full fat cheese and the reduced fat cheese made with the ropy culture JFR1. Both aged full fat cheese and that made with JFR1 had similar melting patterns. They both became soft and creamy without losing shape when heated while reduced fat cheese made with no EPS ran and separated into greasy solids and liquid. Panelists did not detect significant differences between the full fat cheese and reduced fat cheese made with JFR1 which were less rubbery/firm, curdy and crumbly than all other reduced fat cheeses.

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Texture Profile Analysis

M48 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Viscoelastic properties. S. Awad*, A. Hassan, and K. Muthukumarappan, *South Dakota State University*, *Brookings*.

Reduced fat Cheddar cheese is always more firm, rubbery and elastic than the full fat counterpart. The objective of this work was to study the influence of different exopolysaccharide (EPS)-producing lactic cultures on the viscoelastic properties of reduced fat Cheddar cheese. Results showed that the elastic, viscous and complex moduli were higher in reduced fat cheeses made with EPS-nonproducing cultures than those in the full fat cheese. No significant differences in the viscoelastic properties were found between young reduced fat cheese made with a ropy strain of *Lactococcus lactis* ssp *cremoris* (JFR1) and its full fat counterpart. The slopes of the viscoelastic moduli as a function of frequency were significantly lower in the full fat than in reduced fat cheeses. Creep test showed that fresh reduced fat cheese made with JFR1 was less rigid and more deformable than those made with EPS-nonproducing cultures. The creep/recovery properties of young reduced fat cheese made with JFR1 and the full fat type were similar. No significant differences were found in the viscoelastic properties between reduced fat cheese made with no EPS and those made with EPS-producing adjunct cultures of *Streptococcus thermophilus*. After 6 months of ripening, cheeses made with EPS-producing cultures maintained lower elastic and viscous moduli than did those made with no EPS.

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Viscoelastic Properties

M49 Mexican Mennonite-style cheese: Sensory profile of young cheeses from Chihuahua, Mexico. D. L. Van Hekken*[1], M. A. Drake[2], F. J. Molina Corral[3], V. M. Guerrero Prieto[3], and A. A. Gardea[3], [1]*USDA, ARS, Eastern Regional Research Center*, *Wyndmoor, PA*, [2]*North Carolina State University*, *Raleigh*, [3]*Centro de Investigacion en Alimentacion y Desarrollo*, *Cuauhtemoc, Chih, MX*.

Sensory profiles of fresh semi-hard Mennonite-style cheese produced in the northern Mexican state of Chihuahua were developed to characterize the complex flavor and texture of the traditionally-made Hispanic-style cheese.

Multiple allotments of Mennonite-style cheese (9 raw milk and 6 pasteurized milk cheeses), obtained within 3 days of manufacture from 15 different cheese plants throughout Chihuahua, Mexico, were shipped overnight to ERRC and evaluated between 14 and 18 d after manufacture. Microbial analysis was conducted prior to testing to ensure product safety. Descriptive analyses of cheese flavor and texture were conducted with panelists trained to use a universal or product specific SpectrumTM intensity scale, respectively.

As expected, sensory profiles of cheeses varied among the different manufacturers. Overall, salty and sour tastes and diacetyl flavor were the most prominent attributes. The raw milk cheeses had more intense sour and bitter notes compared to cheeses manufactured from pasteurized milks. Many cheese texture attributes were similar, but raw milk cheeses were perceived as firmer than pasteurized milk cheeses.

As the demand for Hispanic-style cheeses increases, defining and understanding the sensory attributes of traditionally-made Mexican cheeses provides guidance as new ways are explored to improve the production and shelf life of the cheese.

Key Words: Cheese, Hispanic-Style, Sensory

M50 Organic acid profiling of commercially available Hispanic cheeses. N. Gonzalez*[1], K. Hein[2], M. Sancho-Madriz[1], H. Heymann[2], and K. Adhikari[1,3], [1]*California State Polytechnic University*, *Pomona*, [2]*University of California*, *Davis*, [3]*Kansas State University*, *Manhattan*.

Hispanic cheeses are an important part the Hispanic diet. Not much effort has been made to standardize the processes for manufacturing Hispanic cheeses.

The objective of the study was to determine the organic acid profiles of Hispanic cheeses from two manufacturers for comparison purposes. Organic acids affect the sensory properties and shelf-life of fermented dairy products such as cheese. The content of various organic acids in Hispanic cheeses might be an indicator of consistent manufacturing processes among manufacturers.

Organic acid profiling of three varieties of Hispanic cheeses (Asadero, Panela, and Queso Fresco) of two brands (Brand A and Brand B) was performed by using ion-exchange high performance liquid chromatography (HPLC). The organic acids separated and quantified included citric, lactic, and acetic acids. Univariate and multivariate statistics was done using SAS® and Unscrambler® to find differences in the cheese varieties.

The analysis of variance (ANOVA) results indicated that all the cheeses from both producers differed significantly ($P < 0.05$) for all three organic acids. Mean separation by Fisher's least square differences indicated that the citric acid content was similar for the cheeses from both producers except for Asadero from Brand B cheese company. Lactic acid content differed significantly ($P < 0.05$) in all varieties of both brands. No clear trends were detected for acetic acid. Principal Component Analysis (PCA) of the data showed that the Brand B Asadero was an outlier due to low levels of citric and acetic acid as compared to the rest of the cheeses. The PCA map also showed that organic acid contents were not consistent between the same varieties of the two brands tested. When the brands were compared by partial least square regression, citric and acetic acids were negatively correlated, while lactic acid was positively correlated.

Our study indicated major dissimilarities between the same cheese varieties of the two brands. This indicates that manufacturing standards should be more uniform among different producers of Hispanic Cheeses.

Acknowledgements: Agriculture Research Initiative for funding the project.

Key Words: Hispanic Cheeses, Organic Acids, HPLC

M51 Effect of processing parameters on the rheological properties of cheese milk at cutting and its impact on cheese yield. R. Mishra*, S. Govindasamy-Lucey, M. Johnson, and J. Lucey, *University of Wisconsin*, *Madison*.

Objective of this study was to understand the effects of altering rennet gelation conditions on fat and nitrogen recoveries in cheese. Effects of varying gelation temperature (GT) (28.8-35.6°C), gelation pH (6.39-6.73) and milk solids nonfat (MSNF) (8.3-11.7%, casein: 2.8-4.0%) on rheological properties of milk and resulting Cheddar cheese yield were studied using a two-level factorial, central composite rotatable design. Cheese was made in 20 L vats where gels could be cut in < 1 min, in contrast to commercial cheese vats where the cutting

cycle can be quite long. Gel cutting point for different cheesemaking conditions was subjectively assessed. In separate experiments, dynamic small amplitude oscillatory rheology was used to study gelation properties, at the previously subjectively selected cutting times. Large deformation properties of milk gels at these cutting times were studied using a single low shear rate. Second order polynomial models successfully predicted the relationship between processing parameters and moisture-adjusted cheese yield (MACY). MACY was strongly ($P < 0.05$, $R^2 = 0.83$) negatively affected by gelation pH and positively by MSNF levels and its quadratic term. In gels with similar gelation pH and GT, an increase in MSNF resulted in an increase in fat and, nitrogen recoveries in cheese. Storage modulus (G'_{cut}) values and yield stress at cutting (s_{ycut}) increased with increasing MSNF. In gels with similar MSNF and GT, a decrease in gelation pH resulted in an increase in fat and nitrogen recoveries and MACY. G'_{cut} tended to decrease and s_{ycut} increased. In gels with similar gelation pH and MSNF, a decrease in GT resulted in an increase in fat and nitrogen recoveries and MACY except at very low (28.8°C) temperatures where very low fat recoveries were observed. G'_{cut} tended to decrease and s_{ycut} tended to increase with decrease in GT. Gel characteristics at cutting and the time required for cutting are important considerations in optimizing fat and nitrogen recoveries.

Key Words: Rheology, Gelation, Yield

M52 Effects of various emulsifying salts on the rheological and texture properties of pasteurized process Cheddar cheese. N. Shirashoji*[1,2], J. J. Jaeggi[2], and J. A. Lucey[2], [1]*Food Research & Development Laboratory, Morinaga Milk Industry Co.*, *Kanagawa, Japan*, [2]*University of Wisconsin*, *Madison*.

The objectives of this study were to understand how various types of emulsifying salts (ES) alter the functionality of pasteurized process Cheddar cheese. Process cheeses were made from 4 mo old Cheddar cheese and the types of ES investigated were: trisodium citrate (TSC), disodium orthophosphate (DSP), tetrasodium pyrophosphate (TSPP) and sodium hexametaphosphate (SHMP) (concentrations of ES ranged from 0.25-2.75%). Cheese mixtures were heated at 80°C for various holding times (0-20 min) using a Blentech twin-screw cooker. A central composite experimental design and response surface methodology were used for data analysis. Hot melted cheese was poured into pouches and stored at 5°C for 7 d. The pH value of all cheeses was maintained at pH ~5.6. The functional properties were assessed using small amplitude oscillatory shear (SAOS), texture profile analysis, degree of flow (DOF) value at 60°C using UW Melt profiler. Several significant prediction models were demonstrated for the key responses (e.g. DOF; R^2>0.68, adhesiveness, R^2>0.70). DOF and hardness increased and loss tangent (meltability index) at 40°C decreased as the concentration of ES increased except for TSPP. For TSPP minimum meltability occurred at ~1.1% ES addition. For SHMP, with increasing holding time and high ES concentration there was an increase in the hardness and the storage modulus value at 70°C (from SAOS). The cheese made with TSPP showed no significant trends in hardness. Negative correlations were observed between hardness and meltability in cheeses made with TSC, DSP, SHMP ($r > -0.92$), but there was no significant correlation in cheese made with TSPP ($p > 0.1$). The maximum value of loss tangent was positively correlated with DOF in cheeses made with DSP, TSPP and SHMP ($r > 0.68$) but not for cheese made with TSC. This study revealed that each type of ES may have different affects on process cheese functionality.

Acknowledgements: Morinaga Milk Industry Co.

M53 The dynamics of sequential casein hydrolysis: An analytical approach. P. Joseph*[1], D. McMahon[1], J. Broadbent[1], and C. Oberg[2], [1]*Utah State University*, *Logan*, [2]*Weber State University*, *Ogden, UT*.

Proteolysis is a vital event that occurs during cheesemaking and maturation of a variety of ripened cheese. The hydrolyzed products vary from large peptides, comparable in size with intact caseins, intermediate-sized and small peptides, and free amino acids and their degradation products. Many methods used for assessing proteolysis in cheese during ripening have followed the fate of small peptides arising from α_{s1}-casein (f 1-23) and β-casein (f 193-209) due to their role in flavor attributes. From a functional point of view, however, the hydrolysis of α_{s1}-casein (f 24-199) and β-casein (f 1-192) and their products would be important as they could impact the association and linkage of peptides due to their hydrophobic regions, size, and associated phosphoserines. The aim of this study was to develop a method to follow the sequential hydrolysis of intact caseins and α_{s1}-(f 24-199) and β-(f 1-192) caseins using reverse phase-high performance liquid chromatography (RP-HPLC) and capillary electrophoresis (CE). Sampling was done at different time points in the cheesemaking process and during aging until 6 months and extracted with a 150 mM trisodium citrate/0.2% sodium chloride buffer. The large peptides were concentrated using a 3K Dalton membrane and analyzed by RP-HPLC. RP-HPLC was performed with a 0.1% trifluoroacetic acid (solvent A)/0.085% TFA in 80% acetonitrile (solvent B) linear gradient elution on a Beckman System Gold and monitored at 214 and 280 nm. The amount of solvent B was raised from 40 to 60% in 30 min. Intact and α_{s1}-(f 24-199) and β-(f 1-192) caseins observed at draining (cheesemaking) and 1 week (ripening) were found to be reduced at 6 months. Further, 3-4 (medium to large) peptides were observed that significantly changed in peak areas and size over time. These peptides can be used to track molecular changes occuring in the cheese matrix during ripening and could serve as indicators of functional properties.

Acknowledgements: Dairy Management Inc. for funding, Mr. Steven Larsen for cheesemaking.

Key Words: Caseins, Reverse Phase-High Performance Liquid Chromatography, Capillary Electrophoresis

M54 Effects of insoluble calcium phosphate content on rennet coagulating properties of milk. J. Choi*[1], D. S. Horne[2], and J. A. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Charis Food Research, Hannah Research Institute*, *Ayr KA6 5HL, Scotland*.

In considering rennet curds as hard sphere particle gels, internal micelle structure is considered irrelevant. Attractive hydrophobic interactions, calcium phosphate crosslinks and electrostatic repulsion are the main forces that maintain internal stability of casein micelles. Loss of colloidal calcium phosphate (CCP) from within casein micelles modifies these interactions, which should impact the properties of rennet-induced gels. To examine the impact of removing CCP from micelles on gelation properties, two approaches were used. Diluted lactic acid was added to skim milk to decrease pH to 6.0, 5.8, 5.6, and 5.4. EDTA was slowly added (0, 2, 4, and 6 mM) to skim milk whose final pH values were adjusted to pH 6.0. Dynamic low amplitude oscillatory rheology was used to monitor gel development. In low pH samples storage modulus (G′) exhibited a maximum (GM); with a decrease in G′ during longer aging times. Microstructure of rennet-induced gels near GM and three h after this GM was studied using confocal scanning laser microscopy. Gels at GM were subjected to a constant low shearing to fracture of the gel. With a reduction in pH, and consequent decrease in CCP content, GM value and yield stress decreased while the loss tangent value increased (indicating a weaker, more flexible casein network). A similar trend was observed for addition of EDTA. There was a significant positive correlation between CCP and GM ($r > 0.94$) and a negative correlation between CCP and maximum loss tangent ($r > -0.79$). There was a decrease in apparent interconnectivity between strands in gel microstructure during aging, which agreed with the decrease in G after GM. Loss of CCP reduced casein cross-linking and probably increased repulsion between exposed phosphoserine residues, resulting in weaker more flexible gels. There was a highly significant positive correlation ($r > 0.84$) between loss tangent value of these rennet-induced gels and the maximum loss tangent values (i.e. an index of meltability) of direct acid cheeses made from these gels.

Key Words: Colloidal Calcium Phosphate, Rennet Coagulation

Extension Education

M55 WWW.Foragebeef.ca A new way to promote research. D. McCartney*, *Agriculture and Agri Food Canada*, *Alberta, Canada*.

Forage and cow calf producers in Canada and the Northern United States have a new source for the latest research information covering a wide variety of topics. The web site provides three levels of information. The top level is the most important points or "Knowledge Nuggets" for the respective topic. The next level is for the reader who wants more information about the topic. These are the "Fact sheets" and direct links are provided to the best information available in North America. The objective is to select the most comprehensive and applicable fact sheets in North America. From thousands of fact sheets the best 5 to 10 have been selected by extension agrologists for each specific topic. The third level focuses on relevant scientific review papers that summarize the science behind the fact sheets for the various topics. These review papers originated via the scientific journals. The site features in depth information on forage production, silage management, forage and seed production, beef cow calf management, nutrition, animal health issues, grazing management and range management topics. This is a living web site. Current agricultural news stories from various provincial Departments of Agriculture in Canada are presented along with weather and market reports. In the future, research results and summaries will continually be added to the site. WWW.Foragebeef.ca has attracted over 3000 visitors per month during the first year in operation.

Key Words: Information, Transfer, Web sites

M56 Factors influencing beef producers participation in preconditioned certified calf sales. M. D. Corro*, D. Lalman, R. P. Wettemann, and J. Evans, *Oklahoma State University*, *Stillwater*.

The Oklahoma Quality Beef Network (OQBN) was organized in 2001 with the primary objective of adding value to weaned calves and capturing a portion of this value for both the cattle producer and the cattle buyer. The OQBN provides a process verification system relative to management practices applied to beef calves around the time of weaning. Furthermore, livestock market owners cooperate with producers by assembling OQBN process verified calves and marketing them in certified calf sales. Survey data were collected from OQBN participants on three consecutive years (2001, 2002 and 2003) to determine factors which influencing beef industry stakeholders to participate in certified preconditioned calf sales. The chi-square test was used to evaluate differences between groups of stakeholders and sales. A majority, 66.4% of the Beef industry Stakeholders became aware about preconditioned certified sales through Extension offices, Auction Barn Operators and Cattlemen's Association meetings. Eighty six percent of the producers participating in the program operated a commercial cow/calf enterprise with several producers involved in a combination of commercial cow/calf and purebred cattle or stocker enterprises. A total of 71% of the producers sold less than 50 head of cattle in anyone OQBN auctions. Since 75% of respondents indicated they normally marketed more than 50 calves, this suggests that many participants marketed only a portion of their calf crop through this system. The percentage of producers receiving a premium price of $4 cwt. or more above the regular market, was greater ($p<0.05$) in 2002 than in 2001 and 2003. OQBN Buyers perceived they paid a premium price above the regular market price for preconditioned cattle. No statistical difference ($P>0.05$) was found among the perceived premium price received by producers and the perceived premium price paid by buyers. The premium price, convenience, and other benefits were the main reasons for beef industry stakeholders for participating in certified calf sales.

Key Words: Preconditioning, Calves, Certified sales

M57 Producer experiences in whole farm planning for the production of grass-finished beef. T. M. Johnson*[1], R. E. Morrow[2], C. A. Wells[3], and J. K. Apple[4], [1]*National Center for Appropriate Technology*, *Fayetteville, AR*, [2]*USDA-NRCS*, *Little Rock, AR*, [3]*Springpond Holistic Animal Health*, *Prairie Grove, AR*, [4]*University of Arkansas*, *Fayetteville*.

In Northwest Arkansas, 11 farms participated in a SARE project to evaluate the potential of producing and direct marketing, grass-finished beef. Several key components to success were identified through producer discussion. Producers must strive to put together a program that contains the proper genetics, produces excellent forage availability and quality, and improves soil characteristics. Producers reported the program required more management, time, and attention to detail than their previous program. Some producers were more successful than others at making strides toward this goal depending on individual priorities. The majority found that involvement in the project resulted in improved pasture and forage management, and animal performance. Producers also found that calves with intermediate frame and intermediate maturity were important to produce beef at acceptable rates of economic return on grass. Both forage quantity and quality were important to achieve gains of greater than 0.9kg/d, and daily paddock rotations may be required as animals approach harvest weights. Live weight gains between 453 and 544 kg live weight were worth $1.35/0.45 kg. Total value also increased $1.19 for each day of age. Shear force values declined as ADG increased. The project also developed an economic model to assist producers in making financial decisions for cattle on grass. Other findings included color scores for both lean and fat. Lean L*, a*, and b* were 34.01 ± 0.47, 25.15 ± 0.39, 21.81 ± 0.23 respectively. Fat L*, a*, and b* were 76.35 ± 0.61, 6.00 ± 0.43, 23.71 ± 0.41 respectively. Average Warner Bratzler shear force values were 3.47 ± 0.19 kg. Knowledge of the relationship of primal values to overall values can provide insight into enhancing profitability.

Key Words: Grass-finished Beef, Marketing, Sustainability

M58 Demonstration of organic burial composting of dead cattle. K. W. VanDevender[1], J. A. Pennington*[1], J. L. Gunsaulis[2], and M. R. Gross[2], [1]*University of Arkansas Cooperative Extension Service*, *Little Rock*, [2]*University of Arkansas Cooperative Extension Service*, *Fayetteville*.

A demonstration of organic burial composting (OBC) was conducted to illustrate that OBC could become a legal and effective option for disposal of dead cattle. On 9/23/2002, the carcass of a mature dairy cow was placed on an 45-cm pad of green sawdust and covered with 45 cm of sawdust, exceeding the requirements suggested by the On-Farm Composting Handbook NRAES-54. Then, an existing fence and cattle panels were used to build a fence around the pile. This pile was located outside and exposed to the weather. From 10/24/02 to 12/03, an additional 14 animals were added to the pile as it increased in size from 5 m x 5 m to 5 m x 15 m. Initially, more sawdust was added with each additional mortality. After all available sawdust was used, other on-farm carbon sources such as waste silage and waste hay were used. On 10/02/02, nine days after the first carcass was placed, the pile temperature was 38°C. The temperature climbed to a recorded peak of 40°C on 10/7/02. By 10/24/02, the temperature had dropped to 34°C. On this date the pile was excavated in four separate locations that included the front leg area, the body cavity area, the tail/hip area, and the head area. In the front leg area, only one large leg and hoof bone with some connective tissue was found. In the body cavity area, the only identifiable pieces were a few hairs. In the tail/hip area, only a few large bones were located. In the head area, the skull and some soft tissue were found. While excavating the pile, no excessive odors or flies were observed. In the 31 days since placement of the carcass, the decomposition process had almost completely processed the mortality. Generally, the compost pile temperature increased to about 40 to 47°C after burial. Once this peak temperature was reached, the temperature decreased over a period of several weeks to about 29°C. The most rapid decomposition took place with the first animal being placed in green sawdust. As more mortality was added to the pile and other carbon sources were used, the rate of decomposition decreased. Effective 5/01/04, composting was approved as an option for disposal of dead cattle in Arkansas.

Key Words: Composting, Dairy cattle, Organic burial

M59 Use of coal combustion products (fly ash) for reducing mud problems in heavy use areas for dairy cattle. J. A. Pennington*[1], K. W. VanDevender[1], M. C. Andrews[2], and D. J. Griffin[3], [1]*University of Arkansas Cooperative Extension Service*, *Little Rock*, [2]*University of Arkansas Cooperative Extension Service*, *Clinton*, [3]*University of Arkansas Cooperative Extension Service*, *Marshall*.

Coal ash was applied to heavy use areas of four dairy farms to reduce problems associated with mud. On sites 1 and 2, fly ash was mixed into an equal volume of soil. At site 1, the soil ash mixture was 45 cm deep on an equipment road and was 10 to 15 cm deep on a travel lane and an area in front of a commodity barn. At site 1, fly ash also was pneumatically applied to the muddy area around a waterer to a depth of 45 cm. At site 2, a cattle travel lane was mixed with fly ash to a depth of about 20 cm. At both sites, soil was mixed with a bulldozer, watered, and compacted. On site 3, a lane to the milking parlor was refurbished with 30 cm of a 70:30 volumetric blend of bottom ash and fly ash (BAB). Also at site 3, pads were built with extra BAB at a feeding area for hay and a storage site for hay, but were 15 cm thick. At site 4, BAB was used to build a 25 cm pad for a feeding area and an existing travel lane. Dump trucks and a bulldozer were used to deliver, spread, and partially pack the BAB. Cattle were able to walk on the packed BAB surfaces immediately. After the pads absorbed water from the soil and rainfall, they reacted chemically and became a hard surface. It was best to add moisture and compaction as the pad was built. The soil ash mixtures with at least 20 cm of pad at sites 1 and 2 have supported vehicle and cattle traffic, even under moist conditions. At site 1, the 10 cm pad placed at the entrance to a commodity barn failed when a tractor broke through. This failure occurred when the soil under the 10 cm pad became saturated after heavy rain. Pure fly ash had the consistency of talcum powder, required special pneumatic trailers to haul, and was extremely dusty to handle. In these demonstrations, BAB was preferred to soil mixing with fly ash because it had a soil-like consistency and was easy to transport and handle at the application site. If a premixed material is not available, fly ash and soil can be mixed 50:50 (volumetric basis) to form a supporting pad to reduce mud problems of heavy use areas.

Key Words: Fly ash, Coal combustion products, Heavy use area

M60 HOTCOW - An internet website for heat stress information from the International Dairy Heat Stress Consortium. W. Graves*[1], N. Graves[1], P. Hansen[2], J. Fain[1], and A. DeVries[2], [1]*University of Georgia*, *Athens*, [2]*Univerisity of Florida*, *Gainesville*.

Heat stress is responsible for large declines in pregnancy rates of dairy cattle during hot months throughout much of the United States. Since the summer depression in fertility is greater for high-producing cows than for low-producing cows, the continual improvement in milk yield per cow means that problems of heat stress will be exacerbated in the future. Despite its importance, there are few effective strategies for reducing the effects of heat stress on reproduction. The International Dairy Heat Stress Consortium was formed to bring together the resources of multiple institutions and scientists to address these challenges. One of the objectives of the Consortium is to develop industry-wide and farm-specific recommendations for implementation of strategies for improving fertility on commercial dairies and provide this information to dairy producers through web-based technologies. A website was developed at the link http://hotcow.ads.uga.edu using Microsoft FrontPage software. A Flash introduction was also developed using CoffeeCup Firestarter Shareware. Information on the IFAS grant objectives, consortium directory, publications and resources, meetings and conferences, heat stress links and contact information are provided. Also, easy access to the DairyMAP herd analysis program is available. Hundreds of pages of reference materials and other links dealing with dairy heat stress information are readily accessible. Members of the Consortium can easily be contacted through Microsoft Outlook. Information on various educational opportunities is also included. Over 800 people have visited the web site thus far.

Acknowledgements: This program was supported by USDA CSREES Grant No. 2001-52101-11318 through the Initiative for Future Agricultural and Food Sciences Program.

Key Words: Heat stress, Dairy cattle, Internet

M61 Financial performance of dairies in Florida and Georgia in 2003. A. de Vries[1], R. Giesy[1], L. Ely*[2], B. Broaddus[1], C. Vann[1], and B. Butler[1], [1]*University of Florida*, *Gainesville*, [2]*University of Georgia*, *Athens*.

The Dairy Business Analysis Project (DBAP) includes an annual survey of the financial performance of dairies primarily located in Florida and Georgia. Its objective is to document the dairies' financial success using standardized, accrual accounting methods in order to calculate benchmarks and provide feedback on the dairies financial strengths and weaknesses.

Twenty-seven dairies submitted financial data in 2003. Twenty-six dairies were included in the summary results. Of these, 17 were located in Florida, and 9 in Georgia. The average herd size was 1,316 cows and 619 heifers with 17971 lbs. milk sold per cow. The average culling rate was 40%. There was an average of 24 FTE workers per farm and 0.96 million lbs milk sold per FTE worker. Total revenue per cwt. was $17.66 / cwt with $15.89 / cwt milk income. The average total expense was $18.27 / cwt. The largest expense items were purchased feed ($7.16 / cwt), labor ($3.22 / cwt), and livestock ($1.95 / cwt). Net farm income from operations was on average $-.61 / cwt and net farm income was $-.51 / cwt. The debt to equity ratio was .62, the rate of return on assets was -0.01, the rate of return on equity was -0.18, the operating profit margin ratio was -0.06. There is no clear association between income, expenses or returns with herd size in 2003. Milk price / cwt was lowest for <500 cows ($15.45) but other income was highest ($1.94 / cwt). Total expenses were highest for the smallest herds ($19.26 / cwt) resulting in the lowest net farm income from operations ($-1.66 / cwt). Milk price and total income decreased with production level. Net farm income was highest for lowest production level.

Key Words: Dairy, Financial, Management

M62 Association between bulk tank milk urea nitrogen and DHI production variables in southern California dairy herds. G. Higginbotham[1], W. VerBoort[2], N. Peterson*[3], and J. Santos[4], [1]*University of California Cooperative Extension*, *Fresno*, [2]*California DHIA*, *Fresno*, [3]*University of California Cooperative Extension*, *San Bernardino*, [4]*University of California, Davis*, *Tulare*.

A retrospective study from January, 2001 to December, 2003 was conducted using data from DHI monthly tests to investigate the relationship between daily bulk tank milk urea nitrogen (MUN) concentration and selected DHI production and reproduction variables. DHI records from selected Holstein herds (N=16) located in San Bernardino and Riverside counties of southern California were analyzed along with their daily bulk tank component information which included MUN. Average herd size and rolling herd average for milk was 1,061 cows with a range of 231 to 1720 cows/herd and 9,771 kg, respectively. Monthly mean MUN was 11.3 mg/dl ranging from 5.5 to 16.8. Season affected concentrations of MUN being significantly ($P < 0.001$) lower (10.3 mg/dl) during the winter and significantly ($P<0.001$) higher (12.1 mg/dl) during months of heat stress. MUN was negatively correlated with true protein ($r^2=0.0182$; $P < 0.002$) and casein ($r^2=0.0249$; $P<0.002$). Test day somatic cell count (TDSCC) as mean SCC and as linear score (L2) showed a negative linear relationship (TDSCC, $P<0.001$; L2, $P<0.001$ with MUN but relationships were weak (TDSCC, $r^2=0.14$; L2, $r^2=0.07$). Services per conception showed a negative linear relationship with MUN ($P<0.001$) but the relationship was not strong ($r^2=0.10$). Test day milk was significantly lower during the fall ($P<0.001$), with test day milk fat and protein percent significantly lower in the summer ($P<0.001$). MUN data from herds studied were not at levels thought to hinder reproductive performance.

Key Words: MUN, DHI, Lactating cows

M63 Survey of drinking water flow rates in tie-stall and stanchion dairy barns. I. Possin*[1], R. Shaver[2], and B. Holmes[3], [1]*University of Wisconsin-Extension*, *Fond du Lac*, [2]*University of Wisconsin*, *Madison*, [3]*University of Wisconsin*, *Madison*.

Water intake influences dry matter intake and milk production in dairy cattle. Lactating dairy cows drink 75 to 150 liters per day depending primarily on

level of milk production, ration moisture content, environmental temperature, and salt intake. Cows typically spend only 5 to 10 minutes per day drinking water at a rate of 10 to 20 liters per minute (lpm), and inadequate water bowl flow rates could limit water consumption. The objective of our study was to survey water bowl flow rates in tie-stall and stanchion barns, and to investigate whether or not water flow rates may be limiting milk production. Fifty-three dairy farms with tie-stall or stanchion barn housing systems were selected for the study. Herd size average and range were 69 and 32 to 96 milking cows, respectively. Bulk tank milk production per cow per day averaged 30.8 kg with a range of 11.2 to 45.3 kg across the herds. Water flow rates were measured 3x at the water entrance to the barn and at three water bowls located the nearest, middle, and farthest from the entrance on each side of the two-row barns. Bulk tank milk weights, dumped milk weights, and number of cows milked were recorded. Only 46% of the 318 water bowls measured delivered 11 or greater lpm. Water entrance flow rates averaged 2.24 times greater at 26.9 lpm than water bowl flow rates at 12.1 lpm. As herd size and distance from water entrance increased, water flow rates declined from 12.6 to 11.0 lpm. No difference ($P > 0.10$) in milk production between high and low water flow rate herds was observed. Most herds had supplemental water available during daily release for cow exercise and barn cleaning which seemed to negate any adverse effects of insufficient water intake on milk production. Thirteen of the 53 dairy farms had variable water bowl flow rates both below 3.8 and higher than 11.3 lpm, suggesting that water bowl maintenance was an issue on about a quarter of the dairy farms surveyed.

Acknowledgements: Appreciation is extended to Tom Anderson, Matt Glewen, and Zen Miller for assistance with on-farm data collection.

Key Words: Water, Flow rate, Dairy cows

Growth and Development: Growth, Diet and Performance

M64 Performance of Holstein and Jersey calves compared with performance of Jersey × Holstein and Holstein × Jersey crossbred calves. J. V. Ware*[1], S. T. Franklin[1], A. J. McAllister[1], J. A. Jackson[1], and B. G. Cassell[2], [1]*University of Kentucky*, *Lexington*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to compare differences in performance among purebred and crossbred calves. Holstein and Jersey cows were bred using mixed semen, resulting in treatment groups of Holstein × Holstein (HH), Jersey × Jersey (JJ), Holstein × Jersey (HJ), and Jersey × Holstein (JH) calves. Calves (n = 68) were removed from their dams prior to nursing, weighed, and fed pooled colostrum, at approximately 5% of birth weight, within 3 h of birth. Calves received pooled colostrum again 12 h later. Calves were moved to individual hutches and fed milk at approximately 5% of body weight twice daily. Water and a starter ration were provided beginning on d 3. Milk and starter intakes were recorded daily. Body weights were obtained weekly through 8 wk. Hip heights were obtained within 48 h after birth and at 6 wk of age. Calves were weaned after consuming starter at greater than or equal to 1% of their body weight for three consecutive days. Mean weekly dry matter intakes (total of milk and starter) were lowest ($P < 0.05$) for JJ (4.9 ± 0.5 kg) but not differ among HH, HJ, and JH (7.0 ± 0.3, 6.8 ± 0.3, and 6.1 ± 0.3 kg, respectively). Mean weekly body weights were greatest ($P < 0.05$) for HH (57.5 ± 0.9 kg) and lowest for JJ (37.5 ± 1.6 kg) with HJ and JH intermediate (49.3 ± 1.1 and 47.0 ± 1.2 kg, respectively). Gain through 56 d was greater ($P < 0.05$) for HH (35.7 ± 0.8 kg) and HJ (34.5 ± 0.8 kg) compared to JJ (24.9 ± 0.8 kg). Gain for JH (29.8 ± 0.8 kg) was intermediate and did not differ ($P > 0.05$) from HJ or JJ. As a percent of birth weight, gains for HH (96.5 ± 2.2 %) and HJ (95.4 ± 2.2 %) were greater ($P < 0.05$) than for JJ (68.6 ± 2.2 %). Percent gains for JH did not differ ($P > 0.05$) from the other treatments. Hip heights did not differ ($P > 0.05$) among HH, HJ, and JH (mean = 0.82 ± 0.01 m) but were lower ($P < 0.05$) for JJ (0.78 ± 0.01 m). In conclusion, HJ calves had the ability to perform in a comparable manner to HH calves.

Key Words: Calves, Crossbred, Dairy

M65 The effect of feeding three milk replacer regimens preweaning on first lactation performance of Holstein dairy cattle. C. Ballard*[1], H. Wolford[1], T. Sato[2], K. Uchida[2], M. Suekawa[2], Y. Yabuuchi[2], and K. Kobayashi[2], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Zen-Noh National Federation of Agricultural Co-operative Associations*, *Tokyo, Japan*.

As previously reported, sixty Holstein heifer calves at two farms were blocked at birth and randomly assigned to one of three milk replacer (MR) treatments formulated on DM basis: 1) 27% CP/20% Fat fed at 1.5% BW for first week, 2.25% BW from 8 days through 5 weeks, and 1.25% BW from 6 weeks to weaning; 2) 27% CP/20% Fat fed at 200g 2x/day for 2 weeks, 250g 2x/day through weaning; or 3) 27% CP/15% Fat fed at 1.5% BW for first week, 2.25% BW from 8 days through 5 weeks, and 1.25% BW from 6 weeks to weaning. The objective of this study was to measure growth and performance of heifers from 18 months of age through their first lactation. Data was analyzed using Proc GLM with farm and block(farm) in the model. No treatment differences were found for weight and stature of animals at 30 mos of age (n=14, 18, 19). No significant difference in age or weight at calving was realized, although heifers fed milk replacer at a fixed rate tended to be younger and weigh less. Incidence of retained placenta and postpartum metabolic disorders were similar for all treatments. Heifers also had similar calving ease scores with 79, 78 and 68%, respectively having easy calving scores of 1 and 2. No difference in milk yield was realized at 100 dim. Heifers fed the 27/20 MR as a % of body weight yielded nearly 700 kg more milk than treatments 2 or 3 at 200 dim (n=14,18,19). Milkfat and protein yield was similar for all treatments. Although not significant, 3.5%FCM yield at 200 dim tended to be higher for 27/20 MR heifers fed as a % of BW. Implementation of enhanced early nutrition programs may positively impact first lactation milk yield.

	Treatment				
Item	1	2	3	SEM	*P*
Wt, kg Mo 30	653.96	648.68	672.05	18.96	0.511
WH[1], Mo 30	143.10	142.17	142.63	0.75	0.694
S-P[2], Mo 30	176.86	175.25	177.49	1.46	0.494
Age at Calving, d	796	753	783	16	0.264
Wt at Calving, kg	670.60	630.02	666.01	15.52	0.118
Milk-200d					
Yield, kg	6803[a]	6014[b]	6154[b]	206	0.036
Fat, kg	254	229	231	10	0.757
Protein, kg	200	175	184	7	0.530
3.5FCM, kg	7066	6316	6400	249	0.104

[1]Wither height, cm, [2]Shoulder to pin, cm, [a,b]Means within a row differ ($P < 0.05$).

Key Words: Milk Replacer, Heifer Growth, Lactation

M66 Improved prediction of retained energy in a dynamic beef cattle growth and composition model accounting for variable maintenance. L. G. Barioni*[2], J. W. Oltjen[1], and R. D. Sainz[1], [1]*University of California*, *Davis*, [2]*Embrapa Cerrados*, *Planaltina, DF, Brazil*.

Animal growth and composition models base their predictions on estimated retained energy. Therefore, variation in maintenance requirements related to

previous nutrition and animal state should be accounted for. In this study, the Davis Growth Model (Oltjen et al., 1986, J. Anim. Sci. 62:86) was re-parameterized using data from an independent experiment (Sainz et al., 1995, J. Anim Sci. 73:2971). The dataset contains measurements of diet energy concentration, dry matter intake, and initial and final body composition for 110 animals. Steers were fed one of two diets. During the growing phase, the low-concentrate diet (ME = 1.87 Mcal/kg) was available ad libitum (FA) and the high concentrate diet (ME = 3.06 Mcal/kg) was either available ad libitum (CA) or was limited (CL) to match the weight gains by the FA group. During the finishing phase, steers were fed the high concentrate diet, either for ad libitum intake (CA) or restricted to 70% ad libitum intake (CL). Thus the treatments included just a growing phase CA, CL, FA or both growing and finishing (CA-CA, CL-CA, CL-CL, FA-CA, and FA-CL). The model parameters for maintenance requirement (α) and protein synthesis (k2) were fitted simultaneously to the data by minimizing the error sum of squares of body protein plus the error sum of squares of body energy, weighted according to the respective experimental variances. When including data from all treatments, α converged to 0.1171 Mcal/kg$^{0.75}$ (EBW basis). When estimated for each treatment, α varied as follows: for the first period, α_{CA} = 0.0882; α_{CL} = 0.1112; α_{FA}= 0.1085; and for the final period, $\alpha_{CA\text{-}CA}$ = 0.1063; $\alpha_{CL\text{-}CA}$ = 0.1120; $\alpha_{CL\text{-}CL}$ = 0.1107; $\alpha_{FA\text{-}CA}$ = 0.1363; $\alpha_{FA\text{-}CL}$ = 0.1210 MCal/kg$^{0.75}$. Root mean square error of prediction (RMSEP) was reduced from 191.9 to 148.1 Mcal for retained energy, and from 19.6 to15.8 kg for final body fat when maintenance was adjusted for each treatment. These results indicate that accounting for variable maintenance can significantly improve predictions in dynamic models of beef cattle growth and body composition.

Acknowledgements: Supported by CAPES, Brazil

Key Words: Beef Cattle, Growth, Maintenance

M67 Comparison of modern commercial and low cholesterol swine crosses on performance characteristics. M. J. Anderson*, J. W. Johnson, J. R. Blanton Jr., and S. W. Kim, *Texas Tech University*, *Lubbock*.

The objective of this study was to create a crossbreed using a low serum cholesterol swine (LC) and a modern commercial swine (M; Camborough-22, PIC) that exceeds or is equal to a straight-line MxM cross in performance. LC was developed through unilateral selection for serum cholesterol at d 56 for three generations and maintained at Texas Tech University. In addition to having lower serum cholesterol (65.5±2.1mg/dL vs. 85.6±2.1 mg/dL) LC is more obese than modern swine. M and LC were bred to form four treatments: offspring from the crosses between M male and M female (MM, n=4), between M male and LC female (MLC, n=4), between LC male and M female (LCM, n=4), and between LC male and LC female (LCLC, n=2), where n=number of pens (4 pigs/pen). Pigs were fed based on a 5 phase (P) feeding program for 140d until they reach 76.1±2.5 kg (P1: 7d; P2: 7d; P3: 17d; P4: 61d; and P5: 24d). Body weight and feed intake were measured every 7d from birth to d-56, and every 14d subsequently. Gain/feed of LCM was greater (P<0.05) than LCLC, whereas it did not differ (P>0.05) from MM and MLC. Regressions fitting the growth of pigs from different breedings were obtained using the REG procedure in SAS. Growth of pigs in LCM was 0.588xD-5.295 (R^2=0.97, P for S<0.0001, P for I<0.0001), MM was 0.519xD-5.019 (R^2=0.94, P for S<0.0001, P for I =0.0001), MLC was 0.489xD-5.408 (R^2=0.93, P for S<0.0001, P for I =0.0001), and LCLC was 0.417xD-4.579 (R^2=0.94, P for S<0.0001, P for I=0.004), where D=day of age, S=slope, and I=intercept. Slopes of regressions were compared using the contrast option in SAS. Slopes of LCM and MM were different (P=0.0016) whereas the slopes of MM and MLC were the same (P=0.2295). Slopes of LCLC and MLC were different (0.0158) as well. The results indicate that the pigs in LCM grew faster than the pigs in MM but the growth of pigs in MM and MLC was the same. The pigs in LCLC grew slowest. Both crossbreeds (LCM and MLC) preformed as well as, or better than the two straight-line crosses (MM and LCLC). Therefore, both of the crossbreeds performed well enough to use for future studies in carcass characteristics.

Key Words: Crossbreeding, Swine, Growth Performance

M68 Dietary *trans*-9, *trans*-11 and *trans*-10, *trans*-12 CLA do not alter growth characteristics in mice. J. W. Perfield II*, S. L. Giesy, D. A. Dwyer, and D. E. Bauman, *Cornell University*, *Ithaca, NY*.

The effects of *trans*-10, *cis*-12 and *cis*-9, *trans*-11 conjugated linoleic acid (CLA) in growing rodent models have been broadly reported. However, the *trans*/*trans* isomers of these fatty acids, the main CLA isomers present in heat-treated sunflower oil, have not been extensively investigated. Therefore, the objective of this study was to investigate the effects of *trans*-10, *trans*-12 and *trans*-9, *trans*-11 CLA in growing mice. To do this we synthesized and purified (> 95%) these CLA isomers in our laboratory. The *trans*-10, *cis*-12 CLA isomer has been shown to affect lipid metabolism in growing mice and it was included as a positive control. Twenty male ICR mice (~16 g) were randomly assigned to one of four groups consisting of the same basal diet supplemented with 1%: 1) corn oil (CO; Control), 2) *trans*-10, *cis*-12 (*t*-10, *c*-12) CLA, 3) *trans*-10, *trans*-12 (*t*-10, *t*-12) CLA, or 4) *trans*-9, *trans*-11 (*t*-9, *t*-11) CLA. Total fat content of the diets was 6%, and mice were fed their respective diets for 4-wk. Data were analyzed using the GLM procedures of SAS and included Tukeys adjustment factor. Growth rate and final body weight did not differ among treatments. The *t*-10, *t*-12, and *t*-9, *t*-11 CLA isomers had no effect on body composition. However, the *t*-10, *c*-12 CLA caused a 14% reduction in empty carcass weight, a 68% decrease in fat content, and increased water and protein content by 9 and 14%, respectively. The *t*-10, *c*-12 CLA treatment also ablated development of the epididymal fat pad, while increasing liver weight by 57%, and liver lipid content by 120% when compared to the other treatments. Hepatic concentrations of *t*-10, *c*-12 CLA, *t*-10, *t*-12 CLA, and *t*-9, *t*-11 CLA were 0.67, 0.28 and 0.31 g/100 g of fatty acids for their respective treatments. In contrast to hepatic tissue, epididymal fat had a greater incorporation of *t*-10, *t*-12 (2.15 g/100 g), and *t*-9, *t*-11 CLA (2.14 g/100 g). Overall, effects of *trans*-10, *cis*-12 CLA on carcass and liver lipids were dramatic while *trans*-10, *trans*-12 and *trans*-9, *trans*-11 CLA had no effects on lipid accretion or growth rate of mice.

Key Words: CLA, Mouse, Lipid Metabolism

M69 Time course of growth factor mRNA expression during differentiation of porcine embryonic myogenic cells. G. Xi*, M. White, M. Hathaway, and W. Dayton, *University of Minnesota*, *St. Paul*.

The IGFs and members of the TGF-beta superfamily regulate proliferation and differentiation of myogenic cells. In this study, we used real-time RT-PCR to explore the time course of IGF-I, IGF-II, IGFBP-2, -3 & -5, IGF-type-I receptor, myostatin and TGF-beta mRNA expression in differentiating porcine embryonic myogenic cell (PEMC) cultures. Creatine phosphokinase activity and myogenin mRNA expression were used to monitor cell differentiation. IGF-I mRNA levels were low in 48 h proliferating PEMC cultures, and increased 5 fold (P < 0.01) during differentiation, reaching a peak at 120 hrs. IGF-II mRNA increased 48% at 72 h (P<0.05) and then decreased 65% by 144 h (P < 0.01). IGF-type-I receptor mRNA levels decreased 43% (P<0.05) between 48 h and 144h in culture. IGFBP-3 mRNA levels were relatively high during proliferation, dropped by 40% (P<0.01) at 72 h, recovered to initial expression levels at 96 h and reached their highest levels at 144 h . This general pattern was also observed using immunolocalization of IGFBP-3 protein in differentiating PEMC cultures with maximal levels detected at 144 h. IGFBP-2 mRNA levels progressively increased throughout differentiation reaching their highest level at 144 h increasing approximately 3.6 fold (p<0.01) compared with initial 48 h levels. Conversely, IGFBP-5 mRNA levels began relatively high and progressively decreased as differentiation progressed, dropping approximately 3.2 fold (p<0.01) compared with levels at 48 h. Measurement of TGF-beta1 and myostatin (GDF-8) mRNA levels during PEMC differentiation revealed that TGF-beta1 mRNA levels decreased 30% (p<0.01) at 96 h, quickly rebounded to a peak level at 120 h, and returned to 48hr levels by 144 h. Interestingly, myostatin mRNA levels decreased dramatically (75%, P<0.01) and remained relatively low throughout the remainder of the differentiation process. Our data demonstrate that these important growth factors are differentially regulated during PEMC differentiation and provide new information about their potential interactions during myogenic differentiation and muscle development in porcine muscle cells.

Key Words: Porcine Myoblasts, Differentiation, Growth Factor Expression

M70 Effect of maternal age at first pregnancy on fetal and placental growth in Columbia and Romanov ewes. P. P. Borowicz*, J. S. Caton, K. A. Vonnahme, M. A. Ward, E. Borowczyk, A. T. Grazul-Bilska, D. A. Redmer, and L. P. Reynolds, *North Dakota State University*, *Fargo*.

Adolescent pregnancy outcome is characterized by low birth weights, high mortality rates and reduced postnatal performance. Intrauterine growth retardation and reduced fetal viability are also correlated with reduced placental development and blood flow, which compromises fetal nutrient and oxygen uptake. In this experiment we investigated effects of maternal age (age at first pregnancy) on placental and fetal size. To obtain genetically similar fetuses we performed embryo transfer. The experimental group was compromised of donor (n = 6) and recipient (n = 24) ewes. Within each breed (Columbia and Romanov) there were 3 donors and 12 recipients (6 yearlings [early adulthood, 1 year and 7 months old] and 6 lambs [peripubertal, 7 months old]). Ewes and lambs were penned separately within a breed and age, and were housed inside under controlled conditions, and complete pellets diets were fed to requirements. Ewes were slaughtered at day 135 and fetal and placental tissues were collected and measured. Fetal and placental weights were greater ($P < 0.05$) for Columbia vs. Romanov; however there was no breed × age interraction for any variable ($P > 0.10$). We observed that despite no significant differences in fetal girth and crown lump length, weights were less ($P < 0.006$) for fetuses from lambs vs. yearlings (4.22 ± 0.40 vs. 4.98 ± 0.42 kg). Differences in placental weights were reflected by reduced fetal placental (cotyledonary; $P < 0.03$) and maternal placental (caruncular; $P < 0.05$) weights in lambs vs. yearlings. As a percentage of fetal weight, fetal heart, kidney, and liver weights were similar in fetuses from lambs vs. yearlings. These data indicate that although maternal age at first pregnancy in the two breeds has a dramatic effect on fetal and placental weight, the effect on fetal organ growth is symmetric indicating smaller but developmentary normal fetuses in lambs compared with yearlings. Supported by NIH grant HL64141 to DAR and LPR.

Key Words: Age, Fetal Growth, Pregnancy

M71 An evaluation of the accuracy of a heart girth tape and the CalfScale® foottape for eetermination of birth weight of newborn dairy calves. E. Vernooy*[1], D. Kelton[1], K. Leslie[1], T. Duffield[1], E. Wilkins[1], and L. Wright[2], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Elora Dairy Research Station*, *Elora, ON, Canada*.

Many factors contribute to the survival and growth of newborn dairy calves. Birth weight has become a frequently investigated variable in animal survival and performance models. Recent studies have focused on the ratio between cow weight and calf weight at the time of calving. Since electronic scales are not often accessible in dairy herds, there needs to be a device available to the dairy producers that will accurately measure the birth weight of the calf. The devices that are commercially available rely on the relationship between body size, shape and weight. The currently used tools are tapes that measure the heart girth or the cornonary band circumference. Both of these devices have precalculated conversions to relate circumference to body weight. The accuracy of these measuring tapes for the estimation body weight of newborn calves is not well documented. It was the goal of the present study to determine the correlation between both of these measuring devices and the actual body weight of neonatal calves. In the study, 188 neonatal Holstein calves were weighed with a livestock scale, as well as each of the two measuring devices. The calves ranged from 1 d to 10 d from birth. Age was not corrected for in the analysis. Univariate analysis was conducted to compare each of the devices to the livestock scale. When compared to the livestock scale, the foottape device showed a correlation of 0.2914 (R^2) . On the other hand, when the heart girth was compared to the livestock scale, a correlation of 0.5605 was produced. The present study has demonstrated considerable variability in the accuracy of commercially available measuring devices, and illustrates the need for further examination and analysis of these devices.

Key Words: Measuring Devices, Birthweight, Dairy Calves

M72 Glucose oxidation and lipogenesis in hybrid striped bass fed diets with different starch ratios. S. Rawles*[1], T. G. Gaylord[2], and R. Lochmann[3], [1]*USDA/ARS - H. K. Dupree Stuttgart Nat'l Aquaculture Res. Ctr.*, *Stuttgart, AR*, [2]*USDA/ARS/SGPGR - Hagerman Fish Culture Exp. Sta.*, *Hagerman, ID*, [3]*University of Arkansas - Pine Bluff*, *Pine Bluff*.

Increasing the ratio of amylose (AMY) to amylopectin (PEC) in the diet improves carbohydrate (CHO) use in some mammals. Slower digestion of AMY results in lower glycemic index and lipogenesis and leaner growth. Carnivorous fish may benefit from this strategy since fish do not use CHO well and any increase in dietary inclusion could reduce feed costs. A 7-wk feeding trial with hybrid striped bass (HSB) was conducted using isonitrogenous, isocaloric, semipurified diets containing 25% CHO of increasing AMY:PEC ratio. Liver slices were then incubated with radiotracers ([U-14C]glucose, glc and [3H]palmitate, pal) to determine glc utilization and de novo lipid and triacylglycerol biosynthesis. Hepatic glycogen production decreased with increasing AMY and was 10X lower than the rate of [14C]glc oxidation to CO2 in all treatments. CO2 production accounted for 88 to 96% of total glc utilization and was lowest in fish fed either the GLC diet or the highest amount of AMY (30PEC). Rates of both esterification (from pal) and glyceride formation (from glc) were of similar magnitude as glycogen production and also appeared lowest in fish fed the GLC or 30PEC diets. Trends in glc oxidation, therefore, mirrored trends in lipogenesis and are most likely due to differences in digestion, excretion, and glc sequestering at the cellular level. Concentrations and activities of glc metabolizing enzymes are lowest in fish. Although glc requires no enzymatic digestion, reduced glc phosphorylation results in significant loss via urinary excretion. On the other hand, in vitro glc metabolism and lipogenesis were inversely related to dietary AMY content and also suggests significant CHO loss. High-amylose starch may be resistant to HSB digestion. High rates of CO2 production among all treatments suggest significant oxidation of dietary CHO; however, the tracers used preclude distinction of Krebs vs. pentose cycle CO2. In conclusion, high-amylose diets had minimal positive effects on HSB carbohydrate use.

TABLE 1. Glc utilization and lipogenesis in hybrid striped bass fed different starch ratios[1]

CHO[2]	CO_2	Glycogen	Glyceride	Esterification
CHO[2]	CO_2	Glycogen	Glyceride	Esterification
CHO[2]	CO_2	Glycogen	Glyceride	Esterification
		product formation		
		product formation		
100PEC	3390±213a	249±22a	149±40ab	101±10
70PEC	3378±603a	187±23b	190±46a	103±10

[1]Product nmol/min/mg liver±SE; n=5-6/diet. Letters indicate significant differences (P<0.10) [2]Diet CHO from glucose (GLC); 100% PEC (100PEC); 30% AMY:70% PEC (70PEC); 70% AMY:30% PEC (30PEC)

Key Words: Hybrid Striped Bass, Carbohydrates, Lipogenesis

M73 Allometry of postweaning growth in straightbred and crossbred Botucatu rabbits. E. Bianospino, A. S. A. M. T. Moura*, S. Fernandes, and F. E. Wechsler, *UNESP/ Faculdade de Medicina Veterinária e Zootecnia*, *Botucatu, SP, Brazil*.

The objective was to determine whether there are differences in the allometry coefficients of organs, tissues and commercial carcass cuts between straightbred and crossbred Botucatu rabbits, from weaning up to 91 d of age. A total of 128 rabbits, straightbred Botucatu and Botucatu x White German Giant crossbreds, were involved in a completely randomized design, with a 2 x 2 factorial arrangement (2 genetic groups and 2 sexes) applied to the main plots (cages). Rabbits were weaned at 35 d and sequentially slaughtered at 42, 49, 56, 63, 70, 77, 84, and 91 d of age, four per genetic group x sex combination. The weights of skin, empty gastrointestinal tract, distal parts of fore and hind legs, commercial carcass, head, thoracic viscera, liver, kidneys, spleen, dissectible fat, and of the commercial cuts (fore part, loin and hind part) were measured.

Meat and bone weights were determined for the left hind leg. The log weights of organs, tissues and parts were regressed against the log weights of commercial carcass. No differences in the allometry coefficients between genetic groups or sexes were detected. Skin, empty gastrointestinal tract, distal parts of fore and hind legs, thoracic viscera, liver, kidneys, and spleen had coefficients lower than 1 (0.83, 0.80, 0.59, 0.84, 0.77, 0.55, and 0.22, respectively), indicating that they reached maximum growth during the experimental period. The allometric coefficients of the loin and leg meat were slightly larger than 1 (1.11 and 1.16, respectively), whereas the hind and fore parts presented isometric coefficients (1.03 and 1.05, respectively). The allometric coefficient of dissectible fat was larger than 1 (1.58), whereas the coefficient of bones was smaller than 1 (0.63). There was no indication of maturity differences between the two genetic groups from 35 to 91 d of age. The relative magnitudes of allometry coefficients of organs, tissues and parts will aid in choosing the best slaughter age.

Acknowledgements: This project received financial support from FAPESP, SP, Brazil.

Key Words: Carcass, Growth, Rabbit

M74 Effects of diet and bST on gene expression profile in the liver of heifers. B. J. Lew*[1,2], J. S. Liesman[1], T. E Van Dorp[1], M. D. S. Oliveira[2], S. Sipkovsky[1], and M. J. VaneHaar[1], [1]*Michigan State University*, *East Lansing*, [2]*Sao Paulo State University (UNESP)*, *Jaboticabal, SP, Brazil*.

Our objective was to examine the effect of a high energy-protein diet and bST on the expression of genes involved in growth, development and metabolism in the liver of Holstein heifers shortly after puberty. Liver tissue used was collected in a previous experiment conducted in 1994 (Radcliff et al., 1997) where Holstein heifers were randomly assigned to 1 of 4 treatments - low or high diet (0.8 or 1.2 kg of BW gain/d, respectively), with or without bST administration (25 ug/kg BW/d) - from 120 d of age until the early luteal phase of the fifth estrous cycle. RNA from liver was extracted from 32 heifers (8/treatment), and quality checked using the Agilent Bioanalyzer. RNA was pooled (2/pool), and the 16-pooled samples were examined using a bovine-specific cDNA microarray (National Bovine Functional Genomics Consortium Library) containing 18,263 ESTs. A loop design was used with cDNA samples labeled with Cy3 or Cy5 dyes prior to hybridization. Data was normalized for dye intensity biases using a robust local regression technique (SAS PROC LOESS). Significance levels of differential gene expression among treatments were assessed using a mixed model approach. Independent of diet, bST administration altered the expression of 667 genes while high diet altered the expression of 1187 genes ($P<0.05$). Compared to low diet, high diet without bST, affected expression of 1215 genes ($p<0.05$). bST altered expression of 807 genes in the high diet ($P<0.05$) and 695 genes in low diet ($p<0.05$). Genes altered included several metabolic pathways-related molecules, hormones, growth factors and receptors involved in growth and development. In conclusion, dietary energy and bST administration alter expression of several genes in liver of a dairy heifer, especially genes related to metabolism and growth and development.

Acknowledgements: To CAPES and CNPq for sponsoring first author.

Key Words: Microarray, Liver, Nutrition

M75 Leptin and leptin receptor expression in swine tissues in response to in vivo somatotropin treatment. T Ramsay* and M Richards, *USDA-ARS, Beltsville, MD*.

The present study examined the response of the leptin and leptin receptor genes to porcine somatotropin (pST) stimuli in finishing pigs. Twelve crossbred barrows (Yorkshire x Landrace) were individually fed a diet containing 18% CP, 1.2% lysine, and 3.5 Mcal of DE/kg *ad libitum*. At 90 kg, six randomly selected pigs were treated with daily injections of recombinant pST, (10 mg). The other six pigs were injected with bicarbonate buffer (controls). With initiation of pST treatment, the amount of feed offered was at 85% of calculated ad libitum intake, based upon BW and adjusted every 3 d. Diet restriction was performed to correct for the known inhibition in feed intake due to pST treatment in swine. Animals were maintained on treatment for 2 wk with a blood sample obtained on d14. Tissue samples were collected on d15, frozen in liquid nitrogen and stored at -80°C prior to analysis for gene expression by RT-PCR and transcript quantification by capillary electrophoresis with laser-induced fluorescence detection. Samples included outer (OSQ) and middle subcutaneous adipose tissues, leaf fat, liver, latissimus dorsi and biceps femoris. Restricted feeding resulted in no change in bwt of control pigs while pST treatment increased bwt by 6.9 ± 0.5 kg ($p < 0.001$). Treatment with pST produced a twelve-fold increase in serum ST ($p < 0.002$). Serum leptin was elevated by 17% in swine treated with pST ($p < 0.01$). Leptin mRNA level was increased in liver by pST treatment ($p < 0.05$). Leptin receptor (Ob-Rb) expression was reduced 27% by pST administration in liver ($p < 0.04$) and by 49% in OSQ ($p < 0.02$) relative to control animals consuming equivalent amounts of feed. The present data suggest the effect of pST on leptin gene expression in ad libitum fed pigs is primarily the result of pST′s inhibition of feed intake, since the restriction feeding regimen precluded detection of major change in leptin gene expression. Changes in leptin receptor expression by *in vivo* pST treatment suggests a change in sensitivity to leptin in liver and OSQ.

Key Words: Leptin, Somatotropin, Leptin Receptor

M76 Effects of Gammulin® on performance in non-stressed neonatal dairy calves. C. C. Stanley*, C. C. Williams, J. M. Heintz, E. M. Rees, and D. T. Gantt, *LSU AgCenter*, *Baton Rouge, LA*.

Sixteen Holstein calves (8 female, 8 male) were used to determine the feasibility of including bovine serum protein (Gammulin®; American Protein Corp.) in neonatal calf diets in a normal production environment utilizing sound management practices. All calves were removed from their dams, weighed, and placed into individual hutches within 12 h of birth. Calves received 1.9 L of colostrum at each of the first 2 feedings. Beginning on day 2, calves were fed a commercial milk replacer (IBA, Inc., 20% CP; 20% crude fat) once daily. Milk replacer was reconstituted to 21.4% DM and fed at a rate of 10% of initial body weight. At this time, calves were assigned to one of 2 dietary treatments consisting Gammulin® supplementation (60 g/d from days 1-5, 45 g for days 6-10, and 30 g for days 11-15) or no Gammulin® in milk replacer. Gammulin® supplementation was discontinued on day 16. Calves were offered a commercially available calf starter (18% CP; Herd Maker B90 Supreme, Land O'Lakes Farmland Feed, Inc.) and water free choice beginning on day 2. Feed intake and fecal scores were recorded daily for all calves. Body weight was measured on days 7, 16, 23, and 30. Blood and saliva samples were collected at 24 h and on days 7, 16, and 23. Serum was harvested from blood and frozen until samples were analyzed for IgG concentrations with commercially available kits (VMRD, Inc.), and it was determined that all calves had adequate passive immunity. Saliva samples were analyzed for IgA concentrations using commercially available kits (VMRD, Inc.). Although there was a treatment by period interaction ($P < 0.05$), fecal scores for both treatments were not indicative of a problem with scours. There were no treatment effects on average daily gain, grain intake, or IgG concentrations ($P > 0.05$). As expected, grain intake and ADG increased over time during the 30 day trial. Concentrations of salivary IgA were not detectable in any of the samples, and serum IgG concentrations decreased ($P < 0.01$) from 24 h to day 23. These data indicate that Gammulin® supplementation will not improve performance in calves not subjected to stress.

Key Words: Dairy Calves, Gammulin^®^, growth

M77 Blood chemical and plasma amino acid profiles of old versus mature young beef cows. G. Sipe*[1], B. Zanghi[1], G. Wu[2], J. Boling[1], and J. Matthews[1], [1]*University of Kentucky*, *Lexington, KY*, [2]*Texas A&M University*, *College Station, TX*.

To develop an aging cattle model to facilitate future research on age related metabolic function, an initial study was conducted to characterize the influence of age on blood chemical and plasma amino acid profiles of mature young (2-3

yrs old, n = 13, BW = 580 ± 14 kg) versus old (7-12 yrs old, n = 12, BW = 679 ± 24 kg) non-pregnant beef cows of predominantly Angus breeding. All cows grazed the same mixed forage pasture prior to and at the time of blood sampling. Plasma Ala and Gly concentrations (mmol/mL) were 11.5 (P = 0.08) and 20.3% (P = 0.005) lower, respectively, whereas taurine was 22.1% greater (P = 0.01) for old versus young cows. Serum chemistry and blood cell analyses indicated that old cows had lower K^+ (18%, P = 0.01), creatinine (21.6%, P = 0.05), white blood cells (32.2%, P = 0.01), red blood cells (11.2%, P = 0.002), and lymphocytes (16%, P = 0.02) compared to young cows. In contrast, total protein (6.3%, P = 0.005), globulin (9.3%, P = 0.03), total bilirubin (19.3%, P = 0.05), hematocrit (6.2%, P = 0.04), hemoglobin (33.4%, P < 0.0001), and monocytes (29.4%, P = 0.01) were greater in old versus young cows. Serum enzymes, such as Ala aminotransferase (ALT), Asp aminotransferase (AST), and creatine kinase were 22.7, 13.0, and 50.9% lower (P < 0.02), respectively, in old versus young cows, whereas gamma-glutamyl transferase (GGT) was 44.5% greater (P = 0.002). This study has established a baseline for specific blood constituents of the aged versus young mature beef cow and will allow further studies on the ability of geriatric cows to respond to various metabolic challenges, as indicated by alteration of blood constituents.

Key Words: Aging, attle, Amino Acids

M78 The effects of feeding *ad-lib* fresh milk or milk replacer during nursing period on skeletal growth rates of Holstein heifers. U. Moallem*[1], D. Werner[2], H. Lehrer[1], M. Katz[1], L. Livshits[1], I. Bruckental[1], and A. Shamay[1], [1]*Institute of Animal Science, ARO, Israel*, [2]*Extension Service, Ministry of Agriculture, Israel*.

The objective of this study was to compare the effects of feeding *ad-lib* fresh milk vs. commercial milk replacer on skeletal growth and feed efficiency. Forty-six 3 d old Israeli-Holstein calves were individually housed and randomly assigned to one of two treatments: 1) Milk replacer (MR) - calves had free access to milk replacer in two 60-min meals per day fed until 60 d of age and; 2) Milk (M) - calves had free access to fresh milk as in Treatment 1. Calves had free access to water and starter mix and individual feed intakes were recorded until 90 d of age. Both liquid feeds were offered on equal DM basis. Weekly measurements of live body weight (LBW), hip height (HH), withers height (WH), hip width (HW) and heart girth (HG) were taken until 90 d of age. Daily liquid DMI was higher in the MR than the M calves (1.22 vs. 1.11 kg/d; P < 0.0001), but starter mix intake was higher in M group than MR (0.146 vs. 0.126 kg/d; P < 0.01). The total ME and crude protein intakes were significantly higher in the M group than in MR; 5.43 vs. 5.24 Mcal/d (P < 0.01) and 334 vs. 309 g/d (P < 0.0001), respectively. No differences in DMI were observed during the post-weaning period (60 to 90 d of age). At weaning, live body weight (LBW) and hip width (HW) were greater for the M than the MR calves, 81.8 and 76.5 kg, and 27.3 and 26.4 cm, respectively, but no differences were observed in WH, HH and HG. Average daily BW gain during pre-weaning period was 713 and 803 g/d for the MR and M calves, respectively (P < 0.004). At 90 d of age LBW, HH and HW of the M calves were significantly greater than in the MR calves (P < 0.05). Dry matter and ME efficiencies prior to weaning were 0.53 vs. 0.64 kg BW/kg DMI and .136 vs. .147 kg BW/Mcal for MR and M groups, respectively (P < 0.02). In conclusion, feeding *ad-lib* fresh milk compared to milk replacer increased DM and ME efficiencies, increased LBW and HW gain, but had no effect on other skeletal measures.

Key Words: Nursing Management, Skeletal Growth

M79 Effects of in-ovo administration of monoclonal anti-myostatin antibody on post-hatch chicken growth and muscle mass. Y. S. Kim*[1] and H. Y. Jin[2], [1]*University of Hawaii, Honolulu*, [2]*Kangnung National University, Gangnung, Korea*.

Myostatin, a member of the TGF-beta superfamily proteins, is a potent negative regulator for skeletal muscle growth. In this study, we raised a monoclonal anti-myostatin antibody and examined the effects of in-ovo administration of the antibody on post-hatch chicken growth and muscle mass. E. coli-expressed mature form of myostatin was purified by electro-elution of myostatin bands after fractionation by SDS-PAGE, and used as an immunogen in producing monoclonal antibodies against myostatin. One hybridoma clone that showed the strongest affinity to the immunogen in Western blot analysis was used in producing ascites fluid. The monoclonal anti-myostatin antibody (mAb c134) was affinity-purified using a protein A column. The mAb c134 showed in Western blot analysis a strong binding affinity to a commercially available mature myostatin produced in mammalian cell culture system. In a competitive ELISA, the mAb c134 binding to myostatin was inhibited by a commercially available mature myostatin in a dose-dependent manner, demonstrating the binding ability of the mAb c134 to the native form of mature myostatin. When the cross-reactivity of the mAb c134 with some members of TGF-beta superfamily was tested in Western blot analysis, it cross-reacted with rhBMP2, but not with rhTGF-beta3 and pTGF-beta1. To examine the effects of in-ovo administration of the mAb c134, eggs were injected once with 3 μg mAb c134 in 20 μl PBS per embryo into the albumin area on day three after incubation. After hatching, chicks were raised for 24 days. The in-ovo administration of the mAb c134 did not affect either postnatal chicken growth or breast muscle mass. The results of this study indicate that the mAb c134 binds to the native from of mature myostatin, but its ability to inhibit biological activity of myostatin in vivo remains to be further examined.

Acknowledgements: This study was supported by USDA T-STAR grant.

Key Words: Monoclonal Anti-myostatin Antibody, Myostatin, In-ovo Administration

M80 Impact of dietary-lysine restriction in early-finisher on subsequent growth response to dietary lysine level in late-finisher pigs. J. M. DeDecker*[1], M. Ellis[1], B. F. Wolter[2], and B. A. Peterson[1], [1]*University of Illinois, Urbana*, [2]*The Maschhoffs, Inc., Carlyle, IL*.

The effect of lysine restriction in early-finisher pigs (period 1; 69.7 ± 0.90 to 97.4 ± 0.20 kg) on subsequent growth response to dietary-lysine level in late-finisher pigs (period 2; 97.4 ± 0.20 to 129.0 ± 0.35 kg) was evaluated in a randomized complete block design with a 3 × 3 × 2 factorial arrangement of treatments: 1) period 1 digestible lysine (0.35 vs 0.55 vs 0.75%), 2) period 2 digestible lysine (0.60 vs 0.75 vs 0.90%) and 3) sex (barrows vs gilts). Cross-bred pigs (n = 1,620) were housed in a wean-to-finish facility in single-sex groups of 30. In period 1, there were lysine × sex interactions (P < 0.05) for G:F. G:F was lower (3%) for gilts than barrows at 0.60 and 0.75% lysine, but higher (2.5%) at 0.75% lysine. In period 1, increases in lysine resulted in a linear increase (P < 0.001) in ADG (667, 834, and 957 g/d, resp.), a quadratic increase in G:F (0.28, 0.35, and 0.39 g/g, resp.), but no change in ADFI. In period 2, increases in period 1 lysine level resulted in linear decreases (P < 0.001) in ADG (1014, 928, and 898 g/d, resp.) and G:F (0.37, 0.34, and 0.33 g/g, resp.). Increasing period 2 lysine level produced a linear increase in period 2 ADG (P < 0.01; 902, 970, and 967 g/d, resp.) and G:F (P < 0.001; 0.33, 0.35, and 0.36 g/g, resp.) and reduced ADFI (P < 0.05; 2771, 2769, and 2684 g/d, resp.). There was a period 1 × period 2 lysine level interaction (P < 0.01) for G:F. Pigs fed 0.35% lysine in period 1 showed a greater increase in G:F as lysine in period 2 increased than those fed 0.55 and 0.75% lysine in period 1. For the overall growth period (69.7 to 129.0 kg), pigs fed 0.75% lysine in period 1 had greater ADG and G:F than those fed 0.55% which were higher than 0.35% lysine. In summary, lysine restriction in early finisher resulted in increased ADG and G:F in late-finisher but reduced overall growth rate and feed efficiency.

Key Words: Pigs, Lysine, Growth

M81 Jogging temporal variables as performed under 2005 stock horse breed association guidelines. J. Booker and M. Nicodemus*, *Mississippi State University*, *Mississippi State*.

In 2005, stock horse breed associations updated the western pleasure gaits definitions in order to discourage excessive slow gaits being performed in the show arena. Earlier jogging kinematics research found the gait more closely resembled an adaptation of a slow walk. Study objectives were to measure the temporal variables of the jog as performed according to 2005 stock horse breed association guidelines. 4 registered stock horses competitively showing in their respective breed associations were filmed at 60 Hz. 4 strides of a sound, consistent jog for each horse were evaluated frame-by-frame for hoof contacts and lift-offs. The jog had a lateral footfall sequence with a mean stride duration of 921 ± 34 ms and a velocity of 1.10 ± 0.09 m/s. The stride length was 1.10+0.10 m. Paired t-tests confirmed gait symmetry, as there was no significant differences ($p > 0.05$) found between the left and right limbs during the stance phase. The majority of the stride was spent in stance (Fore: 68+4%; Hind: 61+4%) with the horse spending a more significant amount of time on the fore than the hind limbs. Lateral advanced placement was 46+9% of the stride and was significantly longer than diagonal (7+4%), which indicated diagonal couplets instead of diagonal pairs. Lateral advanced lift-off (46+5%) was significantly longer than the diagonal (3+3%) with 44% of the strides being performed with the diagonal limbs coming off the ground at the same time. The longest limb support phase of the jog was diagonal bipedal (80 ± 8%) followed by tripedal support with two forelimbs (19 ± 8%), quadrupedal (17 ± 8%), and tripedal with two hind limbs (4 ± 8%). The horses spent more time being supported by the forelimbs, as the tripedal support with two forelimbs was significantly longer than the tripedal with two hind. There was no period of suspension. These findings suggest that even with current changes in judging standards the jog being performed in the show arena is not similar to that of a trot; but rather, the jog may be more closely paired with that of the 4-beat stepping gaits of the gaited horse.

Key Words: Temporal Variables, Jog, Stock Horse

M82 Assessment of calcium, phosphorus, and oxalate intake and excretion by horses grazing Kikuyu grass pastures in Hawaii. V. S. Gusman[1], J. R. Carpenter*[1], S. C. Miyasaka[1], and B. W. Mathews[2], [1]*University of Hawaii*, *Honolulu*, [2]*University of Hawaii*, *Hilo*.

Tropical "hazardous grasses" as classified by USDA (oxalate abundance) are currently continuously grazed year round by Hawaii's horses. Kikuyu grass (Pennisetum clandestinum) is an aggressive African species found in Hawaii in the dry/semi-moist habitats (~500-2000 m elevation). Significant evidence of skeletal problems ("Big head") occurs in Hawaii's horses. Objectives of this study were to evaluate various kikuyu grass pastures on the islands of Hawaii and Maui, determine the types and levels of any supplements fed, examine the Ca, P, and oxalate composition of both the kikuyu grass and total diets, and identify relationships between Ca, P, and oxalate of diets and feces. Trial used 20 horses of various breeds (14-22 yrs of age), and from 4 sites per island (2-3 horses per site). Weight of each supplement fed was recorded for each site. Kikuyu intake (DM) was fixed at 1.75% of body weight. Hand plucked kikuyu grass, representative samples of pasture supplements (alfalfa cubes, timothy hay, or guinea grass), and freshly excreted fecal samples were taken at each site during 4 seasons. Samples were dried (50°C) and ground, then analyzed for minerals (ICPES), nutrients (NIRs), and total and soluble oxalates (HPLC). Ca and P levels (DMB), and Ca:P ratio ranged from 0.25-1.06%, 0.18-0.36% and 0.80 to 3.01:1, respectively. Mean Ca and P levels for both kikuyu grass and total diet did not differ ($P>.05$) with season or location. The average Ca:P ratios for islands and sites did not differ, but values ranged from 1.08 to 1.91 and were below the NRC guide of 2:1. Total (T) and soluble (S) oxalates, and Ca:T and T:S of Kikuyu did not differ between islands, seasons or sites; but, insoluble oxalate differed ($P<.01$) with island, and Ca:T and T:S of total diet differed ($P<.001$) with season. Fecal oxalates did not vary between location but did vary ($P<.01$) between season. Total oxalates were found to be well beyond safe feeding levels (>0.5%) with 0.84 % on the Big Island and 0.76% on Maui. Even after supplement, critical levels of >0.5% T were still seen on both islands and in all seasons.

Key Words: Equine, *Pennisetum clandestinum*, Macro-Minerals and Oxalates

M83 Fermentation in equine cecal cultures fed low and high starch diets with or without an enzyme supplement. P. M. Yocum*[1], V. Fellner[1], S. J. McLeod[1], and M. Schuler[2], [1]*North Carolina State University*, *Raleigh*, [2]*Enzitech, LLC*, *Troy, VA*.

An *in vitro* batch culture study was conducted to determine the effects of starch and enzyme supplement on fermentation by equine cecal microorganisms. Fresh cecal contents were transported to the lab, filtered and added into beakers containing a pre-weighed amount of substrate. The substrate was incubated for 12, 24 or 48 h. Dietary ingredients included corn, oats, alfalfa pellets and a vitamin mineral premix. Diets fed were: 1) Low Starch (10% Corn; LS), 2) High Starch (70% Corn; HS), 3) LS + 50 mg Equigest, 4) HS + 50 mg Equigest, 5) LS + 100 mg Equigest, and 6) HS + 100 mg Equigest. Data were analyzed as a completely randomized block design with a factorial arrangement of treatments. At 12 h, the HS diet lowered ($P<0.05$) total short chain fatty acids (SCFA) (91 µmol/ml) the acetate to propionate ratio (2.7) and methane (358 nmol/ml) compared to the LS diet (100 µmol/ml, 2.9 and 730 nmol/ml, respectively). Total SCFA concentration was greatest ($P<0.05$) in the LS + 50 mg Equigest and HS + 100 mg Equigest diets. At 48 h, total SCFA concentration did not differ between the low and high starch diets. The HS diet increased ($P<0.05$) propionate (46 µmol/ml) and lowered the acetate to propionate ratio (2.1) when compared to the LS diet (35 µmol/ml and 3.0, respectively). Isobutyrate and isovalerate, were significantly greater in the LS compared to the HS diet. Both methane and culture pH were lower ($P<0.05$) with the HS diet. Addition of 50mg of Equigest resulted in the greatest increase ($P<0.05$) in concentrations of total SCFA, propionate, butyrate and isovalerate compared to all other diets. Data suggest that the effect of the enzyme supplement varies with time of incubation and level of starch in the diet. Presence of Equigest enzyme extracted more energy from the feed and increased acetate concentration in cecal cultures receiving excess starch in the high corn diets.

Key Words: Cecal Fermentation, Starch, Enzyme

M84 Pedigree effects on semen parameters in Tennessee Walking Horse stallions. P. E. Roberson*, F. Harper, and C. J. Kojima, *The University of Tennessee*, *Knoxville*.

The Tennessee Walking Horse (TWH) industry is an integral factor in the economy of the state of Tennessee. Breeders of TWH have expressed concern that level of inbreeding and pedigree (line effects) are adversely affecting fertility rates among stallions. A study was conducted to test the hypothesis that certain semen characteristics are influenced by pedigree in TWH breeding stallions. Semen characteristics from eleven stallions (collected throughout the 2004 breeding year) were analyzed. The variables were as follows: concentration (CON; million sperm/mL); volume (VOL; mL); percent motility (MOT); and total motile sperm (TMS; CON × VOL × MOT). Pedigree analysis revealed that the stallions were derived from 4 distinct pedigree lines (denoted here as LINES A, B, C and D). Inbreeding coefficients were calculated for each stallion (16.4 ± 1.8, mean ± SEM). The statistical model included age of the stallion in years (AGE) and inbreeding coefficient (F) as covariates and season of collection (3 month intervals;QTR) and LINE as main effects. Analysis of variance was followed by Fisher's LSD test. For all variables tested, no significant difference due to QTR was observed. There were significant effects of LINE on VOL ($P < 0.0001$), CON ($P = 0.0005$), and TMS ($P < 0.005$). There was no significant

difference observed in MOT due to LINE (P > 0.05). As the sample sizes are quite small (line D is represented by one sire), additional data are needed to confirm these results. These preliminary data indicate that variability seen in semen characteristics may be explained by pedigree when sire, age, season of collection, and level of inbreeding are accounted for.

Number of sires	2	3	5	1
Mean F	22.5	10.0	18.2	15.2
Mean AGE	12.0	17.0	12.6	28.0
Mean VOL	89.2^{A}	69.6^{B}	$56.6^{B,C}$	39.0^{C}
Mean CON	$113.3^{B,C}$	171.8^{A}	$128.2^{A,B}$	67.8^{C}

Mean values shown with uncommon superscripts within a row differ (P < 0.05).

Key Words: Horse, Semen, Inbreeding

Nonruminant Nutrition: Additives and Supplements

M85 A strawberry flavor in drinking water and feed improves water intake and growth of pigs at weaning. E. Roura*[1], D. Solà-Oriol[2], and D. Torrallardona[2], [1]*LUCTA SA, Barcelona, Spain*, [2]*IRTA, Centre Mas Bové, Reus, Spain*.

A two-phase trial was conducted to study the effects of a strawberry flavor (flavor) and a high intensity sweetener (HIS) in drinking water and feed on the performance of weanling pigs. Eighty 21 day-old Landrace piglets (6.6 ± 1.40 kg) were distributed in 24 pens with three or four pigs, each provided with an independent water container. In phase I, all pigs were offered the same unflavored diet for a period of 14 days but four treatments were administered in the water: either with no additions (C), or with flavor (A), with HIS (S) or both flavor and HIS (AS). In phase II (day 14 to 27), the animals in each treatment were divided into two groups receiving unflavored water but offered either flavored or unflavored feed. At the end of phase I, average water intake was 618, 681, 642 and 645 g/p/d, and weight gain was 168, 199, 189 and 180 g/p/d for groups C, A, S and AS, respectively. Thus, group A compared to C showed 10% (P > 0.1) and 18% (P < 0.1) higher water intake and weight gain, respectively. In addition, feed to gain ratio during the same period was better (P < 0.05) for A (1.37) than that for C (1.63) and intermediates for S (1.45) and AS (1.50). No differences in feed intake were observed. Statistics of phase II suffered from a low number of replicates. Nevertheless, it seems relevant (P < 0.01) that the group receiving flavor+HIS through water in phase I followed by flavor+HIS through feed in Phase II increased body weight gain by 18% over those receiving flavored water in Phase I and unflavored feed in Phase II. Thus, in phase II, the withdrawal of flavor in water together with not adding flavor in feed resulted in the lowest performance. Overall, these results suggest that water intake after weaning is encouraged with the use of flavor, and that this has beneficial effects on piglet performance. After the withdrawal of flavor in water, improving piglet performance might be linked to flavoring also the feed. The interaction between flavoring drinking water and flavoring feeds at weaning merits further studies.

Key Words: Water Intake, Piglet Weaning, Flavor

M86 Effect of oregano, cinnamon and chili pepper herbal extracts as growth promoters on growth performance of young pigs. G. Velazquez[1], A. G. Borbolla*[1], G. Mariscal-Landin[2], T. Reis de Souza[3], and A. Pinelli[4], [1]*Universidad Nacional Autonoma de Mexico, Mexico City, Mexico*, [2]*INIFAP CENID Fisiología, Ajuchitlan, Queretaro, Mexico*, [3]*Universidad Autonoma de Queretaro, Queretaro, Queretaro, Mexico*, [4]*Centro de Investigación en Alimentación y Desarrollo A.C., Mexico City, Mexico*.

The aim of this work was to evaluate the effect of oregano, cinnamon and chili pepper herbal extracts (HE) as growth promoters on live weight (LW), daily weight gain (DWG), daily feed intake (DFI) and feed conversion (FC) of pigs weaned at 19 days of age during 35 days (weaned stage) after weaning (divided into two feeding phases). Eighty-four pigs were randomly assigned to four treatments (tx): negative control (NC), diet with no growth promoter added; positive control (PC), diet with carbadox as growth promoter; negative control + 150 ppm of HE (NC150), diet NC with the addition of 150 ppm of HE; and negative control + 300 ppm of HE (NC300), diet with the addition of 300 ppm of HE. The pigs were distributed into 24 pens (three or four pigs/pen and six pens/tx). A randomized complete block design with covariable (initial weight) was used for the data analysis. The blocking factor was the week of weaning. The experimental unit was the pen for DFI and FC; and the pig for LW and DWG. Phase I lasted 14 days after weaning and Phase II for 21 days. The PC had higher LW (P < 0.001) compared with NC150, NC300 and NC (14.5 vs. 13.0, 12.5 and 11.9 kg, respectively). On week two of phase II, NC150, NC300 and PC showed higher DWG (P < 0.05) compared with NC (516.2, 477.9 and 525 vs. 398.8 g, respectively). The DFI for PC in both phases were higher (P < 0.05) compared with the rest of experimental groups. FC was lower (P < 0.005) for the NC300 and PC groups compared with NC and NC150 (2.0, 1.7 vs. 2.4 and 2.5, respectively) during phase I. In phase II, FC was lower (P < 0.005) in NC150, NC300 and PC compared with NC (1.3, 1.3, 1.4 vs. 1.6, respectively). The use of herbal extracts in young weaned pigs statistically imitates some of the parameters achieved when the antibiotic-origin growth promoter, carbadox, is used in the fed.

Key Words: Herbal Extracts, Growth Performance, Weaned Pigs

M87 Intestinal morphology of weaned pigs fed diets containing herbal extracts as growth promoters. G. Velazquez[1], A. G. Borbolla*[1], G. Mariscal-Landin[2], T. Reis de Souza[3], and A. Pinelli[4], [1]*Universidad Nacional Autonoma de Mexico, Mexico City, Mexico*, [2]*INIFAP CENID Fisiología, Ajuchitlan, Queretaro, Mexico*, [3]*Universidad Autonoma de Queretaro, Queretaro, Mexico*, [4]*Centro de Investigación en Alimentación y Desarrollo A.C., Mexico City, Mexico*.

The aim of this work was to evaluate the effect of herbal extracts (HE) used as growth promoters on villous height (VH) and crypt depth in the duodenum (D), jejunum (J) and ileum (I) of fifty-two weaned (22 d) pigs. At day of weaning (d 0), four pigs (d 0 pigs) were randomly chosen and slaughtered to obtain basal levels of VH and CD from D, J and I. The remaining pigs were randomly assigned to four treatments: negative control (NC), diet without any growth promoter; positive control (PC), diet with carbadox as growth promoter; negative control + 150 ppm of HE (NC150), NC diet with the addition of 150 ppm of HE; and negative control + 300 ppm of HE (NC300), diet with the addition of 300 ppm of HE. Pigs were allocated in 16 pens (four pens/treatment). A split plot experimental design was used for data analysis. At days 7, 14 and 21 postweaning, four pigs from each treatment were randomly killed to obtain intestinal samples. The experimental unit was the pig, and the analysis unit was the villous. Fourteen days after weaning, VH in D, J, and I of all pigs regardless of treatment decreased 60% (P < 0.01) when compared with the VH at d 0. At day 21, however, DVH (P < 0.05), JVH (P < 0.07) and IVH (P < 0.09) were highest for NC150. CD increased (P < 0.005) in all treatment groups regardless of treatment when compared to CD of pigs at d 0. CD in D and I were equal (P > 0.05) for all treatments at d 7 and d 14. JCD was the lowest (P < 0.05) in PC, NC150 and NC300. At d 21, DCD was similar (P > 0.05) among treatment groups. JCD was lowest (P < 0.01) in CN300 pigs when compared with CD of the PC pigs (95 vs. 130 µ). In I, NC150, NC300 and PC had the lower (P <

0.001) CD when compared with NC (100, 100 and 101 vs. 140 μ). HE can produce a faster recovery of the VH when supply in the diet of weaned pigs. Whether it will increase performance remains to be evaluated.

Key Words: Intestinal Morphology, Weaned Pigs, Herbal Extracts

M88 Effect of essential oils (Fresta F Conc®) supplementation on growth performance, immune response and fecal noxious gas of weaned pigs. J. H. Cho*[1], Y. J. Chen[1], B. J. Min[1], K. S. Son[1], H. J. Kim[1], O. S. Kwon[1], S. J. Kim[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Korea*, [2]*Yuhan Co.*, *Korea*.

Ninety six crossed pigs [(Duroc × Yorkshire) × Landrace] were used to determine the effects of essential oils (Fresta F Conc®) supplementation on growth performance, immune response and fecal noxious gas of weaned pigs. Treatments were: 1) CON (basal diet without antibiotics), 2) T1 [basal diet + 0.1% of CSP(CTC + Sulfathiazole + Penicillin)], 3) T2 (basal diet + 0.03% of Essential oils), and 4) T3 [basal diet + 0.1% of CSP (CTC + Sulfathiazole + Penicillin) + 0.02% of Essential oils]. For d 0 to 14, ADFI was increased in pigs fed T3 diet ($P < 0.05$). For d 14 to 28, pigs fed T3 diet had significantly increased ADG and ADFI compared to pigs fed CON diet ($P < 0.05$). For d 28 to 49, ADG in pigs fed T3 diet were higher than that of pigs fed CON diet ($P < 0.05$). For the entire experimental period, ADG and ADFI in pigs fed T3 diet were the highest compared to pigs fed CON and T1 diets ($P < 0.05$). Serum IgG concentration of T3 treatment was greater than that of others ($P < 0.05$). For d 0 to 14, volatile fatty acid (VFA) productions in pigs fed T2 diet were lower than those of pigs fed CON and T1 diets ($P < 0.05$). For d 14 to 28, propionic and butric acid productions of T2 treatment were the lowest among the treatments ($P < 0.05$). For d 28 to 49, Pigs fed T2 diet were the lowest in propionic acid and butric acid ($P < 0.05$). Overall, NH_3-N in pigs fed diets added essential oils was lower than pigs fed others ($P < 0.05$). For d 14 to 28, digestibility of dry matter in pigs fed T1, T2 and T3 diets was higher than that of pigs fed CON diet ($P < 0.05$) and T3 treatment was the highest on digestibility of nitrogen ($P < 0.05$). For d 28 to 49, digestibility of nitrogen in pigs fed T3 diet was the highest among others ($P < 0.05$). In conclusion, the results suggest that the dietary essential oils and antibiotics improve growth performance, IgG level and nitrogen digestibility and reduce noxious gas production in weaned pigs.

Key Words: Essential Oils, Weaned Pigs, Growth Performance

M89 The effect of dietary garlic and rosemary on grower-finisher pig performance and sensory characteristics of pork. S. Cullen, F. Monahan, and J. O'Doherty*, *University College Dublin*, *Ireland*.

The objective of this study was to investigate the effects of inclusion of rosemary (Rosmarinus officinalis) and garlic (Allium sativum) in pig diets on apparent nutrient digestibility, pig performance, carcass characteristics and sensory characteristics of the pork. Seventy individually fed grower finisher pigs (42 to 93 kg) were offered the following diets ad-libitum: (1) control diet (wheat, pollard and soya bean meal based), (2) control diet supplemented with rosemary at 1 g/kg (low rosemary; LR), (3) control diet supplemented with rosemary at 10 g/kg (high rosemary; HR), (4) control diet supplemented with garlic at 1 g/kg (low garlic; LG), and (5) control diet supplemented with garlic at 10 g/kg (high garlic; HG). The pigs offered the garlic diets (LG and HG) had a significantly lower feed intake ($P < 0.01$) and lower digestible energy intake ($P < 0.05$) compared to the pigs offered the control and rosemary (LR and HR) diets during the grower-finisher period. The pigs offered the garlic (LG and HG) diets had a significantly better food conversion ratio (FCR) ($P < 0.05$) than the pigs offered the control and rosemary (LR and HR) diets during the grower-finisher period. The pigs offered the high inclusion of garlic (HG) had a lower dry matter digestibility ($P < 0.05$) and organic matter digestibility ($P < 0.05$) than pigs fed the low garlic (LG) diet. The inclusion of high level of rosemary (HR) in the diet resulted in a lower gross energy digestibility and digestible energy content ($P < 0.05$) compared to the low rosemary (LR) inclusion. Sensory panellists found a significant difference ($P < 0.001$) in the sensory properties of cooked muscle from the control and HG treatments. In conclusion, the addition of garlic to the diets of grower-finisher pigs reduced feed intake and improved FCR while the addition of rosemary had no beneficial effects on growth performance and carcass characteristics.

Key Words: Pigs, Garlic, Rosemary

M90 Effect of a commercial essential oil on growth performance, intestinal microfloral colony and digestive enzyme activities in broiler chickens. I. S. Jang*, Y. H. Ko, H. Y Yang, S. Y. Kang, J. K. Jin, S. S. Jun, and C. Y. Lee, *Jinju National University*, *Jinju, Korea*.

The present study was designed to define whether a blend of commercial essential oils (EO) extracted from herbs could affect growth performance, antimicrobial activity and the functional activity of the gut in growing broiler chickens. A total of one hundred twenty 3-d-old male broiler chickens were fed a basal diet (CON), basal diet supplemented with 10 ppm antibiotics (ANTI), 25 ppm EO (EO I) or 50 ppm EO (EO II) until 35 days of age. As a result, there were no differences in BW, weight gain and FCR among the five groups of birds fed the corresponding diets throughout the entire experiment (3-35 days). The weights of internal organs including the liver, pancreas, intestine and mucosal tissues were not affected by the dietary treatments. The colony-forming units (CFU) of E. coli in the lower ileal-cecum of the birds fed the diet supplemented with EO was similar to that of birds fed the diet fortified with antibiotics without affecting the number of lactobacilli CFU. The activities of pancreatic trypsin and amylase, and intestinal maltase were significantly enhanced ($P < 0.05$) in the birds fed EO II diet compared with those fed CON or ANTI diets. It is concluded that dietary supplementation of a commercial EO causes a significant decrease in E. coli population and increase in digestive enzyme activities, suggesting that EO can be used as alternatives to antibiotics in broiler chickens.

Key Words: Essential Oils, Broiler, Digestive Functions

M91 Effect of dietary herb products (Animunin Powder®) on egg characteristic, blood components and nutrient digestibility in laying hens. K. S. Son*, O. S. Kwon, B. J. Min, J. H. Cho, Y. J. Chen, H. S. Kim, and I. H. Kim, *Dankook University*, *Cheonan, Korea*.

This study was conducted to investigate the effects of dietary Animunin Powder® on the egg quality characteristics, blood components and nutrient digestibility in laying hens. A total of two hundred seventy laying hens were randomly allocated into three treaments with fifteen replications for eight weeks. Dietary treaments included: 1) CON (Control), 2) AM1 (Control + 0.1% Animunin Powder®) and 3) AM2 (Control + 0.2% Animunin Powder®). During the period of 0-4 weeks, the birds fed the AM1 diet had an improved egg production rate compared to the birds fed the CON ($P < 0.05$). During the period of 4-8 weeks, the birds fed AM1 diet showed a statistically improved egg production rate compared to the control treatment ($P < 0.05$). No significant differences were founded in the egg weight ($P > 0.05$). During the period of 4-8 weeks, the hens fed the AM2 diet had improved egg yolk color compared to the hens fed CON and AM1 diets ($P < 0.05$). For the period of 0-4 weeks, haugh unit of the AM2 treatment showed significantly improved results compared to the control treatment ($P < 0.05$). Average egg shell breaking showed no significant differences through the experiment period, but in the period of 4-8 weeks the AM2 treatment tended to be improved compared to the CON and AM1 treatments ($P > 0.05$). There was no significant difference in egg shell thickness ($P > 0.05$). In the serum cholesterol, the AM1 and AM2 treatments were significantly lower than the control treatment ($P < 0.05$). The concentrations of RBC and WBC in the AM treatments tended to increase but there were no significant differences ($P > 0.05$). For the differences of lymphocytes between the end and initiation of the experiment, the hens fed the AM1 treatment were significantly different compared to the hens fed the CON and AM2 treatments ($P < 0.05$). During the period of the experiment, the hens fed the AM2 diet were tended to show higher DM digestibility than the hens fed the CON and AM1 diet, but it was not statistically different ($P > 0.05$). In conclusion, dietary Animunin Powder® could improve egg production rate, egg yolk color and haugh unit.

Key Words: Herb Products, Egg Quality, Bood Components

M92 Dietary nucleotides supplementation alleviates villus atrophy and improves immune response of early weaned piglets. D. Martínez-Puig*[1], E. Borda[1], E. G. Manzanilla[2], C. Chetrit[1], and J. F. Pérez[2], [1]*BIOIBERICA S.A.*, *Palafolls, Barcelona, Spain*, [2]*University Autònoma Barcelona*, *Barcelona, Spain*.

Transition from sow's milk to a solid food in the early weaned pigs is associated with a variable period of anorexia and the withdrawal of some micronutrients contained in milk. Dietary nucleotides are known to have an important role in cell division, cell growth and modulation of the immune system. As a first step, we studied the nucleotide composition in the milk from five 21-day lactating sows. The nucleotide content of the five milk samples analyzed was 102.8 ± 9.16 µmol/100 mL. Pyrimidines, in the form of 5'UMP and 5CDP, represented 85% of the total free nucleotides. A product based on this composition (Nucleoforce®) was administered to 36 early weaned piglets (21 d) dosed at 0, 1,000 and 2,000 ppm. On day 7 after weaning six animals per group were euthanized, and samples of jejunal mucosa were processed for histological measurements. Another group of six unweaned piglets were euthanized on day 27 of lactation as a positive control for histological measurements. No differences were found among treatments on average daily feed intake. Villus height was higher in the nursing pigs (448 µm) than in the control group (275 µm). The Nucleoforce® supplemented groups showed intermediate ($P < 0.001$) villous heights, 351 and 378 µm with the doses of 1,000 and 2,000 ppm, respectively. Similar results were observed in the measurement of the total surface area of the villi ($P < 0.001$) but no changes on crypt depth were observed between weaned and unweaned piglets or with the nucleotide supplementation. The absolute number of intraepithelial lymphocytes per villus increased ($P < 0.001$) with the dose of 1,000 ppm (12.7) and 2,000 ppm (14.9) compared with the control diet (10.2), showing a close relationship with the height of the villi. The overall results suggest that dietary supplementation of Nucleoforce® appears to alleviate postweaning villus atrophy.

Key Words: Nucleotides, Piglet, Villus Atrophy

M93 Effect of blended organic acids on growth performance and intestinal microflora of post weaning piglets. V. Bontempo*, R. Maiorano, A. Agazzi, B. Tonini, and G. Savoini, *Dept Veterinary Sciences and Technology for Food Safety*, *Milan, Italy*.

Organic acids have been investigated for many years as a potential alternative to prophylactic use of feed antibiotics in order to reduce post weaning lag and improve the performance of nursery pigs. However, their effects have been often found to be variable and more studies are necessary to evaluate the possible mechanism of action. The aim of this study was to determine the effect of dietary supplementation of blended organic acids on growth performance and intestinal equilibrium of post weaning piglets. One-hundred and sixty weanling piglets averaging 28 d of age and 8.9 ± 1.4 kg initial BW were fed one of two dietary treatments for 49 d after weaning: 1) Control diet (C), and 2) Control diet + organic acids blend (OA). Organic acids blend (Ascor chimici, Italy) consisted of fumaric acid, lactic acid, citric acid and malic acid and were included at 0.2% to starter diet. Diets contained no added antibiotic. Piglets were weighted at 0, 14, 28 and 49 d. On the same time faecal samples were collected from eight piglets per group and analysed for pH and microbial population. Feed consumed was recorded for each group for the whole nursery period. No significant differences were observed within the groups both in live weight and ADG considering the overall period. However, from 14 d to 28 d and from 28 d to 49 d, piglets fed the organic acids tended to grow faster (280 vs. 240 g/d and 510 vs. 480 g/d, respectively; $P \leq 0.07$) than control. No differences were observed for feed conversion between dietary treatments for any of the periods studied. Faecal pH was not influenced by treatment while fecal Lactobacillus populations tended to be increased by OA addition (16×10^8 vs. 9×10^8; $P \leq 0.08$). No differences were observed in the E. Coli populations. These results suggest that blended acidifiers may improve growth of piglets during starter period.

Acknowledgements: The authors are greatful to Dott. Paolo Cavassini, Ascor Chimici, Italy.

Key Words: Piglets, Nursery, Organic Acids

M94 Large bowel fermentation of resistant starch and conventional fiber supplements in the growing boar. T. C. Rideout*[1], Q. Liu[2], and M. Z. Fan[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Agriculture and Agri-Food Canada*, *Guelph, Ontario, Canada*.

We investigated the production of short-chain fatty acids (SCFA) and amino acid metabolites in the large intestine of pigs in response to the consumption of three varieties of resistant starch (RS) in comparison to conventional fiber supplements. Forty-two grower boars (initial BW, 30 kg) were fed an atherogenic basal (control) diet or the basal diet supplemented with 10% of resistant starch (Novelose^®^ 330; Novelose^®^ 240; and Avebe potato starch), guar gum (GG), or cellulose (Cell) for a period of 36 d according to a completely randomized block design. Consumption of GG enhanced the cecal production of isobutyric, butyric, isovaleric, and hexanoic acid and resulted in a higher ($P < 0.05$) total cecal SCFA concentration (104.24 ± 9.73 mg/g DM) in comparison to the control (64.11 ± 7.36 mg/g DM) and the Novelose 240 group (56.29 ± 9.73 mg/g DM). Pigs consuming Novelose 330 had a higher ($P < 0.05$) cecal concentration of butyric acid in comparison to the control group (11.89 ± 0.99 vs. 4.98 ± 0.84 mg/g DM). Cecal indole production was lower ($P < 0.05$) in pigs consuming Novelose 330 (0.04 ± 0.02 mg/g DM), Novelose 240 (0.04 ± 0.02 mg/g DM), and Avebe potato starch (0.02 ± 0.02 mg/g DM) in comparison to the control group (0.12 ± 0.01 mg/g DM). Consumption of the dietary fiber supplements did not ($P > 0.05$) affect SCFA or amino acid metabolite concentrations in the colon. In conclusion, the source and physiochemical properties associated with unique dietary fiber preparations differentially affect microbial fermentative activities in the cecum of pigs.

Key Words: Resistant Starch, Short-Chain Fatty Acids, Growing Boars

M95 Effect of gluconic acid on swine in vitro caecal fermentation. A. Piva*, E. Grilli, G. Biagi, and G. Casadei, *University of Bologna*, *Bologna, Italy*.

Gluconic acid (GA) derives from the incomplete oxidation of glucose by some *Gluconobacter* strains. When fed to monogastric animals, GA is poorly absorbed in the small intestine and can reach the lower gut where it is fermented to butyric acid. This study investigated the effect of GA on in vitro growth response and proteolytic state of swine caecal microflora. A diet for pigs (CP, 15.8%; DE, 15.0 MJ/kg) was predigested in vitro to simulate ileal digestion and later used as the substrate in the in vitro fermentation. Caecal content was collected from six pigs, diluted with buffer and used as inoculum. The inoculum was flushed with CO_2 and dispensed into five glass syringes and five vessels per treatment, containing predigested diet. Syringes and vessels were incubated at 39°C for 24 h. There were 6 treatments: control diet, or control diet with GA added at 2,000, 4,000, 6,000, 8,000, and 10,000 ppm. Gas production was measured recording the cumulative volume of gas produced every 30 min. Samples of fermentation fluid were collected from each vessel at time 0, 4, 8 and 24 h for ammonia and at time 24 h for short-chain fatty acids (SCFA) determination. During the 24 h caecal *in vitro* fermentation, total gas production and maximum rate of gas production were increased by all GA concentrations in a dose-dependent manner ($P < 0.001$). Ammonia in fermentation liquor was reduced by GA at 2,000 (26%; $P < 0.01$) and 4,000 ppm (17%; $P < 0.05$) after 4 h and at all concentrations ($P < 0.001$) after 8 h and 24 h, with the only exception of GA at 2,000 ppm. After 24 h of fermentation, total SCFA, acetic acid, butyric acid, acetic to propionic acid ratio, and acetic + butyric to propionic acid ratio were linearly increased in all GA treatments ($P < 0.001$). This study showed that GA can positively influence the activity of the swine caecal microflora controlling the proteolysis during the 24 h of fermentation moreover implementing the production of butyric acid which maintains the mucosal health status.

Key Words: Gluconic Acid, Microflora, Pig

M96 The effects of feeding trans-10, cis-12 and cis-9, trans-11 conjugated linoleic acid on broiler breeder growth. E. J. Clarke*[1], A. L. Lock[2], P. Garland[3], D. E. Bauman[2], and G. E. Mann[1], [1]*University of Nottingham*, *Sutton Bonington, Loughborough, UK*, [2]*Cornell University*, *Ithaca, NY*, [3]*BOCM Pauls*, *Tucks Mill, Burston, Diss, UK*.

Trans-10, cis-12 conjugated linoleic acid (CLA) has been shown to reduce body fat accretion in several species. In this study, we fed CLA to female broiler breeders and assessed the effects on growth rate, body fat and liver fatty acid composition. Thirty-two female Ross 308 parent stock 1-d old chickens were individually caged and fed either a standard control diet incorporating 3.5% soybean oil (n = 16) or a diet incorporating 3.5% CLA (Luta CLA-60; 30% c9, t11 CLA and 30% t10, c12 CLA; n = 16). Birds were reared under a modified version of the Ross parent stock management regime to maintain a growth rate in excess of the standard recommended regime. Experimental diets were fed from d 0 to d 49 during which time birds were weighed at weekly intervals and feed intake recorded so that feed conversion efficiency (FCE) could be calculated. At 49 d of age eight Control and eight CLA birds were slaughtered and body fat and liver fatty acid composition determined. The remaining eight Control and eight CLA birds were housed on a single floor pen and placed on a standard rearing diet with feed intake of 10-15% above the standard controlled intake regime until slaughter at 133 d of age. During CLA feeding (0 to 49 d) there was no difference in growth rate or FCE between the two groups. At d 49 there was no difference in total body fat (CLA, 9.4 ± 0.3%; Control, 9.6 ± 0.4%). However, there were significant treatment effects on liver fatty acid composition with elevations ($P < 0.001$) in 16:0 and 18:0 as well as c9 t11 CLA and t10 c12 CLA and reductions ($P < 0.001$) in 18:2 n-6, 20:2 n-6, 20:3 n-6, 20:4 n-6, 22:5 n-3 and 22:6 n-3 in the birds fed CLA. At d 133, after birds had all been fed the same diet, those previously fed CLA were significantly smaller than birds fed the Control diet (CLA, 2.63 ± 0.05 kg; Control, 2.83 ± 0.07 kg; $P < 0.05$). However, there was no difference in body fat (CLA, 6.9 ± 0.5%; Control, 6.2 ± 0.4%) or liver fatty acid composition. The results suggest that feeding of CLA during early life can affect subsequent growth through a mechanism that may not involve differences in body fat.

Acknowledgements: CLA was donated by BASF AG, Ludwigshafen, Germany and chickens by PD Hook, UK

Key Words: Conjugated Linoleic Acid, Chickens, Growth

M97 The effect of omega-3 fatty acids on sow and litter performance. S. A. Meers*, C. R. Dove, and M. J. Azain, *University of Georgia*, *Athens*.

The objective of this study was to determine the effects of feeding a diet containing n-3 fatty acids during late gestation and(or) lactation on sow reproductive performance. The study was designed as a 2 x 2 factorial arrangement with main effects of feeding n-3 fatty acids in the Gestation diet (G) and(or) Lactation diet (L). Diets were corn-SBM based diets such that the G diet was calculated to contain approximately 3,290 kcal ME, 13% CP and, 0.78% lysine, while the L diet was calculated to contain 3,242 kcal ME, 17.5% CP and, 1.15% lysine. Omega-3 fatty acids, supplemented in the form of a protected n-3 product (Fertilium^®^, United Feeds, Sheridan, IN), added to the G or L diet resulted in a shift of the n-6/n-3 ratio from approximately 20 in the Control to 13 in the Omega-3 G diets and 13 to 10, respectively, in the L diets. Sows (n = 44) were allocated by parity to either the Control or Omega-3 diet at approximately d 60 of gestation. Sows were moved to the farrowing barn on d 110 and switched to the L diet, with half of the sows in each dietary treatment maintained on the same treatment and half switched to the other diet (Control or Omega-3). Litters were weaned at an average of 21 d and sows were maintained on their respective experimental diet through re-breeding. Nursery performance of the progeny was monitored to 35 d post weaning. Gestation diet had no effect on sow performance through gestation. However, there was a main effect of G diet on feed intake during the lactation period. During lactation, sows fed the Control diet during gestation had greater consumption (7.2 kg/d) than those fed Omega-3 diet (6.4 kg/d, $P < 0.02$). Pigs from sows fed Omega-3 L diet, challenged with LPS at d 14, showed a trend for attenuated temperature change and body weight loss. Additionally, those sows fed Control diet during gestation weaned heavier litters (63.7 kg) than sows fed Omega-3 diet (54.24 kg, $P < 0.05$). While there is need for continued work in this area, it is apparent that feeding a diet containing Omega-3 fatty acids during late gestation had an effect on sow feed intake, and thus litter performance during lactation.

Key Words: Sow, Performance, n-3 Polyunsaturated Fatty Acid

M98 Blood analytes and performance of lactating sows fed diets added with $NaHCO_3$. J. Cruz[1], A. G. Borbolla*[1], J. Bouda[1], and G. Mariscal[2], [1]*Universidad Nacional Autonoma de Mexico*, *Mexico City, Mexico*, [2]*INIFAP CENID Fisiología*, *Ajuchitlan, Queretaro, Mexico*.

Thirty-six primiparous sows were used to determine the effect of $NaHCO_3$ on productive performance and blood analytes during 21 days of lactation. The sows were randomly distributed in three treatments (n = 12): the control diet (C); the control diet containing 0.5% of $NaHCO_3$ (0.5%); and the control diet with 1% of $NaHCO_3$ (1%). At farrowing and lactation, the body weight (BW), backfat thickness at 10th and 13th rib, and the size (LS) and weight of litter were recorded. On 3rd, 12th, and 21st days of lactation, the concentrations of glucose, urea, total proteins, albumin, free fatty acids, electrolytes (Na+, K+, Cl-) and creatine kinase in blood serum were determined. The values of pH, blood pCO_2, HCO_3 and base excess were determined in heparinized blood between the 10th and 12th days of lactation. The results were analyzed using the multivariate analysis of variance for the repeated measures and a randomized complete model to determine the effect of experimental diets on blood analytes, acid-base status, and productive performance. The BW of sows and the LS were used as covariables. The use of $NaHCO_3$ in the diet increased ($P < 0.001$) the daily feed intake (DFI) (5.21, 5.02, and 4.28 kg for treatments 0.5%, 1% and C, respectively) without affecting other variables of the productive performance. Blood pH was also increased ($P < 0.02$) in sows with the addition of 1% $NaHCO_3$ in diet compared with the C (7.41 vs. 7.36). The addition of $NaHCO_3$ tended ($P < 0.08$) to decrease the blood pCO_2, but the values of base excess and HCO_3 were not affected. The biochemical analytes of serum did not show changes of tissue mobilization; however, the free fatty acids indicated a higher ($P < 0.01$) mobilization of lipids in the C diet compared with the other experimental diets (0.617, 0.074, and 0.127 mmol/L for groups C, 0.5% and 1%, respectively). The addition of $NaHCO_3$ in sow diets is an alternative for the DFI stimulation in primiparous sows, and it may have a possible role in decreasing fat tissue mobilization.

Key Words: Lactating Sows, $NaHCO_3$, Feed Intake

M99 Effects of supplemental inulin on utilization of iron in corn-soy diet by young pigs for hemoglobin synthesis. K. Yasuda*[1], K. R. Roneker[1], D. D. Miller[1], R. M. Welch[2], and X. G. Lei[1], [1]*Cornell University*, *Ithaca, NY*, [2]*USDA/ARS US Plant Soil & Nutrition Laboratory*, *Ithaca, NY*.

Inulin is a blend of fructan chains found in nature as plant storage carbohydrates and may exert nutritional and health-promoting effects in the large intestines. The objective of this study was to determine if supplemental inulin improved bioavailability of iron from a corn-soy based diet to young pigs. A total of 14 weanling pigs (7.63 kg BW) were divided into two groups and fed the corn-soy based diet (without inorganic iron added, total iron = 61 mg/kg) or the diet supplemented with 4% inulin (Raftline HP, Orafti, Tienen, Belgium) for 6 weeks. Weight gain, blood hemoglobin concentration, and hematocrit of individual pigs were measured weekly. Daily feed intake of individual pigs was also recorded. Compared with those fed the basal diet, pigs fed the inulin-supplemented diet had 17% higher (11.6 vs. 13.6 g/dL, $P < 0.01$) final blood hemoglobin concentration and 17% greater (18.9 vs. 22.2%, $P < 0.03$) overall hemoglobin repletion efficiency. Growth performance and hematocrit were similar between the two treatment groups. In conclusion, supplemental 4% inulin in the corn-soy diet improved dietary iron utilization by young pigs.

Acknowledgements: Supported in part by a grant from Harvest-Plus, International Food Policy Research Institute, Washington, D.C.

Key Words: Inulin, Iron, Pigs

M100 Efficacy of pantothenic acid as a modifier of body composition in a porcine model of obesity development. C. A. Baldwin* and T. S. Stahly, *Iowa State University*, *Ames*.

Pantothenic acid (PA) in amounts above that needed to maximize body growth has been determined at our station to effectively reduce fat tissue accretion in growing pigs. In the current study, the efficacy of PA to minimize fatty tissue accretion in a porcine model of obesity development was determined. Heavy weight pigs (154 kg BW, 27% body fat) were allotted to one of four dietary regimens (17 individually penned barrows/treatment) consisting of a basal diet (8 ppm PA) supplemented with 0, 80, 800, 8,000 ppm added PA. The basal diet consisted of a dietary nutrient mix representative of the American diet (34% of calories from fat), and was provided at daily caloric intakes equivalent to 1.8 times each animal's maintenance needs for 144 days. A state of obesity development occurred over the duration of the study. Specifically, pigs accrued 73 kg of body weight, of which 48% was fat tissue (determined by DEXA analysis). BW gains and BW gain/feed ratios were not altered by PA additions. Fat tissue content of BW gain responded quadratically to increasing PA additions. Specifically, fat tissue content was reduced by 3.2 percentage units by a ten fold addition of PA (80 ppm) but was increased by 2.2 and 1.4 percentage units by 100- and 1,000-fold additions (800 and 8,000 ppm) of PA, respectively. The 80 ppm addition is equivalent in dosage (mg PA ingested/kcal of dietary energy expended) to that observed to reduce body fat accretion in growing pigs fed a high starch diet ad libitum. Hepatic ACO, ACC, and FAS mRNA expression (six pigs/treatment) did not differ between the 0 and 8,000 ppm supplemented PA diets. Based on these data, PA is not an efficient modifier of body composition in a porcine model of obesity development induced by a high fat dietary regimen.

Key Words: Pantothenic Acid, Pigs, Obesity

Nonruminant Nutrition: Mannan-Oligosaccharides, Yeast Culture, and Probiotics

M101 Effects of feeding galactomannan oligosaccharides on growth performance, immune response and intestinal microflora in newly-weaned pigs. Z. P. Hou[1], Y. L. Yin*[1,2], E. A. Jeaurond[2], H. Namkung[2], and C. F. M. de Lange[2], [1]*The Chinese Academy of Sciences*, *Changsha, China*, [2]*University of Guelph*, *Guelph, Ontario, Canada*.

One hundred and twenty newly-weaned piglets (15-19 days old; four pigs per pen; six pens per treatment) were used to investigate the effect of feeding galactomannan oligosaccharides (GMOS; from sesbania gum, containing 20% galactose and 15% mannose) on growth performance, immune response and intestinal microflora. Five dietary treatments were: basal diet (control), medicated diet (control + 110 ppm lincomycin), and three dietary inclusion levels of GMOS (control + 0.1%, 0.2%, or 0.3%). The inclusion of lincomycin in the diet did not influence any of the response criteria ($P > 0.10$), except for intestinal microflora. During week 1 post-weaning, ADG (80 vs. 45 g/d on control vs. 0.3% GMOS; SE, 29) and ADFI (141 vs. 110 g/d on control vs. 0.3% GMOS; SE, 28) decreased linearly ($P < 0.05$) with increasing dietary GMOS level. After week 1 and over the 4-week experimental period, ADG (290 vs. 286 g/d on control vs. 0.3% GMOS; SE, 43) and ADFI (448 vs. 412 g/d on control vs. 0.3% GMOS; SE, 47) did not differ between treatments ($P > 0.10$). On day 4 post-weaning, blood serum levels of IgA (70 vs. 87 mg/dL on control vs. 0.3% GMOS; SE, 5.6), IgG (285 vs. 401 mg/dL on control vs. 0.3% GMOS; SE, 12.5), and IgM (155 vs. 273 mg/dL on control vs. 0.3% GMOS; SE, 13.6) increased linearly ($P < 0.01$) with dietary GMOS level. On day 14 post-weaning, serum Ig levels were not influenced by feeding GMOS ($P > 0.10$). Based on PCR-DGGE analysis, diversity of microflora in ileal digesta was increased by feeding GMOS and reduced by feeding lincomycin as compared to the control. These results indicate that dietary GMOS increases humoral immunity and microbial diversity in the ileum of newly-weaned pigs but reduces feed intake and growth performance during the first week post-weaning.

Key Words: Piglet, Galactomannan Oligasaccharides, Immune Response

M102 Effect of adding a mannanoligosacchride product on performance of nursery pigs fed diets with or without antibiotics. H. Yang*[1], J. Less[2], T. Shipp[3], T. Radke[1], M. Cecava[1], and D. Holzgraefe[1], [1]*ADM Alliance Nutrition*, *Quincy, IL*, [2]*ADM Specialty Feed Ingredients*, *Decatur, IL*, [3]*ADM Animal Health and Nutrition*, *Quincy, IL*.

The objective of this study was to evaluate the effect of a mannanoligosacchride (MOS) product (CitriStim™) on performance of nursery pigs fed diets with or without antibiotics (AB). Weanling pigs (n = 144; 4.56 kg BW) were blocked by initial weight and assigned to one of four dietary treatments (trt), with six pens per trt and six pigs per pen. The trts were a 2 x 2 factorial arrangement, with two levels of MOS (0 vs. 0.2% CitriStim™) and two levels of AB (0 vs. 55 ppm Carbadox). ADG, ADFI and G/F were measured throughout four phases ending at d 7, 14, 28, and 41. Feeds were pelleted in the first two phases and meal thereafter. No interactions (Int) of ADG and ADFI were observed between MOS and AB ($P > 0.05$), indicating they could have an additive effect. MOS improved ADG ($P < 0.05$) and ADFI ($P < 0.05$) from d 0 to 14 and numerically improved ADG and ADFI from d 0 to 41. Although AB did not affect performance from d 0 to 14 ($P > 0.10$), it improved overall ADG ($P < 0.10$) and ADFI ($P < 0.05$). AB did not have a significant effect on G/F from d 0 to 14 and d 0 to 41 ($P > 0.55$). However, MOS tended to improve G/F from d 0 to 14 and d 0 to 41 ($P < 0.11$). MOS dramatically improved G/F in medicated diets but had minimal effects on G/F in non-medicated diets, resulting in an interaction for overall G/F ($P < 0.10$). In summary, MOS and AB improved ADG and ADFI and an interaction of G/F might exist between MOS and AB.

MOS	-	+	-	+		P Value		
AB	-	-	+	+	SE	MOS	AB	Int
End Weight, kg	21.80	22.01	22.36	23.49	0.51	0.213	0.067	0.390
ADG, g (d 0 to 14)	233	260	233	278	14	0.020	0.519	0.507
ADG, g (d 0 to 41)	419	426	435	462	13	0.201	0.060	0.434
ADFI, g (d 0 to 14)	278	309	289	307	11	0.044	0.735	0.557
ADFI, g (d 0 to 14)	278	309	289	307	11	0.044	0.735	0.557
ADFI, g (d 0 to 14)	278	309	289	307	11	0.044	0.735	0.557
ADFI, g (d 0 to 14)	278	309	289	307	11	0.044	0.735	0.557

Key Words: Pigs, Mannanoligosaccharide, Antibiotics

M103 Effect of dietary mannan-oligosaccharides and(or) organic zinc on growth performance and prevalence of post-weaning diarrhoea in piglets. M. Castillo*[1], G. Ferrini[1], E. G. Manzanilla[1], J. Roquet[2], J. A. Taylor-Pickard[3], J. F. Pérez[1], and S. M. Martín-Orúe[1], [1]*Departament de Ciència Animal i dels Aliments, Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*, [2]*Probasa*, *Barcelona, Spain*, [3]*Alltech Biotechnology Centre*, *Summerhill, Sarney, Ireland*.

The efficacy of Mannan-oligosaccharide (MOS) and organic zinc (Zn) to enhance performance and prevent diarrhoea in early-weaned pigs was evaluated. A total of 128 piglets, weaned at 20 ± 2 days were housed in 32 pens following a complete randomized design. Animals received four dietary treatments: a control diet (CT) to which 0.2% of a commercial source of MOS (Bio-Mos^® Alltech Inc, USA; BM), 0.08% organic Zn (Bioplex-Zn™ Alltech Inc, USA; BP) or both additives (BMP) were added. The experiment lasted for 5 weeks including a pre-starter period of two weeks and a starter period of three weeks.

At the end of the pre-starter period, animals were challenged by a controlled stress (room temperature at 17°C and feed deprival for 10 hours). Body weight was individually recorded each week and daily feed intake recorded during the first week, and weekly thereafter (by pen). Faecal consistency was monitored once a day throughout the first 21 days. Feed intake and average daily gain were not different between dietary treatments. All additives improved feed efficiency during the starter period compared to control (0.63, 0.69, 0.67 and 0.68 for CT, BM, BP and BMP, respectively; $P < 0.05$). Differences in faecal consistency between treatments were mostly manifested during the first week. At day four, more than 87% of pens with CT diet showed faecal inconsistence, whereas the rest of diets percentages ranged 37-50%. BM showed the fastest recovery from post-weaning diarrhoea with no animal with faecal inconsistence at the end of the first week ($P < 0.05$). Results suggest that the use of MOS or organic Zn can both improve the adaptation of the weaning pig to the dry food, thus reducing the incidence of post-weaning diarrhoea. This was also manifested by an increase in the feed efficiency ratio.

Key Words: Mannan-Oligosaccharides, Organic Zinc, Weaning Pig

M104 Influence of *Bacillus subtilis* supplementation on egg quality, blood characteristics and fecal NH_3-N in laying hens. H. J. Kim*, J. S. Yoo, O. S. Kwon, B. J. Min, K. S. Son, J. H. Cho, Y. J. Chen, and I. H. Kim, *Department of Animal Resource & Science, Dankook University*, *Cheonan, Korea*.

This study was conducted to investigate the effect of *Bacillus subtilis* on the egg quality, blood characteristics and fecal NH_3-N in laying hens. A total of 252 laying hens were randomly allocated to three treatments with seven replications for six weeks. Dietary treatments included: 1) CON (basal diet), 2) BS0.2 (basal diet + 0.2% *Bacillus subtilis*), and 3) BS0.4 (basal diet + 0.4% *Bacillus subtilis*). For overall period, hen-day egg production tended to increase by 0.4% *Bacillus subtilis* in the diets. However, there was no statistically significant difference ($P > 0.05$). Egg weight, egg shell breaking strength, egg shell thickness, haugh unit, yolk color unit and egg yolk index were not significantly different ($P > 0.05$). However, egg weight and egg shell breaking strength in the BS0.2 treatment tend to increase without statistically significant difference ($P > 0.05$). Difference of egg yolk index in laying hens fed *Bacillus subtilis* supplemented diets were different ($P < 0.05$). The concentrations of red blood cell and white blood cell were not different ($P > 0.05$). NH_3-N concentration in feces with BS0.4 treatment was lower than control ($P < 0.05$). In conclusion dietary *Bacillus subtilis* could decrease fecal NH_3-N.

Key Words: *Bacillus Subtilis*, Egg Quality, Ammonia-N

M105 Effect of milk supplementation with *Lactobacillus brevis* 1E1 on immune cell numbers in the small intestine of piglets. E. A. Halbrook*[1], C. V. Maxwell[1], D. C. Brown[1], M. E. Davis[1], and T. Rehberger[2], [1]*University of Arkansas*, *Fayetteville*, [2]*Agtech Products, Inc.*, *Waukesha, WI*.

An experiment was conducted to determine the effect of milk supplementation with *Lactobacillus brevis* 1E1, a direct-fed microbial, on immune cell numbers in the gastrointestinal tract of pigs. Litters were allotted to two treatments at farrowing: 1) control milk supplement and 2) milk supplement with 1E1. To determine the effect of a direct-fed microbial on the enteric immune system, cells with the following cell surface molecules were quantified in jejunal and ileal sections: CD2 (70% T cells), CD4 (helper T cells), CD8 (cytotoxic and/or natural killer cells), Interleukin-2 receptor (activated T and B cells), Monocyte/Granulocyte, and Major Histocompatability Complex Class II (MHC II; antigen presenting cells). Tissue sections were collected from four pigs/treatment at 5 d prior to weaning, weaning (22.5 ± 0.42 d of age) and 5 d post-weaning. Tissues were frozen and stained for immunohistochemical evaluation. Positively stained cells were counted within 10 randomly selected villi per section. There were no differences ($P > 0.10$) in the number of immune cells within the ileum due to dietary treatment. However, within the jejunum, the number of cells positive for CD2 were lower in pigs supplemented with 1E1 ($P < 0.05$) than control pigs. Pigs supplemented with 1E1 also tended to have a lower ($P = 0.07$) number of cells positive for MHC II in the jejunum than those fed the control diet. Pigs supplemented with 1E1 had no changes ($P > 0.10$) in the number of cells positive for CD4 in the jejunum over the sampling period, whereas, CD4 positive cells increased ($P < 0.05$) at weaning in control pigs, followed by a decrease 5 d after weaning ($P = 0.10$, treatment x time interaction). These data indicate that supplementation of 1E1 to pigs prior to weaning may reduce the number of antigen presenting cells and T cells (especially T helper cells) within the jejunal section of the intestinal tract, which could lead to decreased activation of the gut immune system.

Key Words: Immune System, Lactobacillus, Swine

M106 A quantitative micro-anatomical study to explain the effects of probiotics (*Pediococcus acidilactici*) upon growth performances of weaning piglets. A. Di Giancamillo[1], G. Savoini[1], V. Bontempo*[1], V. Dell'Orto[1], E. Chevaux[2], and C. Domeneghini[1], [1]*Department of Veterinary Sciences and Technologies for Food Safety*, *Milan, Italy*, [2]*Lallemand*, *Blagnac cedex, France*.

The gut offers a great potential for the induction of changes in its microhabitat with possible positive effects on health and productivity. Nowadays research interest is focused in the improvement of defined physiological functions by the use of additives, such as probiotics, that can act producing competitive exclusions of pathogens or harmful antigens in the gut. The aim of this study was to determine the effect of dietary supplementation of Bactocell® on some morpho-functional aspects of the gut in post-weaning piglets. Two hundred weanling piglets averaging 25 d of age and 7.0 ± 0.5 kg initial BW were assigned to two dietary treatments to determine the effects of supplementation with *Pediococcus acidilactici* (Pa) on growth. Piglets were fed one of two liquid dietary treatments for 42 d after weaning: 1) Control (C), and 2) Control diet + Pa (1×10^{10} cfu/g; P). Piglets were weighted and faecal samples were collected at 0, 14 and 42 d. At 42 d post-weaning, 16 animals (eight per group) were sacrificed and both small (ileum) and large (caecum) intestine were histologically examined. Histometry was performed by villi and crypts measurements. Histochemical analysis were performed to investigate the mucin profile of the ileum, while immunohistochemical analysis was used to visualize proliferating epithelial cells and to identify mucosal macrophages. No significant difference in growth was observed within groups. Faecal *Lactobacillus* populations were increased by Pa addition compared to C diet (27×10^8 cfu/g vs. 10×10^8 cfu/g; $P \leq 0.05$). Diet affected gut morphometry of the P animals: histometrical analysis resulted in an increase in villi height (327 µm vs. 300 µm; $P \leq 0.01$) and crypts depth (287 µm vs. 247 µm; $P \leq 0.01$) of the ileum, as well as an increase in the caecum crypts depth (423 µm vs. 387 µm; $P \leq 0.05$). A thicker mucous gel layer in the ileum of C piglets was also observed (2.95 µm vs. 2.35 µm; $P \leq 0.01$). The addition of Pa to piglets diet resulted in greater concentration of beneficial bacteria and in positive effect of gut structure.

Key Words: Gut, Probiotic, Weaning

M107 Effects of dietary *Enterococcus faecium* on growth performance, nutrients digestibility, hematological change and fecal noxious gas content in finishing pigs. Y. J. Chen*, O. S. Kwon, B. J. Min, K. S. Son, J. H. Cho, H. J. Kim, and I. H. Kim, *Dankook University*, *Cheonan, Korea*.

The objective of this study was to investigate the effects of feeding probiotic (*Enterococcus faecium*, EF) on growth performance, nutrients digestibility, hematological change, and fecal noxious gas content in finishing pigs. A total of eighty Landrace × Yorkshire × Duroc pigs with an initial BW of 50.47 ± 2.13 kg were used in this 8-week experiment. Pigs were allotted to four treatments (five replicates per treatment and four pigs per pen) according to a randomized complete block design. Dietary treatments were: 1) CON (control; basal diet), 2) CTC (control diet + 0.1% antibiotic, CTC), 3) EF1 (control diet + 0.1% probiotic, EF) and 4) EF2 (control diet + 0.2% probiotic, EF). During 0-4 weeks, ADG increased slightly in treatment groups without significant difference ($P > 0.05$). In 4-8 weeks, ADG was increased significantly in EF1 treatment compared to CON treatment ($P < 0.05$). ADFI and gain/feed were not affected in

each 4-week period and entire experimental period (P > 0.05). Digestibility of DM was higher in EF2 treatment than CON and CTC treatments (P < 0.05). N digestibility also increased in EF2 treatment compared to CTC treatment (P < 0.05). Hematology characteristics of WBC, RBC and Lymphocyte were not affected by pigs fed diets with *Enterococcus faecium* (P > 0.05). Supplementation of SF in diet decreased fecal ammonia nitrogen (NH_3-N) concentration (P < 0.05). Also, fecal acetic acid, propionic acid and butyric acid concentrations were lower in diets added 0.1% EF than pigs fed diet added antibiotic (P < 0.05). In conclusion, dietary EF can increase growth performance, nutrients digestibility and decrease fecal NH_3-N and volatile fatty acid (VFA) concentration in finishing pigs.

Key Words: *Enterococcus Faecium*, Performance, Finishing Pigs

M108 Effect of supplemental mixed yeast culture and antibiotics on growth performance of weaned pigs. Y. W. Shin, J. G. Kim*, and K. Y. Whang, *Korea University*, *Seoul, Korea*.

The objective of this investigation was to examine the effect of supplemental mixed yeast culture (YC) and antibiotics (AB) on growth performance of weaned pigs. Thirty-six weaned pigs weighing about 5.8 kg were allotted to six dietary treatments with six replications based on sex, litter and body weight. Pigs were adapted to individual crates and dietary treatments before the initiation of the experiment. The experiment was designed in a 2 × 3 factorial arrangement with two levels of AB and three levels of YC. Dietary treatments were; 1) Basal diet (B, no antibiotics), 2) B + 0.1% YC, 3) B + 0.2% YC, 4) B + 0.2% AB, 5) B + 0.2% AB + 0.1% YC, and 6) B + 0.2% AB + 0.2% YC. Basal diet was formulated to meet the 1998 NRC requirements and contained 3,435 kcal/kg ME, 24.7% CP, 1.7% lysine, 0.95% Ca, and 0.75% P. Diets were offered two times a day (0800 and 1800). After 4 hours, any leftover was collected, dried in a dry-oven at 70°C for 12 h, and weighed to determine the feed intake. Body weights of pig were measured every three days, and feed intake was calculated everyday. The ADG of pigs was not different until six days of experiment, however, pigs in 0.2% AB or 0.1%, 0.2% YC treatments tended to grow faster than pigs in other treatments. During day 7 to 15, ADG was significantly increased as levels of YC and AB were increased (P < 0.05). Feed consumption tended to be higher in AB or YC treatments than those in other treatments. The FE was not different for the first six days of experiment. From day 7 to 15, pigs in AB or YC treatments utilized dietary nutrients better than pigs in other treatments (P < 0.05). The results of this study demonstrated that supplementation of YC could improve growth and efficiency in weaned pigs, and synergistic effect was also expected when YC was supplemented with AB.

Effect of supplemental mixed yeast culture and antibiotics on growth performance of weaned pigs

AB	0%			0.2%				
YC	0%	0.1%	0.2%	0%	0.1%	0.2%	SEM	Effect
ADG 0-6 (g/d)	232	235	265	228	259	315	14	
ADG 7-15	396^{cd}	405^{c}	436^{d}	396^{cd}	405^{cd}	547^{a}	13	AB, YC, AB × YC
ADG 0-15	359^{ab}	344^{ab}	383^{b}	329^{c}	347^{ab}	446^{a}	11	YC, AB × YC
ADFI 0-6 (g/d)	348	335	347	331	369	436	16	
ADFI 7-15	609	663	705	662	40	748	21	
ADFI 0-15	516	510	568	540	569	631	18	
FE 0-6 (g/kg)	748	762	792	714	678	793	31	
FE 7-15	676^{ab}	665^{ab}	620^{ab}	619^{ab}	553^{b}	739^{a}	20	AB × YC
FE 0-15	694	694	694	634	618	761	21	

^{a,b,c,d}P < 0.05

Key Words: Yeast Culture, Growth Performance, Weaned Pig

M109 Effect of supplemental mixed yeast culture and antibiotics on nitrogen balance of weaned pigs. Y. W. Shin, J. G. Kim*, and K. Y. Whang, *Korea University*, *Seoul, Korea*.

An experiment was conducted to determine the effect of supplemental mixed yeast culture (YC) and antibiotics (AB) on the nitrogen retention of weaned pigs. Thirty-six weaned pigs (BW = 11.36 ± 0.94 kg) were allotted to six treatments with six replications. This experiment was designed in a 2 X 3 factorial arrangement with two levels of AB and three levels of YC. Dietary treatments were: 1) Basal diet (B, no antibiotics), 2) B + 0.1% YC, 3) B + 0.2% YC, 4) B + 0.2% AB, 5) B + 0.2% AB + 0.1% YC, and 6) B + 0.2% AB + 0.2% YC. Basal diet was formulated to meet the 1998 NRC requirements and contained 3,435 kcal/kg ME, 24.7% CP, 1.7% lysine, 0.95% Ca, and 0.75% P. Pigs were adapted to new environment for three days. Feed allowance was 600 g/d that was about 80% of average feed intake for the adaptation period. Pigs were offered 300 g of diet every 12 hours for the experimental period. One volume of water was mixed with feed to reduce feed wastage and to facilitate feed consumption. Chromic oxide, 0.2% of diet, was used as an indicator. Feces, urine, and refused feed were collected and recorded on daily basis. Collected feces and urine were stored at -20°C until the end of trial, and then mixed according to individual pigs. Feces and urine from each pig were sub-sampled and analyzed. Average daily gain of pigs did not differ, however, it was numerically increased as YC supplementation was increased. Dry matter intake, N intake, fecal N excretion, and N digestibility were similar among treatments. Addition of YC tended to decrease the urinary N excretion, and increase the retained N, but these were not significantly different. Retained N over N intake also tended to increase when YC was supplemented. The results of this experiment suggested that YC supplementation to the starter diets could improve N utilization and this improvement could be higher if AB is added.

Effect of supplemental mixed yeast culture and antibiotics on nitrogen balance of weaned pigs

AB	0%			0.2%			
YC	0%	0.1%	0.2%	0%	0.1%	0.2%	SEM
ADG (g/d)	407.7	474.0	487.5	411.1	421.6	501.1	17.7
DMI (g/d)	563.1	564.3	567.5	553.2	590.7	562.1	2.1
N intake (g/d)	23.5	23.6	23.6	23.1	23.6	23.6	0.1
Fecal N (g/d)	1.9	2.1	2.0	2.1	1.9	2.0	0.1
Urinary N (g/d)	3.7	3.1	3.3	3.0	2.9	2.3	0.2
Retained N (g/d)	17.9	18.4	18.2	17.9	18.7	19.2	0.2
Retained N/N intake (%)	76.3	78.1	77.2	78.0	79.6	51.6	0.8
Digestibility (%)	91.8	91.3	91.4	90.9	92.0	91.4	0.5

Key Words: Yeast Culture, Nitrogen Retention, Weaned Pig

M110 Effect of supplemental mixed yeast culture and antibiotics on fecal characteristics of weaned pigs. Y. W. Shin, J. G. Kim*, and K. Y. Whang, *Korea University*, *Seoul, Korea*.

This study was done to investigate the effect of supplemental mixed yeast culture (YC) and antibiotics (AB) on the fecal characteristics of weaned pigs. Thirty-six weaned pigs (BW = 5.8 ± 0.51 kg) were used for a 15 day growth trial, and fecal samples were taken from all individual pigs at the end of experiment. The experiment was designed in a 2 x 3 factorial arrangement with two levels of AB and three levels of YC. Dietary treatments were; 1) Basal diet (B, no antibiotics), 2) B + 0.1% YC, 3) B + 0.2% YC, 4) B + 0.2% AB, 5) B + 0.2% AB + 0.1% YC, and 6) B + 0.2% AB + 0.2% YC. Basal diet was formulated to meet the 1998 NRC requirements and contained 3,435 kcal/kg ME, 24.7% CP, 1.7% lysine, 0.95% Ca, and 0.75% P. Diets were offered twice a day (0800 and 1800). Serial dilution method was used to enumerate the population of coliform and yeast in fecal samples. Ten volume of deionized water was added to measure the fecal pH. Daily collected fecal and urinary samples were proportionally mixed to make artificial slurry. Ammonia concentration was measured by using indophenol method. The population of coliform was not affected by supple-

mentation of AB or YC, but slightly decreased in AB added treatments. Supplementation of YC increased the population of yeast and AB was also helpful to increase the population of yeast in feces ($P < 0.05$). Fecal pH was lower in AB added treatments than other treatments ($P < 0.05$). The AB added treatments also had a lower ammonia concentration than other treatments in an artificial slurry ($P < 0.05$). The more ammonia reduction was observed when AB and YC were supplemented together ($P < 0.05$). These results indicated that supplement of AB and YC could increase the population of yeast and decrease pH in feces. They were also helpful to reduce the ammonia emission from slurry.

Effect of supplemental mixed yeast culture and antibiotics on fecal characteristics of weaned pigs

AB	0%			0.2%				
YC	0%	0.1%	0.2%	0%	0.1%	0.2%	SEM	Effect
Microflora (CFU/g of feces)								
Coliform	11.6	11.2	10.3	9.7	10.1	10.1	0.2	
Yeast	6.9^{b}	7.2^{b}	7.6^{b}	7.1^{b}	8.3^{a}	8.3^{a}	0.2	AB, YC
Fecal pH	8.3^{a}	8.2^{a}	8.2^{a}	7.6^{b}	8.0^{ab}	7.8^{ab}	0.1	AB
Ammonia concentration (mM/g of artificial slurry)								
0 h	21.3^{a}	21.1^{ab}	19.8^{ab}	19.5^{ab}	19.4^{ab}	16.1^{b}	0.7	AB
8 h	70.2^{a}	58.8^{b}	59.1^{b}	58.1^{b}	35.0^{c}	56.8^{b}	3.0	AB, YC, AB × YC
24 h	91.1^{a}	67.5^{b}	70.6^{b}	79.2^{ab}	47.0^{c}	66.6^{b}	4.0	AB, YC

$^{a,b}P < 0.05$

Key Words: Yeast Culture, Feces, Weaned Pig

M111 Evaluation of yeast culture concentrates in weanling pig diets. A. Balfagon*[1], M. D. Lindemann[1], G. L. Cromwell[1], and G. Keller[2], [1]*University of Kentucky*, *Lexington*, [2]*Varied Industries Corporation (Vi-Cor)*, *Mason City, IA*.

Two experiments involving a total of 78 crossbred weanling pigs were conducted to compare two yeast culture concentrates (YCC) in nursery diets. A basal diet was formulated in both Phase I (Wk 1 & 2) and Phase II (Wk 3 & 4) to which the products (YCC-1: Diamond V XP™, Diamond V Mills Inc., Cedar Rapids, IA and YCC-2: A - Max™ concentrate, Varied Industries Corp., Mason City, IA) were included at 1%. In Exp. 1, six pens of pigs (21 d of age and 7.6 kg BW) were used in a preference test. The feeder location was switched three times each week to obviate behavioral or pen location effects on feed selection. The ratio of diets consumed during each phase and for the total experiment was calculated and analyzed using an unpaired t-test with Welch's correction procedure. While there was a slight numerical favor for the YCC-2 during Phase I (53.0% vs. 47.0%, respectively) and for the YCC-1 during Phase II (55.9% vs. 44.1%), there was no difference ($P > 0.10$) between treatments, with each yeast product accounting for about 50% of the feed intake for the individual and overall periods (YCC-1: 52.7%; YCC-2: 47.3%). In Exp. 2 (the performance test), 50 pigs (21 d of age and 7.1 ± 0.7 kg BW) were allotted in a randomized complete block basis (five pens/trt with five pigs/pen). The performance for the total experiment was: ADG - 410 and 425 g/d; ADFI - 621 and 619 g/d; and F/G - 1.514 and 1.467, respectively, for YCC-1 and YCC-2. There were no significant differences ($P > 0.10$) between products for any weekly period or for the total experimental period. In conclusion, there were no manifest preference or performance differences between the two YCC products.

Key Words: Preference, Weanling Pig, Yeast Culture

M112 Digestibility of CP, AA, and energy in a novel yeast product by pigs. H. H. Stein*[1], M. L. Gibson[2], M. G. Boersma[1], and C. Pedersen[1], [1]*South Dakota State University*, *Brookings*, [2]*Dakota Gold Research Association*, *Sioux Falls, SD*.

Two experiments were conducted to measure the digestibility of CP, AA, and energy in a novel yeast product that was produced by extraction from ethanol by-product streams. In Exp. 1, eight barrows that were equipped with a T-cannula in the distal ileum were randomly allotted to a 2-period switch-back design and fed a yeast-based diet and a N-free diet. Both diets were provided in daily amounts equivalent to three times the energy requirement for maintenance. Ileal digesta were collected from the cannulae and the standardized ileal digestibility coefficients (SID) for CP and AA were calculated. Results of this experiment showed that the SID for CP was 74.8%. The SID for Lys, Met, Thr, Trp, Ile, Leu, and Val were 82.2, 88.6, 71.1, 82.2, 79.5, 84.0, and 74.5%, respectively. The average SID for all indispensable AA was 81.4% while the average for the dispensable AA was 75.5%. Exp. 2 was designed to measure the concentration of DE and ME in the yeast product. Six growing barrows were placed in metabolism cages and randomly allotted to a 2-period switch-back design. A corn-based diet (98% corn, 2% vitamins and minerals) was formulated. A second diet consisting of 40% yeast and 60% of the corn-based diet was also formulated. Both diets were supplied in a daily amount equivalent to 2.5 times the energy requirement for maintenance. Collections of feces and urine were performed and the energy balance for each of the two diets was calculated. The energy concentration in the corn was calculated from the corn-based diet while the energy concentration in the yeast was calculated from the corn-yeast diet using the difference method. Results of this experiment showed that the concentration of DE and ME in yeast (5,600 and 5,350 kcal per kg DM, respectively) is higher ($P \leq 0.001$) than in corn (4,071 and 3,992 kcal per kg DM, respectively). It is concluded that the yeast product extracted from ethanol by-product streams has a high digestibility of AA and a high concentration of energy. This product may be well suited as an energy and AA source in diets for swine.

Key Words: AA Digestibility, Pigs, Yeast

Physiology and Endocrinology I

M113 Desert climatic effects on freezability and some biochemical constituents of Barki ram semen. M. Zeitoun*[1] and K. El-Bahrawy[2], [1]*Alexandria University*, *Alexadria, Egypt*, [2]*Mariyout Research Station, Desert Research Center, Ministry of Agriculture*, *Alexandria, Egypt*.

This study utilized 12 mature fertile Barki rams located in the Maryout Research Station. Semen was collected during June â•“ August (summer season, 1999) and during December â•“ March (winter season, 1998). Semen was collected using an artificial vagina with 0.5 ml Tris buffer in the collection tubes (1:1 dilution). Semen sampler were diluted and packed in straws (0.25ml) and frozen (-196°C) in liquid nitrogen. Data on physical characteristics of semen were recorded (volume, motility, % crsosome integrity, % dead and live, pH, concentration and % abnormality). In addition, seminal plasma of both seasons was harvested and Na+, K+, free amino acids and total protein were determined. Also, SDS-PAGE was conducted to characterize the peptide fractions of seminal plasma of both seasons. Results indicated higher ($p<0.05$) post-thaw (0h) motility in winter (44.1%) than in summer (17.2%) ejaculates, whereas at 4 hrs. post-thaw the percent intact acrosome approached 72.3% and 65.9% for summer and winter ejaculates, respectively. Moreover, percent dead and abnormal spermatozoa were higher ($p<0.05$) in post-thaw spermatozoa of summer than winter ejaculates. Sodium concentration was not different between summer and in winter, however K+ concentrations was higher ($p<0.05$) in winter (71.7 ppm) than in summer (47.3 ppm) ejaculates. This resulted in different K+/Na+ ratio between the two seasons. Total protein was found to be as much twice (14.0g/dL) in summer as in winter (7.7g/dL). The glutamic acid and glycine were higher in winter than summer semen. The SDS-PAGE exhibited two more peptide fractions (330 and 24 kDa) in winter than summer seminal plasma. The total number of peptide fractions was 14 in winter and 12 in summer.

Key Words: Climate, Semen, SDS-PAGE Protein

M114 The effects of Pulsatilla miniplex® administrations on some blood values in dairy cows. F. S. Hatipoglu*[1], M. S. Gulay[1], M. Findik[2], S. Aslan[2], C. Altinsaat[2], and G. Atintas[2], [1]*Akdeniz University*, *Antalya, Turkey*, [2]*Ankara University*, *Ankara, Turkey*.

The experiment was designed to evaluate the effects of Pulsatilla miniplex® (Pm), a female constitution substance with hormone like effect for treatment of sterility, on red blood cell count (RBC), packed cell volume (PCV), hemoglobin (Hb), erythrocyte sedimentation rates (ESR), leukocyte count (WBC), WBC profiles and mean corpuscular hemoglobin concentrations (MCHC). Multiparous Holstein cows (3 to 5 year old) were assigned to control (C; n=21) and experimental (TRT; n=21) groups after the first blood sampling at 30 d prior to expected calving days and kept under the same management conditions. The first subcutanous Pm application (10 ml) was done at the postpartum 2nd hr (d 0) to cows in TRT group, whereas no Pm was administered to cows in C group. Consecutive blood samples were collected from vena jugularis immediately before each Pm administrations on 0, 15, 25, 35 days of postcalving. No significant differences were detected in mean PCV (C=30.5 ± 0.6 vs. TRT=30.1 ± 0.6 %), Hb (C=10.8 ± 0.3 vs. 10.9 ± 0.3 g %), ESR (17.3 ± 0.9 vs. TRT=17.5 ± 0.9 mm/h), lymphocyte (C=55.9 ± 2.7 vs. TRT=50.7 ± 2.7 %), monocyte (C=2.43 ± 0.4 vs. TRT=2.52 ± 0.4 %), neutrophile (C=38.7 ± 2.7 vs. 40.1 ± 2.7 %) or MCHC (C=35.5 ± 0.9 vs. TRT= 36.3 ± 0.9 g/100ml). On the other hand, mean RBC (C=6.0 ± 0.3 vs. 6.3 ± 0.3X10^6/µL; P<0.09), WBC (C=9.06 ± 0.37 vs. 8.15 ± 0.38 x 10^3/µL; P<0.1), basophile (C=0.27 ± 0.14 vs. TRT=0.62 ± 0.14 %; P<0.01), and eosinophile (C=2.75 ± 0.9 vs. TRT=6.19 ± 0.9%; P<0.01) were significant. Overall, the parameters examined remained within the physiological range in both groups. In conclusion, Pm injections after calving did not cause any negative effect on the blood parameters tested in this study.

Key Words: Pulsatilla Miniplex, Blood Parameters, Dairy Cows

M115 Estrogens and isoflavones affect porcine muscle satellite cell growth. C. Rehfeldt*, M. Mau, and T. Viergutz, *Research Institute for the Biology of Farm Animals*, *Dummerstorf, Germany*.

The role of estrogens and estrogen-like compounds, such as dietary phytoestrogens, in pig skeletal muscle growth is largely unknown. The aim of this study was therefore to investigate the effects of estrogens and isoflavones on porcine muscle satellite cell growth in vitro. Myogenic cells were derived from M. semimembranosus of new born piglets, typified for muscle cell specific proteins (desmin, N-CAM) and grown in culture. The effects of different concentrations of 17β-estradiol (0.1 nM; 1 nM; 1µM), estrone (1 nM; 1µM), and of genistein and daidzein (0.1; 1; 10; 100 µM) on DNA synthesis measured as 6 h-[^{3}H] thymidine incorporation (dpm/DNA) were determined in serum-free growth medium. After 7 h (1+6 h) exposure both 17β-estradiol and estrone slightly decreased DNA synthesis (-4 to -7%). Slight decreases were also observed in response to 1 and 10 µM genistein (-5; -10%) and to 0.1, 1, 10, and 100 µM daidzein (-3 to -13%), whereas 100 µM genistein (-74%) substantially lowered DNA synthesis. Associated decreases in cell number (DNA) were observed with 100 µM genistein (-8%) and daidzein (-6%). No signs of apoptosis were observed by cell cycle analysis of cultures exposed to 1 and 10 µM genistein and 17β-estradiol (0.1 nM; 1 nM; 1µM). The results suggest that both estrogens and isoflavone phytoestrogens may directly affect porcine muscle cell growth with the effects being dose-dependent.

This study was supported by the Deutsche Forschungsgemeinschaft (DFG; Re 978-11).

Key Words: DNA Synthesis, Cell Culture, Myogenic Cells

M116 Use of milk oestradiol in conjunction with milk progesterone analysis to quantify reproductive function in dairy cows. D. V. Scholey, N. R. Kendall*, A .P. F. Flint, and G. E. Mann, *University of Nottingham*, *Sutton Bonington Campus, Loughborough, UK*.

While milk progesterone measurement can be used to identify the timing of luteolysis and the postovulatory progesterone rise, it reveals nothing about the characteristics of the follicular phase. The general pattern of follicular phase events entails an increase in oestradiol followed by a fall, triggered by the LH surge, which preceded ovulation. Thus the follicular phase fall in milk oestradiol can be used as an indicator of the LH surge and subsequent ovulation. In this study we have developed a milk oestradiol assay and used it, in conjunction with milk progesterone analysis, to characterise the follicular phase in 24 multiparous lactating dairy cows. Milk samples were collected at daily intervals and analysed for progesterone by ELISA. Based on milk progesterone data, daily samples from the follicular phase period of low progesterone were then analysed for milk oestradiol. Milk was first defatted by centrifugation and surface fat removal. To extract oestradiol, defatted milk was passed through a C18 SepPak cartridge, washed with distilled water and the oestradiol eluted with acetone. The extract was then dried down and resuspended in buffer prior to radioimmunoassay. The mean interval from progesterone fall (to <3ng/ml) to progesterone rise (to >3 ng/ml) was 9.0±0.3 days (range 7-12 days). Within this 9 day period, the interval from luteolysis to the preovulatory oestradiol fall was 4.6±0.2 days (range 3-7 days) and from the oestradiol fall to the postovulatory progesterone rise 4.4±0.2 days (range 3-7 days). Peak milk oestradiol concentrations of 4.0±0.3pg/ml (range 2.0-6.6 pg/ml) were achieved within 3.0±0.2 days (range 2-6 days). Following this peak oestradiol fell to 1.9±0.2pg/ml (range 0.8-4.0pg/ml). We have successfully used milk oestradiol analysis to noninvasively characterise the timing of follicular phase events. Using this approach we are able to obtain far more information than is available following milk progesterone measurement alone.

Acknowledgements: Funded by Defra, Milk Development Council and Intervet under the Link Sustainable Livestock Programme.

Key Words: Milk Oestradiol, Milk Progesterone, Cow

M117 Effect of dietary phosphorus on reproductive function and performance of Holstein cows. S. K. Tallam*, A. D. Ealy, K. A. Bryan, and Z. Wu, *Pennsylvania State University*, *University Park*.

The objective was to determine the effect of dietary P on postpartum resumption of luteal function, response to ovulation synchronization, and reproductive performance. Fifty-four multiparous Holstein cows were assigned at calving to diets containing 0.35 or 0.47% P. Resumption of normal ovarian function was monitored three times weekly by ultrasonography, beginning 10 d after parturition until the end of a 60-d voluntary waiting period. Cows were subsequently synchronized and bred using the Ovsynch protocol. Dietary P did not affect the number of days to first postpartum ovulation or corpus luteum development. Peak serum progesterone concentration for estrous cycles during the voluntary waiting period did not differ, although there was a tendency for greater luteal phase serum progesterone concentration for the 0.35% P group during the first estrous cycle. The ovulation synchronization rate was 61.5 and 69.2% for the 0.35 and 0.47% P groups, respectively, uninfluenced by diet. The overall pregnancy rate at 200 d of lactation (60.9 and 60.0%) and the number of services per pregnancy (2.1 and 1.9) did not differ between groups. Serum P concentration increased (from 6 to 7 mg/dl) with dietary P during the first 3 mo postpartum. Mean milk yield during the first 40 wk of lactation did not differ, averaging 40.5 and 39.0 kg/d for the two groups. Fecal P content measured during the first 16 wk of lactation averaged 0.63 and 0.89% for the 0.35% and 0.47% P groups, respectively. Varying dietary P from 0.35 to 0.47% did not affect resumption of luteal function, response to ovulation synchronization, or reproductive performance.

Item	0.35% P	0.47% P	SEM	*P*
Days to first progesterone increase (> 1 ng/ml)	35.0	40.5	4.4	0.38
Days to first progesterone increase (> 1 ng/ml)	35.0	40.5	4.4	0.38
Number of ovulations (1 to 60 DIM)	1.4	1.3	0.2	0.68
Number of ovulations (1 to 60 DIM)	1.4	1.3	0.2	0.68
Duration of estrous cycle, d	21.0	18.8	1.0	0.12
Duration of estrous cycle, d	21.0	18.8	1.0	0.12
Peak serum progesterone[a], ng/ml	11.2	9.8	1.0	0.35
Peak serum progesterone[a], ng/ml	11.2	9.8	1.0	0.35
Luteal phase progesterone[b], ng/ml	8.1	5.6	1.1	0.12
Luteal phase progesterone, ng/ml	8.1	5.6	1.1	0.12

[a]For estrous cycles during 1-60 DIM; [b]First estrous cycle; [c]First service.

Key Words: Dairy Cows, Phosphorus Requirement, Reproductive Performance

M118 Progesterone (P4) Concentrations and Ovarian Response after Insertion of a New or a 7 d Used Intravaginal P4 Insert (IPI) in Proestrus Lactating Cows. R. L. A. Cerri*, H. M. Rutgliano, R. G. S. Bruno, and J. E. P. Santos, *University of California*, *Tulare*.

Cyclic Holstein cows were synchronized with GnRH followed 7 d later by PGF2a, and randomly assigned to a New (1.38 g of P4; n=31) or a 7-d Used autoclaved IPI (n=31) inserted 48 h after PGF2a injection for 7 d. Blood was sampled at PGF2a injection, daily during IPI treatment, and at 0, 15, 30, 45, 60, 90, 120 and 180 min relative to IPI insertion and removal. Plasma was analyzed for P4 by a validated EIA assay and intra and inter-assay CV were 6.5 and 7.1%, respectively, with a sensitivity of 0.06 ng/mL. Ovaries were examined by ultrasonography at the GnRH and PGF2a injections, daily during IPI treatment, and after IPI removal, when the cow was in estrus and 48 h later. Progesterone concentrations and size of follicles were analyzed by ANOVA using the MIXED procedure of SAS, and estrus and ovulation by the Logistic procedure of SAS. Milk yield and BCS did not influence P4 concentrations. Plasma P4 concentrations increased from 0.18 to 0.78 ng/mL in the first 15 min after IPI insertion, but achieved a plateau (0.9 ng/mL) at 90 min. Concentrations of P4 in the first 180 min tended to be greater (P=0.10) for Used than New IPI (0.90 vs 0.77 ng/mL). Concentrations of P4 decreased daily, but the New IPI sustained slightly greater (P=0.04) P4 concentration (0.67 vs 0.78 ng/mL). On d 7, all cows had P4 <1 ng/mL. After removal of IPI, P4 dropped to basal concentrations by 90 min and no difference was observed between treatments. During d 1 to 7, only 18.8 and 16.8% of the plasma samples from New and Used IPI cows, respectively, were greater than 1 ng/mL (P=0.62). Primiparous had consistently greater (P<0.05) P4 concentrations than multiparous throughout the study. Six New and 8 Used IPI cows ovulated in the first 48 h of insertion, likely as a consequence of a LH surge prior to insertion. After IPI removal, estrus, ovulation, double ovulation, days to estrus and ovulation did not differ between treatments (P>0.15). Both New and Used IPI resulted in similar, and mostly subluteal (<1 ng/mL), P4 concentrations in lactating dairy cows, but prevented ovulation during proestrus.

Key Words: Intravaginal Progesterone Insert, Dairy Cows

M119 Behavioral and endocrine responses to estradiol-17b (E) in ovariectomized Holstein cows. P. Reames*, T. Hatler, and W. Silvia, *University of Kentucky*, *Lexington*.

Ovariectomized Holstein cows (n=7) were used to characterize responses to estradiol-17b (E) when infused at rates to maintain concentrations within physiological ranges. The experiment was conducted in 8 replicates using 3-7 cows/replicate. Cows were pretreated with CIDRs 6 days prior to the start of infusion with E (d -6). CIDRs were removed after 72 h (d -3). E infusions were initiated on d 0. Each cow received an i.v. injection of E at one of 5 doses (designated doses 0, 1, 2, 3, 4): 0, 3, 6, 9 or 12 ng/kg bw, respectively. These doses were calculated to result in 0, 3, 6, 9 or 12 pg/ml in blood. Cows then received i.v. infusions of E at rates of 0, 6, 12, 18 or 24 ug/kg bw/h for 8 h to maintain the concentration. Additional cows (n=1or2/replicate) received an injection of E (500 µg; i.m.) for estrus detection. Cows were brought together for visual estrus detection (30 min) at 10, 12 h post infusion, then at 4 h intervals for 48 h. Estrus was defined as accepting a mount > 2 times during the observation period. Venous blood samples were collected at 2-h intervals throughout the experimental period to quantify LH. This experiment was considered a randomized design. Effects of cow, replicate and dose were tested for by ANOVA. Seven cows received dose 4 and all showed estrus. Five cows received dose 0 (one of them twice). Six cows received dose 1. None of these cows showed estrus. Five cows received each dose at least once. Three showed estrus at doses 2, 3 and 4. Two only showed estrus at dose 4. Thus, cows may differ in the amount of E needed to induce estrus. Of the cows that showed estrus, duration was less for dose 2 (8.8 h) than for dose 4 (17.1 h; P<0.05), indicating that the duration of estrus is dose dependent. The onset of estrus tended to be later for dose 2 (19.6 h) than for dose 4 (13.6 h; P<0.10). The magnitude of the LH surge was less for doses 2 and 3 than for dose 4 (P<0.05), however the timing of the LH surge (after start of infusion) was not different among doses (P>0.4). Thus, estrus in cows receiving dose 2 was shorter and delayed in onset, relative to the timing of the LH surge, compared to cows receiving dose 4.

Key Words: Cow, Estrus, LH

M120 Bovine uterine temperature measured by novel IC thermometer placed in the uterotubal junction. S. Kamimura*[1], E. Kurataki[1], N. Roa Avila[1], K. Hamana[1], K. Morita[1], and I. Shibata[2], [1]*Kagoshima University*, *Kagoshima, Japan*, [2]*Sanyo Electric*, *Tokyo, Japan*.

Physio-environments in bovine uteri have not been adequately reported due to the limitations in methodology. Objective of the study was to measure bovine uterine temperature (UT) by novel IC thermometer (IC). Data was compared with conventional rectal (RT) and vaginal temperature (VT). IC is a chip housed in a button shaped stainless steel enclosure, 17 mm in length, 5mm in width with a range of +15 to +46 C in 0.125 C increments. It was calibrated with a standard mercury thermometer, and was also correlated with a rectal thermometer installed with a thermistor sensor probe (0.1 C precision). UT was measured in 20 min intervals for 4 weeks, while RT and VT was measured every 4 hr. Japanese Black cows, 8 cows in the summer and 3 cows in the winter were subjected to caesarian section (CS). IC was installed in the left uterine horn proximate to the uterotubal junction during CS by trans-lumbar laparotomy. After 4 weeks recording, IC was removed by 2nd CS and mounted on the chip reader in the PC. The accumulated data was analyzed by ANOVA for repeated measures. Ambient temperature (AT) was simultaneously recorded. In 5 cows, blood was daily collected for hormonal assay and underwent ultrasonography to monitor ovarian dynamics. Temperature after operation was temporarily elevated for 4 days (0.14 C) and excluded. Averages in UT, RT and VT in the summer (AT: 28.76 C) were 38.57±0.23 C, 38.67±0.23 C, 38.60±0.35 C, and those in the winter (AT: 14.46 C) were 38.63±0.21 C, 38.68±0.21 C, 38.67±0.20 C, respectively. UT was significantly lower than RT or VT, and UT in the summer was lower than in the winter (P<0.01). Diurnal rhythm was observed at all three temperatures, lowest at 08:00 and highest at 20:00. Upon ovulation, UT in the luteal phase was significantly higher (38.61±0.20 C) than in the follicular phase (38.51±0.22 C, P<0.01), whereas no difference was observed in RT or VT. In conclusion, IC placed in the uterotubal junction successfully measured UT and detected diurnal rhythm. UT fluctuation was stable, but showed luteal hyperthermia.

Key Words: IC Thermometer, Uterine Temperature, Cows

M121 Cloning and characterization of adsf/resistin in korean native cow. J. Park, H. Kang, C. Y. Lee, and Y. S. Moon*, *Jinju Nation University*, *Jinju, Gyung Nam, Korea*.

Adipocyte-specific secretory factor (ADSF)/resistin is a small cysteine-rich protein secreted from adipose tissue and ADSF has been implicated in modulating adipogenesis in human and rodents. The objective of this study was to clone a gene encoding ADSF/resistin and to characterize its function in Korean Native Cow. The coding sequence was 330 base pairs and it encoded a protein of 109 amino acids. An NCBI BLAST-search revealed the cloned cDNA fragment shared significant homology (82%) with the cDNA encoding the human ADSF/resistin. The nucleotide sequence homology of the Korean cow was 68% and 64% for the rat and mouse, respectively. Homology between Korean cow and Genbank deposit sequences of bovine ADSF/resistin was 98% for the nucleotide sequence and 99% for the amino acid sequence. A high frequency of single nucleotide polymorphism was identified in intron 3 but not in any other exons or introns of ADSF. Further studies are required to analysis the association between the polymorphisms and carcass traits in the cow. Tissue distribution of ADSF mRNA was examined in liver, skeletal muscles (sirloin, rump), subcutaneous fat, and retroperitoneal fat by RT-PCR. ADSF mRNAs were detected in fat tissues but not in liver and muscles, suggesting that ADSF/resistin expression may be induced during adipogenesis. Although, the physiological function of ADSF/resistin in cow remains to be determined, these data indicate ADSF is related to the adipocyte phenotype and may have a possibly regulatory role in adipocyte function.

Key Words: Adsf/Resistin, Adipocyte, Cow

M122 Repeatability estimate for embryo survival following insemination at PG-induced heats in beef heifers. M. G. Diskin* and J. M. Sreenan, *Teagasc Research Centre*, *Athenry, Co. Galway, Ireland*.

Embryo survival rate is a major determinant of reproductive efficiency in dairy and beef herds. Data form this laboratory and elsewhere shows that embryo death, before about day 16 of gestation, is the major cause of low cow conception rate. There is some evidence of repeatable differences between animals in their ability to establish and sustain pregnancy and of genetic variability for heifer pregnancy rate and dairy cow sustainability. However, the endocrine, molecular and genetic basis for these apparent differences in embryo survival rate have not been established. The initial objective of this study was to establish repeatability estimates for embryo survival rate in heifers. A total of 69 reproductively normal heifers was used. Each heifer was artificially inseminated (AI) on 4 occasions over a 9-month period using the following regimen. Initially estrus was synchronised using a 2-injection prostaglandin (PG) regimen and heifers were inseminated at 6-12 hours after observed standing estrus (day 0). Heifers were ultrasonically scanned for pregnancy on days 28 and 35. All pregnant heifers received PG on day 35 to induce embryo loss. Six weeks after the induced embryo loss all heifers were reprogrammed using a 2-injection PG-regimen, inseminated and scanned as described above and a similar schedule was followed for a further two rounds of AI. Frozen-thawed semen from one high-fertility bull was used for all AI. Repeatability estimates were derived from an analysis of variance as the intraclass correlation among records on the same individual in different rounds. Conception rate was similar (P>0.05) for each round of AI with an overall rate of 63%. Based on results to-date a repeatability estimate of 0.18 ± 0.003 for embryo survival following a PG-induced heat was recorded. This analysis indicates that embryo survival has low to moderate repeatability.

Key Words: Embryo, Survival, Repeatability

M123 Reproductive performance following estrous synchronization of Angus, Brahman and Angus x Brahman crossbred cows. L Praharani*[1], D. O. Rae[2], and T. A. Olson[2], [1]*Research Institute of Animal Production*, *Bogor, Indonesia*, [2]*University of Florida*, *Gainesville*.

This study evaluated reproductive parameters and timed-artificial insemination (TAI) responses in heifers and cows of differing proportions of Angus and Brahman breeding following estrous synchronization using Synchromate-B (SMB). It was conducted at the Beef Research Unit, University of Florida. Data from 564 heifers and 1,257 cows consisting of 276 Angus (A), 387 Brahman (B), 250 (75%A:25%B), 422 (50%A:50%B), 277 (25%A:75% B), and Brangus (62.5%A:37.5%B) from 1991 through 1997 were analyzed using the PROC GENMOD procedure. The model included the fixed effects of year of breeding, age of cow, body condition score, breed type of cow, and breed type of sire with days from calving to synchronization date as a covariate plus all two-way interactions. Year of breeding, body condition score, and breed type of cow all affected estrus expression rate, pregnancy rate, and calving rate (P<0.01) and age of cow affected pregnancy rate (P<0.01). Few Brahman cows exhibited estrus on the first day after implant removal (P<0.01). The estrus expression, pregnancy and calving rates obtained from estrous synchronization using SMB and TAI were moderate to high. Results showed that the Brahman female reproductive performance was comparable to Angus and their crossbreds. Gestation length of cows was influenced by year of breeding, breed type of cow, and age of cow (P<0.01). Gestation length ranged from 282.1 days to 289.4 days; Angus cows had the shortest gestation length (P<0.01) and Brahman, the longest (P<0.01). There was a positive trend between percentage of Brahman breeding in the cows and gestation length. The introduction of Brahman-bred, particularly in subtropical regions, is important in improving beef cattle productivity because of their subtropical adaptive traits. However, the tendency for high proportion Brahman-bred cows to have longer gestation lengths is of concern, despite reproductive performance similar to Angus cows.

Key Words: Reproductive Performance, Estrous Synchronization, Cows

M124 The Crestar® protocol with estradiol benzoate, PGF2α, PMSG or GnRH to control estrus cycle and ovulation in beef cows. R. J. C. Moreira[1], A. V. Pires*[1], D. Z. Maluf[1], E. H. Madureira[2], M. Binelli[2], J. R. Gonçalves[3], L. G. Lima[3], and I. Susin[1], [1]*ESALQ/University of São Paulo*, *Piracicaba, SP, Brazil*, [2]*FMVZ/University of São Paulo*, *Pirassununga, SP, Brazil*, [3]*FEALQ*, *Londrina, PR, Brazil*.

The objective of this study was to evaluate the effects of using PMSG, GnRH, estradiol benzoate or PGF2α in combination with Crestar® protocol and AI at fixed time on ovulation of beef cows. Three hundred and forty-eight multiparous cows, crossbreed Nelore (Bos taurus indicus) X Charolais (Bos taurus taurus), were divided in two groups: 179 suckling cows and 169 non-suckling cows. Cows received the Crestar® protocol for follicular growth synchronization consisting of a subcutaneous implant with 3mg of norgestomet and 3mg of norgestomet plus 5mg of estradiol valerate injection (day of implant insert). Implants were removed after nine days. Cows were submitted to one of five treatments for pharmacological control of ovulation and were artificially inseminated at fixed time. Experimental treatments were: T1 (n=70): injection of physiological solution 48h after implant removal (D12); T2 (n=68): 0.75mg of estradiol benzoate 24h after implant removal (D11); T3 (n=70): 150μg of PGF2α at same day of implant removal (D9) and 0.75mg of estradiol benzoate 24h after implant removal (D11); T4 (n=70): 500 UI of PMSG at implant removal (D10) and T5 (n=70): 500μg of GnRH 48h after implant removal (D12). Cows were artificially inseminated 54-56h after implant removal. Pregnancy rate was analyzed by logistical regression program. There were no differences (P>0.05) on pregnancy rate among treatments (35.7, 31.4, 22.0, 37.0 and 42.8% for T1, T2, T3, T4 and T5, respectively).

Key Words: Nelore, Pregnancy Rate

M125 Conception rates and serum progesterone concentration in dairy cattle administered gonadotropin releasing hormone five days after artificial insemination. J. M. Howard*[1], R. Manzo[1], J. C. Dalton[2], and A. Ahmadzadeh[1], [1]*University of Idaho*, *Moscow*, [2]*University of Idaho*, *Caldwell*.

The objective of this study was to determine the effect of administration of exogenous GnRH five days after artificial insemination (AI) on serum progesterone concentration and conception rates in dairy cattle. In experiment 1, 23 Holstein cows were synchronized using the Ovsynch protocol. Five days after

AI (d 0) cows were assigned randomly to receive either saline (CON; n = 11) or 100 ug GnRH (GnRH; n = 12). To examine ovarian structures, ultrasonography was performed on d -1 and every other day beginning on d 5 until d 14. On d 5 and d 14 blood samples were obtained to measure serum progesterone concentrations. All cows in the GnRH-treated group developed an accessory corpus luteum (CL), whereas cows in the CON group did not. Mean serum progesterone concentrations did not differ between GnRH and CON groups on d 5 (1.64 ± 0.46 ng/ml vs. 2.04 ± 0.48 ng/ml). On d 14 serum progesterone concentrations were higher ($P < 0.05$) in the GnRH group compared to CON (5.22 ± 0.46 ng/ml vs. 3.36 ± 0.48 ng/ml). In Exp. 2, 542 lactating cows, at two different commercial dairies, were used to test the effect of administering GnRH 5 d after AI on conception rates. Cows were synchronized and detected for estrus according to tail chalk removal. Cows detected in estrus received AI immediately. Five days after AI, cows were assigned randomly to receive either GnRH (n= 266) or saline (n = 276). Pregnancy status was determined by palpation per rectum approximately 40 d after AI. Conception rates did not differ between GnRH and CON groups at either location (26.7% GnRH vs. 24.3% CON). Regardless of treatment, days in milk, parity, milk yield, and number of services had no effect on the odds ratio of pregnancy. In summary, the results of this study indicated that GnRH administered 5 d after AI increased serum progesterone by developing an accessory CL but did not improve conception rates in dairy cattle.

Acknowledgements: Authors would like to express thier appreciation to merial for the product support.

Key Words: GnRH, Progesterone, Conception Rate

M126 Evaluation of progestagen implants reutilization on pharmacological control of estrus cycle and ovulation in beef cows. D. Z. Maluf[1], A. V. Pires*[1], R. J. C. Moreira[1], E. H. Madureira[2], M. Binelli[2], J. R. Gonçalves[3], L. G. Lima[3], and I. Susin[1], [1]*ESALQ/University of São Paulo*, *Piracicaba, SP, Brazil*, [2]*FMVZ/University of São Paulo*, *Pirassununga, SP, Brazil*, [3]*FEALQ*, *Londrina, PR, Brazil*.

Two hundred and twenty-one (78 suckling by 40 to 90 days) Nelore (Bos taurus indicus) X Charolais (Bos taurus taurus) cows were used to evaluate the reutilization of progestagen implants to control pharmacologically the estrus cycle and ovulation. Cows were randomly assigned to one of three protocols for estrous synchronization and artificial insemination in pre-fixed time. In treatment 1 (T1; n=73) cows were implanted with Crestar® (3 mg de norgestomet); in treatment 2 (T2; n=75) cows were implanted with Crestar®, already used in a previous synchronization; and in treatment 3 (T3; n=73) cows received two Crestar® implants, also previously used, both placed side by side in the same ear. All cows were injected with an intramuscular (i.m.) dose of 2 mL of progesterone (25mg/mL) + estradiol benzoate (1mg/mL) at the time of implants insertion (D0). Implants were removed after 8 days (D8) and an i.m. dose of Preloban® (150µg of D-cloprostenol) was administered. Twenty-four hours after implants removal, cows were i.m. injected with a dose of Estrogin® (1mg of estradiol benzoate). All cows were artificially inseminated at 54-56 h after implants removal. Ninety percent of semen used in the experiment was from only one bull, the remaining 10% were equally distributed among treatments. Artificial insemination was performed by only one technician. Suckling cows had a body condition score of 5-6, in a scale of 1-9, and the non-suckling cows were 6-7. Statistical analysis was accomplished by using Statistical Analysis System 8.0 and logistic regression. There was no difference ($P>0.05$) on cow's pregnancy rate among treatments. Pregnancy rates were 39.72, 34.21 and 36.98% for T1, T2 and T3, respectively. Progestagen implants reutilization did not affected pregnancy rate in beef cows ready for reproduction.

Key Words: Nelore, Reproduction

M127 Myostatin inhibits the differentiation of bovine preadipocyte. S. Hirai*, H. Matsumoto, H. Kawachi, T. Matsui, and H. Yano, *Kyoto University*, *Kitashirakawa-oiwake, Sakyo-ku, Kyoto, Japan*.

Myostatin (growth differentiation factor 8, GDF-8) is a member of the transforming growth factor-β superfamily, and a key critical regulator of skeletal muscle development. In cattle, mutation of myostatin gene results in increasing skeletal muscle, which is known as double-muscling. The expression of myostatin mRNA is found primarily in skeletal muscle, but it is also detected in the adipose tissue. Myostatin was reported to inhibit the differentiation of 3T3-L1 preadipocyte. However, the action of myostatin on bovine preadipocyte has not been studied. We investigated the effect of myostatin on the differentiation of preadipocyte in stromal vascular (SV) cells derived from bovine adipose tissue. SV cells were subcultured in DMEM with 5% FBS and 100 µM vitamin C. After confluence (day 0), differentiation was induced by 0.5 mM 1-methyl-3-isobutyl-xanthine, 0.25 µM dexamethasone, 2.5 µg/ml insulin and 5 µM troglitasone for 2 days. Then, the medium was changed to DMEM with FBS, vitamin C, insulin, and troglitasone, and the cells were cultured for 6 days. The cells were treated with myostatin (0, 100, 300 ng/ml) throughout the differentiation period (from day 0 to day 8) or during the early phase of differentiation (from day 0 to day 2) with 4 cultures each per treatment, and harvested for the measurement of glycerol-3-phoshate dehydrogenase (GPDH) activity at the end of the differentiation period. GPDH activity was significantly reduced by the each dose of myostatin treatment throughout the differentiation period ($p<0.01$). However, the high dose of myostatin was required for the significant reduction of GPDH activity ($p<0.01$) when the cells were treated during the early phase of differentiation. These results suggest that myostatin is a negative regulator of bovine preadipocyte differentiation. Myostatin secreted from muscular and/or adipose tissues probably regulates the differentiation of bovine preadipocyte.

Key Words: Myostatin, Bovine, Preadipocyte

M128 Interrelationships among parity, body condition score (BCS), milk yield, AI protocol, and cyclicity with embryonic survival in lactating dairy cows. H. M. Rutigliano* and J. E. P. Santos, *University of California*, *Tulare*.

Lactating Holstein cows, 6,123, from 9 studies in 5 dairy farms were evaluated to determine the relationships among parity, BCS, milk yield, cyclicity (cyclic or anovular), and AI protocol (inseminated at estrus or timed AI) on pregnancy rates (PR) and embryonic survival at the first postpartum AI. Cows were inseminated following a pre-synchronized (2 PGF2a 14 d apart) ovulation (timed AI) or estrous synchronization (inseminated at estrus) protocol initiated 12 to 14 d after the pre-synchronization. Blood was sampled and analyzed for progesterone twice, 12 to 14 d apart, to determine cyclicity. Cows were scored for body condition (1-5 scale) after calving, and again at AI, between 63 and 75 d postpartum. Pregnancy was diagnosed at 30±3 and 50±8 d after AI. Data were analyzed by multivariate logistic regression controlling for study, dairy, parity, BCS, BCS change, milk yield, cyclicity, and insemination protocol. More multiparous than primiparous were cyclic (81.8 vs 69.4%; $P<0.001$). In addition to parity, cyclicity was also influenced ($P<0.001$) by BCS at calving and at AI, BCS change, and milk yield. However, milk yield, BCS at calving and AI protocol had no effect ($P>0.10$) on PR at 30 and 58 d after AI or pregnancy loss. More cyclic than anovular cows were pregnant at 30 (40.1 vs 28.1%; $P<0.001$) and 58 (34.3 vs 22.0%; $P<0.001$) d after AI, and anovulation increased pregnancy loss (14.4 vs 18.7%; $P=0.05$). Pregnancy loss was highest (21.9 vs 16.6 vs 12.1%; $P<0.01$) and PR at d 58 lowest (22.3 vs 30.7 vs 35.6%; $P<0.01$) in cows that lost 1 unit of BCS than those that lost <1 or experienced no change in BCS from calving to AI. Likewise, a higher BCS at AI (3.75 vs 3.0 to 3.5 vs < 2.75) increased ($P<0.01$) PR at 30 (46.3 vs 40.7 vs 34.2%) and 58 (41.8 vs 35.1 vs 28.5%) d after AI. Minimizing losses of BCS after calving and improving cyclicity early postpartum are expected to increase PR because of enhanced embryonic survival. However, AI protocol and milk yield do not affect pregnancy and embryonic survival after the first postpartum AI.

Acknowledgements: NRICGP USDA

Key Words: Embryo Survival, Cyclicity, Dairy Cows

M129 Ontogeny of hypothalamic gene expression during prepuberal development in the gilt. C. R. Barb*[1], R. L. Richardson[1], R. Rekaya[2], R. R. Kraeling[1], and G. J. Hausman[1], [1]*USDA-ARS*, *Athens, GA*, [2]*University of Georgia*, *Athens*.

The molecular mechanisms that regulate hypothalamic development in the pig are complex. To understand physiological pathways controlling age related changes in hypothalamic development, a custom microarray was utilized to profile differential gene expression. Total hypothalamic RNA was isolated from gilts at 90, 150 and 210 days (d) of age and used to prepare dye labeled cDNA probes, which were hybridized to arrays representing about 600 pig genes involved in growth and reproduction. Mixed linear model was used to analyze log transformed intensities in both channels. Sixty three genes were differentially expressed (P<0.01) from 90 to 210 d of age, which included genes involved in feed intake regulation, steroid binding, growth hormone secretion and intracellular signaling. The gene, AGRP and melanocortin-3-receptor involved in feed intake were up-regulated at 150 d and 210 d, respectively. Somatostatin (SS) was up-regulated and SS receptor-1 was down-regulated at 150 and 210 d, respectively. The progesterone receptor, steroid membrane binding protein, janus kinase-1 and MAPK3 were up-regulated at 210d. Neuronal protein, NP25, involved in brain development was also up-regulated at 210d. These results demonstrate, for the first time, differentially expressed hypothalamic genes in the prepuberal pig. The ontogeny of expression of key hypothalamic genes that regulate development, appetite and reproductive function will lead to a more detailed understanding of the molecular mechanisms controlling growth and the onset of puberty in the pig.

Key Words: Pig, Hypothalamus, Gene Expression

M130 Effect of heat stress on the response to superovulation, embryo quality and survival, and the fertility of recipient cows in commercial dairy herds in Mexico. R. Lozano*[1], M. Aspron[3], C. Vasquez[2], and E. Gonzalez-Padilla[2], [1]*INIFAP-Mexico*, *Aguascalientes, Mexico*, [2]*UNAM*, *Mexico D.F.*, [3]*Private consultant*, *Queretaro, Mexico*.

To study the effect heat stress on dairy cows and embryos produced trough MOET, two trials were conducted. Forty-two cows with estimated 305d milk production of 10,756 ± 444 l (P305D) and 111.4 ± 6.7 days in milk (DIM), were superovulated with the same lot of FSH during the temperate (T, n= 20) or the hot (H, n= 22) seasons. In a second experiment, embryos collected and frozen during T or H were transferred to cows at the peak of lactation during the T or H months, resulting four groups: TT (n=26); TH (n=25); HT (n=28) and HH (n=28). Within group, embryos and recepients were randomly assigned. The Temperature-Humidity indexes (THI) differed during collection (70.5±0.3 and 78.0±0.3) and transference (70.2±0.5 and 76.5±0.5) for T and H, respectively. T and H were similar in cows responding (85 and 86 %), fertilization rate (72 and 80%), and number of CL (11.9 and 11.7), respectively, and different (P<0.01) in recovery rate of embryos+ova (89 and 54%), number of embryos/cow (7.47±1.28 and 4.47±1.21) and number of ova/cow (3.17±0.77 and 1.63±0.72), respectively. During T and H, 11.8% and 36.8% of the cows collected yielded 0 to 2 embryos+ova, respectively (P<0.1). Morulas and early blastocysts of excellent quality were more common during T (P<0.01 and P<0.11, respectively). After transference, gestation percentage (GEST) was higher for T embryos (29.8 vs. 17.4%, P<0.14) and was also higher for T recipients (33.3 vs. 14.0%, P<0.05). There was an interaction, since TT was higher (45.0%) than the other groups (P<0.05) and HT (21.5%) higher (P<0.05) than TH (14.5%) and HH (13.4%).GEST was greater for excellent quality embryos as compared to good (30.4 vs. 16.8%, P<0.11). Heat stress reduced the viability of the embryos, and GEST in recipient cows; however there was not reduction in ovarian response or fertilization rate. The reduction of recovery rate during H could be related to ovulation failure or abnormal capture or transit of ova trough the oviduct.

Acknowledgements: Financed by CONACYT, project 31457-B and dairy producers of Aguascalientes, Mexico

Key Words: Heat Stress, Embryo Transfer, Stress-Reproduction

M131 Relationship between milk lactoperoxidase, progesterone and estradiol concentrations during estrus in dairy cows. A. Ahmadzadeh*[1], M. L. Silber[2], and J. C. Dalton[1], [1]*University of Idaho*, *Moscow*, [2]*Washington State University*, *Pullman*.

The objective of the study was to characterize the relationship between milk lactoperoxidase (LP), serum progesterone (P4), estradiol (E2), and behavioral estrus in lactating Holstein cows. Ten cows, 7 with induced estrus and 3 exhibiting spontaneous estrus, were used in the study. Cows were synchronized using two injections of prostaglandin F2α (PGF) 14 d apart. Blood samples were collected for five consecutive days starting with the second PGF injection (d 14) and on d 28. To quantify LP in milk, fresh milk samples were collected twice daily, from d 14 to 19 and on d 28. In cows with spontaneous estrus, blood and milk samples were collected on the day of estrus and 9 d after estrus. To verify estrus, all cows were continuously monitored for behavioral estrus by the HeatWatch® estrus detection system. Four of 7 cows exhibited estrus. There was a strong association between milk LP activity and behavioral estrus. Milk LP activity increased (P < 0.05), compared to the day of the second injection of PGF (d 14) and the day before estrus. Milk LP activity decreased (P = 0.07) during the luteal phase and was similar to the levels observed before estrus. Mean P4 concentrations were lower (P < 0.05; 0.7 ± 0.55 ng/ml) on the day of estrus compared to d 14 and d 28 (2.3 ± 0.55 and 3.7 ± 0.55 ng/ml, respectively). In cows exhibiting spontaneous estrus, milk LP activity was more than two fold higher at the time of estrus compared to the luteal phase whereas serum P4 was lower (P < 0.05) at the time of estrus (0.2 ± 0.6 ng/ml) when compared to the luteal phase (2.3 ± 0.6 ng/ml). Mean serum E2 was higher (P = 0.05) at the time of estrus compared to the luteal phase (15.2 ± 2.4 vs 7.8 ± 2.4 pg/ml). There was no change in LP or serum P4 in cows that did not exhibit estrus. This preliminary data appears to indicate that while milk LP is elevated during estrus, it was also negatively associated with blood P4 and positively associated with blood E2 during estrus.

Acknowledgements: Authors express their appreciation to NAAB for partial support of this study.

Key Words: Milk Lactoperoxidase, Estrus, Cattle

M132 Assessing pregnancy status using digital infrared thermal imaging in Holstein heifers. M. Jones*[1], A. Denson[1], E. Williams[1], A. Dos Santos[1], K. Graves[1], A. Kouba[2], and S. Willard[1], [1]*Mississippi State University*, *Mississippi State,* [2]*Memphis Zoo*, *Memphis, TN*.

Digital infrared thermal imaging (DITI) is a diagnostic technique for non-invasively monitoring body surface temperature (TEMP) gradients in animals as influenced by a change in physiology. The objective of this study was to determine if DITI could be used to detect pregnancy in Holstein heifers using DITI of the animal's side. DITI was conducted at 2-wk intervals alternating sides (n=8 imaging sessions; n=4 left/n=4 right) of pregnant and non-pregnant heifers (n=20, respectively, each session). Ambient (AMB) TEMP, relative humidity (RH), and rectal TEMP (RT) were obtained at each imaging period. DITI images were acquired of the animal's side (shoulder to flank) and DITI TEMP minimum (MIN), maximum (MAX), average (AVG), and standard deviation (SD) were quantified. Mean AMB, RH, and THI were 17.7 ± 1.7°C, 81.4 ± 2.9% and 63.4 ± 2.7, respectively. Results differed by sampling day (P<0.05) in MIN, MAX, AVG and SD TEMP from the left and right sides, which were conducted on different days. There was a day (side) x pregnancy status interaction (P<0.05). Therefore data were analyzed within side (left vs right) across days and pregnancy status for DITI measures. Heifer RT were greater (P<0.05) for non-pregnant (38.31 ± 0.02°C) than pregnant (38.16 ± 0.02°C) heifers regardless of sampling day; however there was no correlation (R=0.08; P>0.10) between RT and day of gestation within pregnant heifers. Right-side DITI revealed a higher (P<0.05) MIN TEMP for pregnant vs. non-pregnant heifers across days, whereas MAX TEMP and SD did not differ (P>0.10) by pregnancy status when AMB was >10°C. Left-side DITI was variable across days for all DITI variables, and left-side DITI for MIN, MAX, AVG and SD were not as correlated to day of gestation (R=0.19, 0.26, 0.26 and -0.23, respectively; P<0.08) as right-side DITI (R=0.48, 0.49, 0.49 and -0.37, respectively; P<0.01). These data suggest that right-side DITI is a better predic-

tor of pregnancy than left-side DITI in Holstein heifers; however, the ability to discriminate pregnant from non-pregnant heifers is questionable, and greatly affected by ambient temperature.

Acknowledgements: Funded by the Conservation Action Network, Memphis Zoo

Key Words: Thermography, Pregnancy, Holstein

M133 Thermography of the vulva in Holstein dairy cows: A comparison of estrus vs. diestrus. M. Jones*[1], A. Denson[1], S. Bowers[1], K. Moulton[1], E. Williams[1], K. Graves[1], A. Dos Santos[1], A. Kouba[1], and S. Willard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*Memphis Zoo*, *Memphis, TN*.

It has been suggested previously that thermal imaging (DITI) of the external genitalia (vulva) of female animals might be used to detect the timing of estrus non-invasively. To this end, a study was conducted in Holstein dairy cows (n=20) to determine if DITI of the vulva could be used to discriminate between estrus vs. diestrus phases of the bovine estrous cycle. Cows were synchronized (CIDR/PGF2α) and study measurements taken daily from the day after CIDR withdrawal (d 1) for 30 d as follows: ambient (AMB) temperature (TEMP), relative humidity (RH), rectal TEMP (RT), blood samples for serum concentrations progesterone (P4) determinations (analyzed by RIA), and vulva surface TEMP via DITI for minimum (MIN), maximum (MAX), average (AVG), and standard deviation (SD) of TEMP gradients. During this study it was noted that during the first estrus (ES-1) and early diestrus (DS-1) periods post-synchrony AMB TEMP (21.4 ± 0.1°C) was greater ($P < 0.05$) than during late diestrus (DS-2) and the return to estrus (ES-2; 12.1 ± 0.2°C). RT was also higher ($P < 0.01$) at ES-1/DS-1 (pooled: 24.5 ± 0.05°C) than ES-2/DS-2 (pooled 23.9 ± 0.03°C). Serum concentrations of P4 did not differ ($P > 0.10$) between ES-1 and ES-2 (pooled: 0.31 ± 0.04 ng/ml), but were lower ($P < 0.01$) than DS-1 and DS-2 (pooled: 10.0 ± 0.52 ng/ml), which also did not differ ($P > 0.10$). At an AMB TEMP of 21.4°C, DITI MIN and SD revealed no TEMP difference ($P > 0.10$) between ES-1 and DS-1, whereas DITI MAX showed a greater ($P < 0.01$) TEMP at ES-1 (37.5 ± 0.12°C) compared to DS-1 (37.2 ± 0.10°C). At an AMB TEMP of 12.1°C, MIN, MAX, AVG, and SD revealed no difference ($P > 0.10$) between ES-2 and DS-2. While DITI MAX TEMP revealed a 0.30°C difference between ES-1 and DS-1, it is unclear whether this magnitude of a difference is physiologically relevant for the detection of estrus. Moreover, the ability to discriminate between estrus and diestrus was greatly influenced by ambient temperature.

Acknowledgements: Funded, in part, by the Conservation Action Network, Memphis Zoo, and the USDA-ARS funded Biophotonics Initiative # 58-6402-3-0120

Key Words: Thermography, Estrus, Holstein

M134 Activin inhibits the differentiation of bovine preadipocyte. H. Matsumoto*, S. Hirai, H. Kawachi, T. Matsui, and H. Yano, *Kyoto University*, *Kitashirakawa-oiwake, Sakyo-ku, Kyoto, Japan*.

The development of beef marbling is associated with an increase in adipocyte number within muscle, suggesting that the differentiation of preadipocyte could occur within the muscle during the formation of beef marbling. Thus, the regulation of adipogenesis would be beneficial for controlling intramuscular fat deposition. Activin, a member of TGF-β superfamily was found in many tissues including muscle and fat, which increased the interest in local effects of activin. Recently, activin A was reported to inhibit the differentiation of a mouse preadipocyte cell line, 3T3-L1 preadipocyte (Hirai et al., Mol. Cell Endocrinol. in press). However, the action of activin A on the differentiation of bovine preadipocyte has not been studied. We investigated the effects of activin A on the differentiation of bovine preadipocyte. Stromal vascular (SV) cells were isolated from bovine adipose tissue and were cultured in DMEM with 5% FBS and 100 μM vitamin C. After confluence, differentiation was induced by 0.5 mM 1-methyl-3-isobutyl-xanthine, 0.25 μM dexamethasone, 2.5 μg/ml insulin, and 5 μM troglitasone for 2 days. Then, the cells were cultured for 6 days in DMEM with FBS, vitamin C, troglitasone and insulin. Activin A was treated throughout the differentiation period. The cells were harvested for the measurements of differentiation markers such as glycerol-3-phosphate dehydrogenase (GPDH) activity, lipid accumulation, and the expression of adipocyte fatty acid-binding protein (aP2) mRNA. Activin A treatment reduced GPDH activity, lipid accumulation, and aP2 mRNA level. These results suggest that activin A inhibits the differentiation of preadipocyte in bovine SV cells. The differentiation of bovine preadipocyte was inhibited by the treatment with 5 ng/ml activin A. On the other hand, 20 ng/ml activin A was required to reduce the level of these adipocyte markers in 3T3-L1 cells. Therefore, bovine preadipocyte may be more sensitive to activin A than 3T3-L1 cells.

Key Words: Activin, Bovine, Preadipocyte

M135 Effect of tumor necrosis factor α on the development of *in vitro* derived bovine embryos. L. Gast* and C. Whisnant, *North Carolina State University*, *Raleigh*.

Tumor Necrosis Factor alpha (TNF- α) is a cytokine released by macrophage cells in response to local infection or disease. Mastitis, a common infectious disease in cattle, has been shown to increase the blood levels of TNF- α mRNA. This immune response pathway leads to an increase in other cytokines and prostaglandins which can compromise oocyte maturation and embryo development. The objective of this study was to improve our understanding of the effects of TNF- α on embryo development. Ovaries were obtained from a local abattoir and immature cumulus oocyte complexes (COC) were aspirated from 2-10mm diameter follicles. For maturation, COCs were placed in M199 including fetal bovine serum (FBS), LH, FSH, Estradiol, and Gentamycin additives and incubated at 39°C for 18-20 hours. After maturation and fertilization, 3 groups of 20-25 presumptive zygotes were randomly placed in control developmental media (M199 plus FBS) or developmental media containing either 50ng/ml or 100ng/ml of TNF- α and incubated at 39°C. Cleavage rate was evaluated 72 hpi and was not affected by the treatments. Developmental data was collected by observation of blastocyst stages (compact morula, early blastocyst, mid-blastocyst, late blastocyst, or hatching blastocyst) at 168hpi and 196hpi. At 168hpi, embryos exposed to 50ng/ml TNF- α developed similarly to the control embryos, unlike the embryos exposed to 100ng/ml TNF- α, which had a 10% decrease in the number of blastocysts. The total percent of all blastocyst stages observed in the treatment groups at 168hpi are as follows: Control 32%, 50ng/ml TNF- α 32%, and 100ng/ml TNF- α 22%. At 196hpi, embryos treated with 100ng/ml TNF- α exhibited a further 7% decrease in observed blastocysts. The total percent of all blastocyst stages observed at 196hpi were control 22%, 50ng/ml TNF- α 30%, and 100ng/ml TNF- α 15%. The control group showed a 10% decrease in total number of blastocysts observed at 196hpi and may be caused by degeneration of some developing blastocysts. In summary, higher doses of TNF- α decreased bovine embryo development, whereas some lower doses can actually increase embryonic development in vitro ($P<.05$).

Key Words: Cytokine, Bovine, IVF

M136 Effects of feeding yeast culture and propionibacteria on milk glucose, plasma glucose and plasma insulin concentrations in Holstein cows. K. V. Lehloenya[1], D. R. Stein[1], M. M. Aleman*[1], D. T. Allen[1], T. G. Rehberger[2], D. A. Jones[1], and L. J. Spicer[1], [1]*Oklahoma State University*, *Stillwater*, [2]*Agtech Products, Inc.*, *Wakesha, WI*.

To determine the effect of supplemental feeding of Diamond V-XP Yeast Culture (XPY) alone or in combination with Propionibacteria strain P169 on concentrations of glucose in milk and plasma and insulin in plasma, 31 primiparous (PP) and multiparous (MP) Holstein cows were fed one of three dietary treatments between 2 wk prepartum to 30 wk postpartum: 1) Control (n=10), fed a corn silage-based total mixed ration (TMR); 2) XPY (n=11), fed Control TMR plus XPY (at 56 g/head/d); and 3) XPY+P169 (n=10), received Control TMR plus XPY plus P169 (at 6 x 10^{11}/head/d). Milk samples during sequential

p.m. and a.m. milkings were collected during a 2-wk period (wk 23 and 24 of lactation) from all cows, and blood samples were collected hourly during a 16-h post-feeding interval during wk 27 of lactation from only MP cows. Milk glucose was affected (P<0.01) by dietary treatment such that both PP and MP cows fed XPY+P169 had 28% greater (P<0.05) milk glucose levels (251± mg/dL) than Control cows and 32% greater milk glucose levels than XPY-fed cows. Diurnal plasma glucose concentration (59±1 mg/dL) was not affected by diet in MP cows. Plasma insulin levels were affected (P<0.01) by dietary treatment and time such that plasma insulin levels in MP cows fed XPY+P169 (0.86±0.05 ng/mL) were 34% and 30% greater (P<0.01) than in MP cows fed Control and XPY, respectively. Although 16-h post-feeding fluctuations in plasma glucose did not significantly differ among Control, XPY and XPY+P169 groups, the lack of a detectable increase in plasma glucose may be due, in part, to the fact that plasma insulin levels increased faster in XPY+P169 fed cows. Milk glucose and plasma insulin responses to XPY+P169 feeding suggest that XPY+P169 supplementation might have enhanced gluconeogenesis and increased glucose uptake by the mammary gland.

Key Words: Yeast Culture, Propionibacteria, Glucose

M137 Supplemental feeding of propionibacteria to lactating dairy cows: Effects on plasma hormones and metabolites. M. M. Alemán*[1], D. R. Stein[1], D. T. Allen[1], K. W. Gates[1], K. J. Mertz[2], T. G. Rehberger[2], D. A. Jones[1], and L. J. Spicer[1], [1]*Oklahoma State University*, *Stillwater*, [2]*Agtech Products, Inc.*, *Waukesha, WI.*

From 14 d prepartum to 175 d postpartum, multi- (MP) and primiparous (PP) Holstein cows were fed one of three dietary treatments: 1) Control (n=13), fed a total mixed ration (TMR); 2) HP169 (n=11), fed TMR plus 6 x 10^{11}/head/d (high dose) of Propionibacterium Strain P169; or 3) LP169 (n=14), fed TMR plus 6 x 10^{10}/head/d (low dose) of P169. Blood samples were collected weekly for 25 wk and analyzed for plasma concentrations of glucose, insulin, insulin-like growth factor-I (IGF-I), leptin, nonesterified fatty acids (NEFA) and cholesterol (CHOL). Between wk 25 and 30 bovine somatotropin (bST) was given to all groups every 2 wk. Plasma glucose was affected by diet x parity (P<0.001) such that glucose levels in LP169 MP cows (59.8±1.1 mg/dL) were 5.5% lower than in HP169 MP cows; LP169 PP cows (67.9±0.9 mg/dL) had 6% to 9% greater plasma glucose levels than HP169 and Control PP cows. Plasma insulin was affected by diet (P<0.001) such that LP169 had less plasma insulin than HP169 and Control cows (during wk 13-25), and HP169 cows had greater insulin than Controls (during wk 1-12). Plasma IGF-I, NEFA and leptin levels did not differ (P>0.15) among diet groups between wk 1 and 25, but PP cows had greater (P<0.02) IGF-I and lower (P<0.01) NEFA levels than MP cows. Plasma CHOL was affected by diet x parity (P<0.01) such that LP169 MP cows (246±11 mg/dL) had 25% greater levels than HP169 and Control MP cows; CHOL levels in PP cows did not differ among diet groups. During bST, HP169 MP cows and LP169 PP cows had lower (P<0.01) IGF-I levels than their respective Controls. Regardless of parity, LP169 cows had greater (P<0.10) leptin levels than Controls cows, and HP169 cows had greater (P<0.01) NEFA than Control cows. We conclude that P169 may hold potential as a direct-fed microbial to enhance metabolic efficiency during early and mid-lactation.

Key Words: Propionibacteria, Direct-fed Microbial, Hormones

Production, Management and the Environment: Environment and Economics

M138 Effects of population density on growth and vermicompost production of earthworms (*Eisenia spp*). J. Hernández*[1], S. Pietrosemoli[1], W. Echeverria[2], R. Palma[2], A. Faria[1], C. Contreras[2], and A. Gomez[1], [1]*La Universidad del Zulia*, *Maracaibo, Zulia, Venezuela.*, [2]*Proyecto FONACIT PS1-2000000792*, *Maracaibo, Zulia, Venezuela.*

During 84 days, in an area classified as dry forest of Zulia state, Venezuela; a medium scale experiment was performed in order to evaluate the effects of three population densities: low, medium and high (1000, 2000 and 4000 earthworm/mt^2 respectively) on earthworm biomass and superficial vermicompost production. Initial biomass was 166.53 ± 11.34 mg/earthworm. Experimental design was a completely randomized with five replicates. Earthworms were maintained in concrete bins with a precomposted mixture 50:50 of oil palm fiber and bovine manure. Total substrate offered was 0.220 m^3 /bin. Every 21 days, biomass of the first 20 earthworms founded in the upper area of the bins was recorded; and free surface vermicompost was collected having its volume measured. Data was analyzed using STATISTIX software. Statistical differences were established among treatments for both earthworm biomass 327.98 ± 46.08; 278.9 ± 47.8 and 198.4 ± 31.4 mg/earthworm and total vermicompost production 0.039 ± 0.004; 0.045 ± 0.002 and 0.049 ± 0.035 m^3 for low, medium and high density respectively. Tukey media test not showed differences between medium and low densities for biomass, and neither between medium and high density for vermicompost production. Population density of earthworms affected biomass and vermicompost production, with the lowest biomass/earthworm with high density treatment, which achieved the best vermicompost production.

Key Words: Population Density, Earthworms, Biomass and Vermicompost

M139 Effects of feeding frequency on growth and reproduction of earthworms (*Eisenia spp*). J. Hernández[1], S. Pietrosemoli*[1], A. Faria[1], R. Palma[2], and R. Canelón[2], [1]*La Universidad del Zulia.*, *Maracaibo, Zulia, Venezuela.*, [2]*Proyecto FONACIT PS1- 2000000792*, *Maracaibo, Zulia, Venezuela.*

During 105 days, in an area classified as dry forest of Zulia state, Venezuela; a medium scale experiment was performed in order to evaluate the effects of three feeding frequency: once (100% substrate), three (50, 25 and 25 % substrate) and four times substrate supply (25, 25, 25 and 25 % substrate) on earthworm biomass, total biomass/feeding frequency and cocoons production. Total substrate offered was 0.220 m^3/bin. Initial density and biomass were 1000 earthworm/m^2 and 234.88 ± 19.93 mg/earthworm respectively. Experimental design was a completely randomized with five replicates. Earthworms were maintained in concrete bins with a precomposted mixture 50:50 of oil palm fiber and bovine manure. Every 21 days, biomass of three groups of 100 earthworms each was recorded. On day 42, cocoons founded on the upper 10 cm of the bins were collected. At the end of the trial after capturing all the specimens in each bin, total earthworm biomass was registered. Data was analyzed using STATISTIX software. Statistical differences were established among treatments for earthworm biomass 136.49 ± 12.29; 147.95 ± 11.92 and 172.56 ± 12.46 mg/earthworm for once, three and four times feed supply respectively. Tukey media test not showed differences between once and three times supply. Cocoons production (345 ± 155.37; 363.6 ± 108.47 and 168 ± 66.126 cocoons for once, three or four time feed supply respectively) and total biomass (426.21 ± 121.26; 383.51 ± 59.13 and 342.15 ± 190.32 g/bin for once, three or four time feed supply respectively) were not influenced by treatments ($p \leq 0.07$ and $p \leq 0.06$). Feeding frequency affected earthworm biomass. The highest individual biomass was registered when feed was supplied four times. Benefits obtained in increasing feed frequency are not equilibrated with increasing of management task required.

Key Words: Feeding Frequency, *Eisenia* Earthworms, Biomass and Cocoons Production

M140 Evaluation of advanced dairy systems shade tracker fans and korral kool coolers on a commercial dairy in Buckeye, Arizona. M. VanBaale[1], D. Ledwith[1], R. Burgos*[1], R. Collier[1], D. Armstrong[1], J. Smith[2], M.

Brouk[2], and L. Baumgard[1], [1]*University of Arizona*, *Tucson*, [2]*Kansas State University*, *Manhattan*.

Multiparous (n=200) and primiparous (n=100) dairy cows balanced for parity, stage of lactation, and milk yield were randomly assigned to one of two cooling treatments (trts). Cows were cooled with Korral Kool (KK) stationary coolers or Advanced Dairy Systems Oscillating Fan plus Misters Shade Tracker (ADS-ST) system. The cooling systems in each pen were attached to a shade structure (121.92 m long by 9.14 m wide by 3.96 m high) oriented north-south. Individual milk yields and pen DMI were collected daily and milk components were obtained monthly. Respiration rates (RR) and body surface temperatures (ST) were obtained weekly at two times during the day and vaginal body temperatures were taken from a sub set (n=6) of cows used in a switch back design over a four day period during wk 13 of the study. BCS and body weights (BW) were observed monthly from a subset (n=20) of both primiparous and multiparous cows throughout the study. Average daily milk production did not differ for multiparous cows housed in ADS-ST or KK (41.8 kg/d) pens. However, daily milk yield for primiparous cows housed under KK conditions (37.8 kg/d) tended to be higher than cows housed under ADS-ST conditions (36.7 kg/d). Weekly DMI were similar between trts (25.0 kg/d) and there was no difference in BW change (6 kg) between multiparous cows, respectively. However, primiparous cows housed under ADS-ST conditions gained less BW (8.6 vs. 39.8 kg) than those cooled with KK. Multiparous cows cooled with ADS-ST had a higher RR (60.5 vs. 58.3 breathes/min), however, RR (59.7 vs. 58.6 breathes/min) in primiparous cows did not differ. There was no trt difference in mean core (vaginal) body temperature (32.6 C) or body surface temperature (32.2 C) respectively. The ADS-ST cooling system used less electricity (526 vs. 723 kwh/d) and water (291 vs. 305 L/d) than the KK coolers. The daily variable costs for the ADS-ST system were lower ($27.30 vs. $33.36) and the daily cost/cow ($0.11 and $0.15), and per cwt of milk ($0.10 and $0.14) was less for ADS-ST compared to the KK coolers.

Acknowledgements: We thank United Dairymen of Arizona, ADS and KK for funding the trial.

Key Words: Evaporative Cooling, Heat Stress

M141 Evaluation of cooling systems to improve lactating Holstein cows comfort in the sub-tropics. C. N. Lee* and N. Keala, *University of Hawaii-Manoa*, *Honolulu*.

Previous studies from various laboratories had demonstrated that summer heat results in lower milk production, depressed fertility, higher respiration rates and increase stress in lactating cows. This study was designed to evaluate various cooling systems in 3 commercial dry-lot dairies located within 1km of each other in the southwestern shores of Oahu. Dairy A (n=200) had only shade, dairy B (n=200) had either shade with fans at the feed alley or shade with foggers at the stanchion and dairy C (n=200) had Koral Kool fans and misters in Saudi pens and pens with oscillating fans with misters. Respiration rates (RR/min.) for summer (Sept.-Oct.) and winter (Feb.-March) for dairy A were 88 and 70, dairy B were 80 and 60 and dairy C were 63 and 52. In dairy B, cows in pens with shade and foggers at stanchion had lower RR than cows with shade and fans over the stanchion (71 vs 89) for the summer months. Similar trend was observed in the winter months. In dairy C, cows in Koral Kool pens had lower RR than cows in pens with oscillating fans with misters; summer 60 vs 65 and winter 47 vs 57. In all dairies, RR were lower in am (0900-1100) vs pm (1300-1500). Koral Kool cows had the lowest RR, followed by oscillating fans then cows under foggers. All theses cows had RR below the critical level of 70/min. The THI directly under shade in all dairies were 3-6 units lower than that under the sun. However, all THI during data collection period were above 72; range of 73-78 in winter and 76-82 in summer. Skin temperatures were lowest for cows standing under the foggers followed by cows under Saudi pens but these animals have similar rectal temperatures. The study showed that adequate shade with strong wind speed and misters are most effective in keeping cows cool in the sub-tropics.

Acknowledgements: This research is supported by USDA/Tropical and Sub-Tropical Agriculture Research.

Key Words: Respiration Rate, THI, Dairy Cows

M142 A comparison of methods for determining body temperature of Holstein cows during hot weather. C. Wildman*, J. West, and J. Bernard, *The University of Georgia*, *Tifton*.

Eight lactating Holstein cows were used in a randomized complete block trial to compare methods for body temperature measurement over a 4 d period during hot weather. Temperature measures were taken intra-vaginally using the HOBO Water Temp Pro® and at the tympanic membrane using a Stowaway XTI Temperature Logger®. Cows were blocked by environment; four cows were located outdoors with shade cloth only and four cows were housed in a free-stall barn with high velocity fans and high-pressure misters for cooling. Body temperatures were recorded at 6 min intervals for calculation of an hourly mean. Ambient temperature and relative humidity were recorded in both environments for calculation of temperature-humidity index (THI). Days were divided into 3 h intervals and hourly data was analyzed for each interval across days. No differences were observed for measurement method during any interval and no significant interactions with measurement method occurred. Mean intra-vaginal and tympanic temperature during the 15:00-18:00 h interval, the time during which environmental temperature was highest, were 39.8 and 39.7°C respectively. Two of the cows in the study also had ruminal cannulae and were used to compare ruminal temperature with intra-vaginal and tympanic membrane measures. Body temperature and weather data were recorded and calculated similarly as for study one. Ruminal temperature was higher than tympanic and vaginal temperature for the 0:00-3:00 h interval (40.2, 38.9, 38.9°C, P=0.0085), 3:00-6:00 h interval (40.4, 38.9, 38.9°C, P=0.0047), and 6:00-9:00 h interval (40.3, 38.7, 38.8°C, P=0.0177). No differences were observed for the other intervals. No differences were noted between tympanic and vaginal temperature at any interval. Results of this research indicate that tympanic and vaginal temperature are similar measures of cow body temperature, while rumen temperatures are elevated at times and may not accurately reflect body temperature.

Key Words: Intra-vaginal Temperature, Tympanic Temperature, Heat Stress

M143 Influence of high temperatures on productive performance of sows. L .M. Ram′rez[1], M. Aparicio[1], J. Morales[1], R. Lázaro*[2], and C. Piñeiro[1], [1]*PigCHAMP Pro Europa, S.A.*, *Segovia, Spain*, [2]*U. P. Madrid*, *Spain*.

The influence that hot summer weather conditions have on reproductive performance of sows, especially during lactation, has been described thoroughly in the literature but few papers have quantified the effects. Heat affects fertility and prolificacy, and increases sow and piglet mortality. August of 2003 was the warmest month in Spain for the last 50 years and an increase of failures in reproduction was observed. We assessed the influence of the high temperatures (often above 40°C) occurring during this month in 58 commercial farms. In the study the reproduction data for the whole year was provided by database PigCHAMP® and included farrowing rate (FR), pre-weaning mortality (PWM), percentage of dead piglets born (DPB), repeat mating rate (RMR), total weaned piglets per sow (WP), sows mortality rate (MR), and weaning to service interval (WSI). The MR observed in August was the highest of the year and was twice as high as the average for 2003 (12.4 *vs* 6.0%; P=0.0001, respectively). Most of the mortality occurred suddenly and close to the farrowing indicating that sows are very sensitive to extreme weather conditions. The DPB (10.8 *vs* 8.4%; P=0.0001) and PWM (11.9 *vs* 10.8%; P=0.06) indexes also increased in August, affecting total WP (9.3 *vs* 9.1; P<0.01). Reproductive parameters were also affected by hot weather conditions and the RMR increased from 14.0 to 15.8% (P=0.07) during August. Probably the increase observed in RMR in August affected FR in December (three months later; 73.8 *vs* 81.9%, the average of the year; P<0.001). The WSI increased in August, although the differences with respect to the average of 2003 did not reach significancy (7.3 *vs* 6.8 d; P>0.10). We conclude that high temperatures negatively impacted mortality and reproductive and productive performance of sows.

Key Words: Heat Shock, Sows, Reproductive Performance

M144 Component and factor analysis of pork farm odor using neural networks. K. Janes, S. Yang, and R. Hacker*, *University of Guelph*, *Guelph, Ontario, Canada*.

The pork industry in many countries has suffered declining and stagnate growth due to public concerns regarding various quality of life issues. Non-farming residents living in close proximity to pork farms (PF) are concerned that the odor emissions originating from PF are a health threat and reduce their enjoyment of the rural outdoors. There has been numerous research studies on modelling of PF odor using single-component analysis, to gain understanding of the odor and to allow a convenient method for measurement. However, PF odor is complex with over 200 different components that interact and a variety of factors that contribute such as humidity. It is proposed that multiple-component, multiple-factor analysis of PF odor using neural networks, will yield more accurate intensity predictions. A data set was compiled from 26 PF with 131 samples for air-phase concentrations of ammonia, hydrogen sulphide, time, date, temperature, humidity and ventilation. Three models were developed using the data sets, one linear multiple regression model (LMR1) and two neural network models (NN1 & NN2). The NN models were constructed using neural network-based structural-learning-with-forgetting method. This method is based solely on data, without initial theories and pre-processing. The results were analysed using mean absolute error, standard deviation and coefficient of determination. A model's precision in predicting PF odor intensity is greater the lower the standard deviation. LMR1 and NN1 realised an E_a of 64.9% & 31.2% a s of 67.7% & 20.5% and an R^2 of 0.48 & 0.83 respectively. These results indicated that LMR1 is far less accurate than NN1. NN2 considered time and temperature in addition to the parameters in NN1. NN2 realized a performance gain in E_a of 11.9% over NN1. Standard deviation decreased from 20.7% to 12.7% for NN1 and NN2 respectively. R^2 remained approximately the same for both NN1 and NN2. These performance gains indicate that factors other than odorants are very relevant to the analysis of PF odor. An enhanced electronic nose that utilized NN2 could greatly assist the pork industry to enhance its public image in an economic manner.

Key Words: Odor, Modelling, Pig Farm

M145 Chemical and environmental treatment of whole tree juniper bedding to lower fecal coliform counts. M. Gamroth*[1] and L. Swan[2], [1]*Oregon State University*, *Corvallis*, [2]*U.S. Forest Service*, *Klamath Falls, OR*.

Byproducts of wood processing are an important source of organic bedding on dairy farms. Unfortunately, organic beddings can be contaminated with mastitis-causing bacteria, especially those made from external bark or whole trees. Samples of fresh chipped whole tree juniper showed high counts of fecal coliform bacteria, including E. coli and Klebsiella species. The objective of this study was to evaluate alternative chemical and environmental treatments to limit the fecal coliform contamination of whole-tree green chipped juniper and dry chipped juniper. Four chemical/environmental treatments were tested on two types of chipped juniper. Whole juniper trees with needles (GREEN) and without needles (DRY) were chipped to about 2.5 to 4.0 cm (1 to 1-1/2 inch) in size. Approximately 1 kg (2.2 lb) portions of the chips were poured into 40 cm x 60 cm (16" x 24") aluminum pans prior to treatment. Treatments to control bacteria were: 50 ppm iodophor solution sprayed over the surface of the panned chips (GERMICIDE), powdered calcium hydroxide, hydrated lime, at 120 ml (4 oz) /cubic foot of chips mixed into panned chips (LIME), open air drying of chips in the dairy barn (AIR DRY), and composting chips held in 19 liter (5 gal) buckets and turned every 5 days (COMPOSTED). Chips treated with lime and germicide were sampled after 14 hours. Air dry and composted were sampled at 7 days and 15 days. Air drying and composting had little effect on bacteria counts. Levels of fecal coliform never reached acceptable levels. The sprayed-on germicide had no effect on bacteria counts in the DRY chips and reduced the count to 600 CFU/g in the GREEN chips. Hydrated lime dusted on the chips reduced bacteria counts after 14 hours of contact time. GREEN chips showed no growth and DRY chips were 100 CFU/g. Lime was the only treatment that helped reduce bacteria counts to acceptable levels.

Key Words: Bedding, Mastitis, Juniper

M146 Effect of season on ammonia volatilization from urine and beef and dairy feces on pasture. P. Tyler*, K. Cummins, C. Wood, and B. Wood, *Auburn University*, *Auburn University, AL*.

An experiment was done to evaluate the effect of season of the year and diet on ammonia volatilization from cattle urine or beef or dairy feces when applied to pasture. Dairy cows were fed corn, soybean, and corn silage diets. Beef cows were grazing annual pastures in fall and winter and bermuda grass in spring and summer. Feces and urine were collected fresh and applied to 1 m plots on typical Peidmont soils in 5 replicates. In equal numbers of control plots no feces or urine was applied. Feces and urine were each mixed, sub-sampled, and weighed amounts placed in the plot. The ring was removed after the urine soaked into the soil or after fecal application. One L of urine or approximately 1 kg of feces was placed in each plot. Ammonia loss was measured by trapping ammonia inside a 15.9 L plastic bucket placed over each urine patch or fecal pile, and flush to the soil, at 0, 6 12, 24, 36, 48, 60, 72, 84, and 96 h after start of the experiment. Ammonia concentration was measured inside the trap after two hours using an electrochemical ammonia measuring device. Mass of ammonia in the trap was calculated. At the end of the experiment, soil samples were taken from each plot to measure concentrations of nitrate, ammonia, and carbon at depths to 20 cm. There was a significant effect of season on ammonia loss to the atmosphere from urine ($P<.01$). Air temperatures had means of 28.3, 24.4, 4.6, and 19.3 degrees C for summer, fall, winter, and spring, respectively. Loss of nitrogen to the atmosphere was 0.33, 0.07, 0.029, and 0.109 % of applied total N for summer, fall, winter and spring, respectively ($P<.01$). Little or no ammonia N was detected volatilizing from plots with feces. In soil, after the experiment, total carbon and N was higher in plots with feces, ($P<.05$) from 0 to 5 cm depth. Ammonia and nitrate-N increased in plots where urine was applied, at the 10-20 cm depth, compared to control or feces plots ($P<.05$), consistent with the small atmospheric loss of ammonia N. Cows on pasture where urine and feces are not mixed in waste management systems may lose relatively small amounts of N to the environment.

Key Words: Ammonia, Environment, Cattle

M147 Validating N to P ratio for estimating N volatilization from dairy manure. V. Moreira* and C. Coxe, *LSU AgCenter SERS*, *Franklinton, LA*.

The objective of this study was to compare mass balance (**MB**) and nitrogen to phosphorus ratio (**N:P**) methods for estimating N volatilization (**NV**). A secondary objective was to evaluate the pattern of NV from manure containing two proportions of urine and feces. Urine and feces were collected separately in 8 buckets from 1 to 4 cows. Immediately after collection, feces and urine were mixed to give ratios of 60:40 (**HU**, n = 2) and 66:34 (**LU**, n = 2). Two 150-g sub-samples were incubated on 9-1/4" x 6-1/2" x 1-1/2" aluminum pans for each time. Incubations occurred from 0600 to 1300 h on June 10, 2004 Two sub-samples per time per bucket were acidified with 2 mL of 66% H_2SO_4 at 0, 2, 3 and 6-h of incubation and immediately stored in a freezer. The pH was measured upon manure pouring. Dry matter, N and P (Kjeldahl method), NDF, and ADF were analyzed after samples were lyophilized. Ambient temperature averaged 28.2° C (22.8 to 31.1° C) and relative humidity was 73.8% (51 to 100%). Manure nutrient contents averaged 10.3% DM, 4.05% N, 0.69% P, 34.3% NDF, and 22.1% ADF at 0-h. The pH slowly increased ($P \leq 0.08$) for LU in the first 16 minutes, but treatments were similar at 2, 3 and 6 h. Nitrogen volatilization (grams) increased with time similarly ($P \geq 0.10$) for both treatments (LU and HU). Volatilization estimated by MB and N:P reached respectively 12.8% and 13.8% after 6 h of incubation. A linear regression equation of NV (grams) was estimated as N:P = 0.006 + 1.051 x MB ($P \leq 0.001$; $R^2 = 0.84$; RMSE = 0.021) and the slope was not significantly different from 1 ($P \geq 0.10$). Urine:feces ratios used in this trial had minimum effect on N volatilization, particularly after 6 h of incubation. Method of estimation did not significantly affect NV ($P \geq 0.10$). The results of this preliminary study indicate that N:P ratio can estimate N volatilization from manure as well as MB, when manure is collected from and stored in confined areas.

Key Words: N Volatilization, Nitrogen to Phosphorus Ratio, Mass Balance

M148 Effects of selected environmental factors on feed intake of three breeds of beef bulls during feedlot performance tests. G. T. Tabler, Jr.*, A. H. Brown, Jr., E. E. Gbur, Jr., I. L. Berry, Z. B. Johnson, D. W. Kellogg, and K. C. Thompson, *University of Arkansas*, *Fayetteville*.

Selected environmental data were analyzed to more precisely define the relationship between climate and feed intake of three breeds of performance-tested beef bulls during feedlot performance tests. Intake data originated from Angus, Polled Hereford and Simmental bulls in University of Arkansas Cooperative Bull Tests at Fayetteville, Hope and Monticello from 1978 through 1990. Bulls were given a 21-d adjustment period, then individually full-fed a total mixed ration twice daily in the same stall for 140 d. As formulated, diet contained 1.6 Mcal NE_m, 0.9 Mcal NE_g and 12% CP per kg DM. Initial age and weight were recorded at start of each test with weights taken at 28-d intervals. Data were pooled, divided into five 28-d periods, with data from each period and breed analyzed separately. Since environmental variables tended to be highly collinear, regression of feed intake on them would be problematic. Therefore, principal components (PCs) were calculated and feed intake was then regressed on a subset of PC values for each animal using standard regression techniques. The PCs associated with initial weight and age had the dominant effect ($P < 0.001$) on intake for Polled Hereford and Simmental breeds, followed by temperature-related PCs ($P < 0.001$). That order was reversed in Angus cattle with environmental PCs having the dominant effect on intake ($P < 0.001$) with weight and age secondary ($P < 0.001$). Numerous PCs affected ($P < 0.001$) feed intake throughout the study. The R-squares ranged from 0.25 to 0.53 depending on breed and period. Results indicate environment has strong, differing effects among individual breeds and effects on intake differ as a feeding period progresses. Evidence further indicates temperature alone is inadequate to represent effects of weather on feed intake.

Key Words: Beef, Climate, Feed Intake

M149 Effect of dietary nitrogen on estimates of nitrogen emission during manure collection in a freestall barn. M. Aguerre*[1], T. Hunt[2], C. Weigel[2], and M. Wattiaux[1], [1]*University of Wisconsin*, *Madison*, [2]*University of Wisconsin*, *Platteville*.

The objective was to measure the effect of dietary CP on estimates of N emission during collection of manure excreted by lactating cows housed in a freestall barn. At the beginning of the trial, 73 cows averaging 170 DIM (SD = 117) were randomly divided in two groups and assigned to two dietary treatments: a recommended diet (REC) formulated to meet the requirements (NRC, 2001) for rumen degradable protein (RDP) and rumen undegradable protein (RUP), or an excess diet (EXC) formulated to supply 10 % excess of RDP and RUP for a production of 36 kg/d of milk. Diets were fed during 4 monthly periods (January to May 2004, except April). Dry matter intake and milk yield were recorded daily. Feed and milk samples were collected at the end of each period. Manure produced in 24 hrs was recorded and sampled after scrapping the alleys in 6 4-hr periods staggered over 3 consecutive days. Dietary CP was 15.9 and 17.1 % (DM basis) for the REC and the EXC diets, respectively, and milk production was 33.8 kg/d/cow for both dietary treatments. Assuming no net gain or loss of body N over the course of the trial, expected manure N was calculated as N intake minus milk N. Observed manure N was the total amount collected from the alleys. Unaccounted N was calculated as expected manure N not recovered from the alleys. Intake of N was lower, but milk N (kg/d/cow) and manure N (%) were the same when cows were fed the REC diet compared with EXC diet. Expected manure N was 0.05 kg/d/cow lower in the REC than the EXC diet. Observed manure N was lower than expected manure N and averaged 0.38 kg/d/cow for both diets. Using unaccounted N as an indicator of N emission, results suggest that losses during collection were influenced strongly by the level of dietary N with higher emission when cows were fed excess dietary N relative to NRC recommendations.

	Rec. Avg	Diet SD	Exc. Avg	Diet SD
N intake, kg/d/cow	0.61	0.04	0.66	0.03
Milk N, kg/d/cow	0.17	0.01	0.17	0.01
Expected manure N, kg/d/cow	0.44	0.04	0.49	0.04
Manure N, % manure DM	3.49	0.3	3.47	0.2
Observed manure N, kg/d/cow	0.38	0.05	0.38	0.03
Unaccounted N, %	14	11.4	21	8.2

Key Words: Air Quality, Manure, Nitrogen

M150 The use of bioaugmentation to reduce odor and enhance nutrient profile in stored dairy manure. C. Ballard*[1], K. Cotanch[1], J. Darrah[1], E. Thomas[1], S. Kramer[1], W. Donohue[2], and W. Campion[2], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Pro-Act Microbial, Inc.*, *Portsmouth, RI*.

Manure management is becoming an increasingly complex issue with regulatory pressures on livestock producers to minimize odor emissions. Pro-Act Microbial, Inc. (PM) has developed a bioaugmentation process, which works as a three-stage digester in manure lagoons and pits. The objectives of this study were to determine the efficacy of the PM system to reduce solids content of stored slurry manure, the effect of the PM system on the nutrient composition of manure at the upper and lower depths of stored dairy manure slurry, and the efficacy of the PM system to reduce objectionable odor and volatile ammonia and hydrogen sulfide in slurry manure. Eight 3785-liter vertical poly tanks were stored above ground and filled with 3200 liters dairy manure slurry averaging 4.16% solids. Tanks were blocked by fill order from spreader and assigned to either control or PM. Microbes, growth accelerator and cycle additive were added to the PM tanks ½ hour after filling. One aquarium pump was installed on each PM tank to serve as a surface aerator. Manure from each tank was sampled at filling and from the top 15-30 cm and bottom 15-30 cm after 67 d of storage. Samples were analyzed for DM, pH, total N, P_2O_5, K_2O, P, ammonia and hydrogen sulfide emissions and odor panel evaluation. No difference in solids content, total N, P_2O_5, K_2O, or P was found. Hydrogen sulfide emissions were significantly less for the PM-treated manure at both depths of manure sampled. Ammonia levels at the bottom of the tanks were also lower for PM. These findings were confirmed by a sensory panel, with 88.89% of panelists finding the PM-treated manure obtained from the top 15-30 cm less offensive while no differences in odor were found for manure from the bottom of the tanks. Manure treated with PM appears to reduce odor gas emissions after 67 d of storage.

Time required for odor gas levels to reach 20 mg/L.

Item	Control	PM	SE	*P*
Ammonia	Time	(seconds)		
Top	388.50	480.25	51.16	0.294
Bottom	474.00	630.00	18.66	0.010
Hydrogen Sulfide				
Top	451.50	1848.50	61.69	<0.001
Bottom	430.00	1217.75	22.21	<0.001

Key Words: Manure, Odor, Additives

M151 Using nonlactating cattle to improve the transition of lactating cows into a new freestall barn. C. Hill*, M. Greenwood, C. Ballard, and R. Grant, *W.H. Miner Agricultural Research Institute*, *Chazy, NY*.

The objective of this study was to determine if conditioning a new freestall barn with heifers and dry cows would improve the rate of adaptation of lactating cows to the new facility. Two pens of 68 stalls each in a new, four-row freestall barn were used in this experiment. The first pen was divided into two halves of 32 stalls each. To condition the pens, pre-breeding heifers were housed in one section and dry cows were housed in the second for 4 weeks prior to introduction of lactating cows to the barn. The second pen was left vacant and unconditioned during this period. Ten primi- and ten multiparous lactating Holsteins between 52 and 182 DIM were blocked according to lactation, mature equivalent milk, and body weight prior to the study and randomly assigned to one of two treatments: conditioned pen (Cond) or unconditioned pen (Uncond). The 20 cows were observed for 24 h and behavioral observations were recorded at 15-min intervals. Observations were performed at -46 d, +2 d, and +17 d relative to moving into the new barn. The -46-d observation was performed in the old barn and used as a covariate in the analysis. Cows moved into either Cond or Uncond pen showed no difference in resting times at +2 d. There was a numerical, but nonsignificant increase in % of day spent resting for cows in the Uncond pen at +17 d (51.5 vs. 56.1%). Time spent feeding and number of meals were also similar for both treatment pens. Rumination decreased slightly at +2 d and +17 d for Cond cows after moving to the new facility, but remained constant for cows in the Uncond pen. Both groups showed a decrease in milk yields after moving into the new facility, with the Uncond pen showing a larger numerical decrease. Housing cattle in a new barn before introducing lactating animals did not seem to affect the adaptation rates of the lactating cows to the new facility. Although the Uncond pen was left empty and clean prior to moving lactating animals, it was not possible to prevent the aroma of the animals in the other pens from diffusing throughout the barn. Therefore, the olfactory stimulus may have eased the adjustment of these cows to the new facility.

Key Words: Adaptation, Cattle Behavior

M152 An adjustment of the empirical Bayes prediction of milk production. J. Villagómez-Cortés* and A. de Vries, *University of Florida*, *Gainesville*.

Objective of this study was to improve the empirical Bayes prediction of future milk weights. The Bayes prediction method was proposed as a means to extend a partial lactation record to obtain estimates of milk weights in the remainder of the lactation. Prediction of future milk production of a cow is important for optimal culling decisions. The originally proposed empirical Bayes prediction method produced better predictions than those produced with the DHIA extension factors. The original method consists of fitting Wood's incomplete gamma function to a reference set of completed lactation milk weights. The reference set of completed lactations should come from cows that are similar to the cow for which predictions are sought. The milk weights from a cow's partial lactation are weighted with the estimated milk weights from the Wood's functions fitted on the reference data set to obtain a realistic, cow-specific Wood's function that can be used to predict future milk weights. However, when few milk weights are available, the resulting Wood's function tends to be near the average of the reference data set. This function may not be realistic for a cow that produced significantly less or more milk in the early part of the lactation. The proposed adjustment consists of regressing a cow's available milk weights on her predicted milk weights from the original method and then adding the intercept to those predicted future milk weights. To test this adjustment, test day milk weights of 386 first lactation cows from a Florida dairy herd were used as the reference set. The first 4 milk weights of 10 randomly selected first lactation cows were used to obtain cow-specific Wood's functions. The average prediction error (actual minus predicted milk weights) for the remainder of the lactation was calculated with and without the addition of the intercept. Average prediction errors were 1.2 ± 4.1 kg and 6.0 ± 4.8 kg, respectively. These results indicate that the adjustment may predict future milk weights better than the original Bayes method.

Key Words: Bayesian, Prediction, Lactation Curve

M153 Economic evaluation of pre-synchronization and resynchronization protocols in lactating dairy cows. R. C. Chebel*[1], H. M. Rutigliano[2], R. L. A. Cerri[2], R. Bruno[2], and J. E. P. Santos[2], [1]*University of Idaho*, *Caldwell*, [2]*University of California-Davis*, *Tulare*.

Holstein cows (1,019) were assigned to a pre-synchronization with $PGF_{2\alpha}$ (CON) or $PGF_{2\alpha}$ and CIDR (CTAI and CED). All cows received 2 injections of $PGF_{2\alpha}$ on d 35±7 and 49±7. Cows in CTAI and CED received a CIDR on d 42±7. After the 2nd PGF2a and CIDR removal on d 49±7, cows were observed for estrus, but only CON and CED were inseminated. On d 62±7 cows not inseminated began the Ovsynch and were timed AI on d 72±7. Blood samples were analyzed for progesterone (P4) on d 35±7, 49±7, and 62±7 and cows were classified as anovulatory (ANV) if P4 < 1.0 ng/mL on d 35 and 49, or otherwise ovulatory (OVL). On d 14±1 after the 1st AI cows were assigned to a resynchronization with CIDR for 7 d (RES) or no resynchronization (RCON). Economic analysis was performed for the first 305 d in milk and included values for: drugs, treatment, semen, estrous detection, AI, milk revenue, feed, cost of days open (DOPN), and value of the cow at the end of the study. Costs were calculated using actual on farm values. Cost of DOPN was calculated as described by French et al. (2003) for a milk price of U $0.30/kg. Cow value was determined according to pregnancy status (pregnant vs open) and if it was marketed or dead by 305 d in milk. The net revenue (NR) for each cow was then calculated and included the cow value at the end of the study period. Data were analyzed using the GLM procedures of SAS (2001). Pre-synchronization protocol had no effect on DOPN, cost of DOPN, cow value, and milk income, but AI cost of cows in the CTAI group was in average U $6.81 higher than CED and ED ($P < 0.01$); however, net revenue was also not affected. Re-synchronization protocol affected DOPN (RES = 157 vs. RCON = 171, $P=0.03$), but it did not affect cost of DOPN, cow value, milk income, AI cost, and NR. The average cow value for cows receiving CED+RES protocols tended to be $92 higher than the other treatment interactions ($P = 0.09$) and the NR from cows receiving CED+RES was $214 higher ($P = 0.03$). Ovulatory cows had lower cost of DOPN (OVL = $221 vs. ANV = $323, $P<0.01$) and higher NR (OVL = $3,723 vs. ANV = $3,364, $P < 0.01$). Pre-synchronization and re-synchronization did not affect NR, but interaction of CED+RES improved NR. Ovulatory cows had improved NR when compared to ANV cows.

Acknowledgements: The authors would like to thank the owner and staff of the Rancho Teresita dairy.

Key Words: Pre-synchronization, Re-synchronization, Economics

M154 Prediction of profitability using milking center data in dairy farms. E. Zimmerman*, J. Delahoy, L. Holden, J. Hyde, B. Hilty, and C. Dechow, *Penn State University*, *University Park*.

Management and use of assets in the milking center impacts overall farm profitability. Return on assets (ROA) is an important indicator of overall profitability, accurately measuring returns as a percentage of total assets invested in the business, regardless of how those assets are financed. The objective of this study was to predict ROA using management and production characteristics associated with the milking center. Appropriate explanatory variables were determined using multivariate analysis in SAS. Data was collected in 2001 from 88 Pennsylvania dairy farms with a subset of 37 farms providing complete financial data for analysis. The average herd size of the dairies was 316 (± 256) cows. The average milk production was 71.3 (± 7.10) pounds per cow in 2001. The average farm size of the dairies was 400 (± 285.8) acres. Average ROA of the dairy farms was 6.89% (± 4.77%). In this dataset, ROA was best explained by herd size (SE: 0.0058), use of the California Mastitis Test (CMT) to detect mastitis (SE: 1.332), and use of bulk tank mastitis cultures (SE: 1.247). The ROA was negatively affected by somatic cell count (SCC) (SE: 1.287) and individual culturing for mastitis detection (SE: 1.363). Groups of production and management factors associated with milking center management can be effectively used to predict return on assets.

Key Words: Profitabilty, Milking Center

M155 A partial budget for change in milking frequency and cow numbers with constrained parlor use. B. Carr[1], M. McGilliard*[1], W. White[1], G. Bethard[2], and R. Pearson[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*G&R Dairy Consulting, Inc.*, *Wytheville, VA*.

A computer spreadsheet was developed to determine the economic advantage of changing cow numbers and milking frequency while maintaining constant hours of parlor use. Input characteristics of the farm included number of milking stalls, employees, and hours of operation for each parlor. Cows in milk were described by number of groups of different sizes, milk yield, body weight, parlor turns per hour, and milking frequency per day. Economic parameters included prices for milk, feed, parlor labor, milking supplies, replacement cows, cull cows, dry cow care, and other marginal costs per cow. Investment costs were included for additional housing facilities and cows purchased for expansion, amortized over 5 and 3 yr (1/cull rate) respectively. A base herd situation can be entered and changes made to it, mostly in terms of number and sizes of cow groups, milking frequency, parlor throughput, and expected milk yield of each group. Scenarios were compared by expected change in net operating income, adjusted for amortized change in capital investment for cows and additional facilities. Expansion costs included cows, housing facilities (priced per cow), and a complement of dry cows. An example herd of 1200 cows in milk, grouped in 5 groups of 240 cows each, was milked twice daily with 4 turns/h in a D-20 parlor in 15 h. To evaluate the consequences of partial 3x milking, one group was reduced to 200 cows (to maintain 15 h/d parlor use) and milked three times daily (+10% milk) with 5 turns/h. Annual milk income decreased by $77,000 while operating expenses decreased by $50,000, replacement cost decreased by $20,000, and amortized cow sales increased by $32,000, for an annual increase of $25,000 in net cash income. Results were particularly sensitive to estimates of milk response and parlor turns per hour from an increase in milking frequency, and were sensitive to cow prices when herd size changed.

Key Words: Management, Milking Frequency, Parlor Throughput

Ruminant Nutrition: Beef Cattle

M156 Effects of replacing corn grain and urea with condensed corn distillers solubles in diets for finishing steers. D. Pingel* and A. Trenkle, *Iowa State University*, *Ames*.

Corn distillers solubles (CDS) a co-product from the dry mill corn ethanol plants is often available at a low cost. Two experiments were conducted to evaluate CDS when fed to finishing steers replacing a portion of the corn and urea. In Exp I, 96 steers (Angus and Charolais crossbred, 386 kg) were stratified by weight and randomly allotted to 16 pens. The steers were fed dry rolled corn and 5% silage and 5% hay with 0%, 4%, 8%, and 12% CDS (DM basis) for 109 d. Daily feed, gain and feed/gain were 9.1, 9.6, 9.7, and 9.4 (kg/d); 1.75, 1.78, 1.75, and 1.79 (kg/d); 5.21, 5.40, 5.51, and 5.27; for 0, 4, 8, and 12% CDS respectively, and were not statistically different (P>0.05). Carcass traits were not statically different (P>0.05). In Exp II ten beef steers were used in two simultaneous 5x5 Latin squares to evaluate replacing dry rolled corn and urea with 4 and 8% CDS, or 10 and 20% wet corn distillers grain with solubles (WDGS). The steers were placed in digestion crates for total collection of feces and urine during a 5 d period following 14 d of diet adaptation. Dry matter intake, DM digestibility, NDF digestibility, and ADF digestibility were 7.99, 8.73, 8.62 and 8.41, 7.96 (kg/d); 79, 78, 76 and 77, 76%; 53, 52, 44 and 52, 55%; 41, 44, 34, and 48, 48%; for 0, 4 and 8% CDS, and 10 and 20% WDGS, respectively. Replacing corn and urea with distillers co-products did not affect digestibility of the corn-based finishing diet (P>0.05). The results of these studies suggest that corn distillers solubles can replace a portion of the diet in finishing beef steers without affecting digestion, performance or carcass value.

Key Words: Cattle, Distiller's Co-products, Digestibility

M157 Effect of clinoptilolite zeolite on cattle performance and manure nitrogen. D. Sherwood*, G. Erickson, T. Klopfenstein, and D. Schulte, *University of Nebraska*, *Lincoln*.

Zeolite clay may be effective in reducing N losses from feedlots. A summer feedlot trial was conducted from May to September using 96 crossbred yearling steers (382 ± 7 kg) to evaluate effects of adding clinoptilolite zeolite at 1.2% of the diet on steer performance and N removed in manure. Steers were stratified by weight and assigned randomly to 12 pens and one of two treatments. Treatments were 1) control diet with 0% zeolite clay (CON) or 2) treatment diet with 1.2% clinoptilolite zeolite clay (CZ). Diets consisted of 62.5% dry rolled corn, 25% wet corn gluten feed, 7.5% alfalfa hay and 5% supplement. Nitrogen intake was calculated using analyzed dietary N concentration for each feedstuff and total DMI. Individual steer N retention was calculated using the NRC (1996) net protein and net energy equations. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Manure N was calculated from the weight of manure hauled and N composition. The percent N recovered was calculated by dividing manure by excreted N. Ammonia emissions were measured weekly during the last six weeks of the feeding period using wind tunnels and an acid trap for 30 minutes in each pen. There were no statistical differences in steer performance between CON and CZ. There was no difference (P=0.61) in ADG between the CON and CZ steers (1.82 vs. 1.79 kg). Gain to feed was not significant (P=0.33) with the CON and CZ steers at 0.145 and 0.138. Nitrogen in manure was not affected (P=0.62) by treatment with 18.2% recovered for CON and 17.2% recovered for CZ. Ammonia emissions were not different (P=0.58) between the CON and CZ pen treatments (53.7 and 59.3 g/hd/d). This trial indicates that feeding clinoptilolite zeolite does not have a negative effect on steer performance. However, N recovery in manure and ammonia emissions was not affected by feeding clinoptilolite zeolite.

Key Words: Cattle, Nitrogen, Emissions

M158 Variation in digestibility of undegradable intake protein among feedstuffs. J. MacDonald*, T. Klopfenstein, and G. Erickson, *University of Nebraska*, *Lincoln*.

Two ruminally and duodenally cannulated steers fed smooth bromegrass hay (IVDMD=58.4%) were used in a mobile bag analysis to determine undegradable intake protein (UIP), total tract indigestible protein (TTIDP) and UIP digestibility (UIPDIG) values for ingredients used in four growing trials. Three of the trials were grazing studies in which at least two ruminally cannulated heifers were used to collect diet samples of the grazed forage throughout the grazing season. Animals on these studies rotationally grazed smooth bromegrass pastures. Diet samples were collected at two times for trial 1 (T1), three times for trial 2 (T2) and eight times for trial 3 (T3). Other samples used in this analysis were: a commercially available methionine source (MET), corn cobs (COB), bloodmeal (BM), corn gluten meal (CGM), SoyPass® (SP), feathermeal (FM), two sources of dry distillers grains (DDGA and DDGB), sorghum silage (SS) and corn bran ruminally incubated for 21 or 30 hours (Bran21 and Bran30). Other samples were ruminally incubated for 16 hours except for forage samples (COB, SS, and grazed diet samples) which were ruminally incubated for 75% of their mean retention time (20 to 30 hours) as determined by their IVDMD. The UIP (% CP) content for grazed diet samples tended to be different (P=0.07) for samples collected in T1 (18.8 vs. 13.9 ± 1.00), increased quadratically (P=0.02) with time in T2 (8.10, 19.2, and 17.5 ± 1.11) and were not different across time (P=0.17) in T3 (mean=10.7 ± 0.94). The TTIDP (%CP) content of grazed diet samples were different (P=0.04) in T1 (9.05 vs. 6.02 ± 0.81) increased linearly with time (P=0.01) from 3.30 to 10.2 ± 0.94 in T2, and increased linearly with time (P<0.01) from 4.65 to 6.80 ± 0.65 in T3. The UIPDIG (%UIP) did not change with time in any of the three trials (P>0.18) and averaged 51.7 ± 1.82, 49.2 ± 5.40, and 45.1 ± 4.75 for T1, T2, and T3, respectively.

Results for other samples are in table 1. There is large variation in UIPDIG that should be considered when calculating metabolizable protein balances.

Table 1. Protein Digistibility Values for Selected Feedstuffs

Sample	CP (%DM)	UIP (%CP)	TTIDP (%CP)	UIPDIG (%UIP)
MET	47.4	101[a]	34.5[a]	65.9[a]
COB	3.78	91.1[b]	44.1[b]	51.6[b]
BM	84.7	89.5[b]	11.8[cd]	89.6[c]
CGM	70.1	69.7[c]	3.55[e]	94.9[c]
SP	49.7	65.3[d]	2.20[e]	96.6[c]
FM	85.8	60.4[e]	16.4[d]	72.9[d]
DDGA	29.7	55.7[f]	5.52[ef]	90.0[c]
DDGB	31.0	51.3[f]	5.70[ef]	88.9[c]
SS	8.89	19.9[g]	12.6[cd]	36.3[e]
Bran21	14.4	18.6[g]	12.7[cd]	31.3[e]
Bran30	14.4	16.6[g]	10.6[cf]	35.4[e]
SE	—	1.98	1.84	3.38

[abcdefg]Superscripts within column differ (P<0.05).

Key Words: Undegradable Intake Protein, Digestibility, Metabolizable Protein

M159 Starch digestion by feedlot cattle: Predictions from analysis of feed and feces for N and starch. R. Zinn*, L. Corona, F. Owens, and R. Ware, *University of California*, *El Centro*.

Data from 32 metabolism trials involving 147 steers and 639 individual starch digestibility measurements were compiled to evaluate the utility of N as a digestion marker to predict total tract starch digestion. All trials were conducted at the University of California Desert Research and Extension Center. Starch digestibility was determined using chromic oxide as an indigestible marker. Animal observations consisted of 10-d for diet adjustment followed by 4-d for collection. During collection, fecal samples (approximately 200 g wet basis) were taken twice daily. Samples from each steer and within each collection period were composited for analysis. Diets contained 46.5 ± 7.4% starch and 1.85 ± 0.20% N. Dietary N concentration explained 14.5% of the variation (P < 0.0001) in apparently digestible N as a percentage of N intake (averaging 67.7%), and 72% of the variation (P < 0.0001) in apparently digestible N as a percentage of diet DM (averaging 1.26%). For calculation purposes, total tract N digestion was estimated using the equation of Holter and Reid (1959; digN, % diet DM = 0.929 diet N, % - 0.5568). Fecal starch concentration (FS, %) alone explained 94.7% of the variation (P < 0.0001) in total tract starch digestibility (TSD, %): TSD = 100.5 - 0.651 FS. Total tract starch digestion (ETSDN, %) was calculated from dietary N (DN, %), fecal N (FN, %), dietary starch (DS, %), and FS as follows: ETSDN =100*(DS - (((DN - ((0.929*DN) - .00557))/FN)*FS))/DS. These values explained 97.1% of the variation in TSD (TSD = 1.029 ETSDN - 2.59, P < 0.0001). Omitting cases where TSD was less than 95% so that data was restricted to steam flaked grain, FS explained 82.0% of the variation (P < 0.0001) in TSD (TSD = 99.9 - 0.463 FS) whereas ETSDN explained 91.8% of the variation (P < 0.0001) in TSD. Based simply on dietary and fecal concentrations of starch and N, starch digestibility was reliably determined. This procedure can markedly simplify field measurements of total tract starch digestion to assess grain quality and efficacy of processing (e.g., steam flaking; silage processing).

Key Words: Starch, Digestion, Cattle

M160 Influence of corn vitreousness and processing on site and extent of digestion by feedlot cattle. L. Corona* and R. Zinn, *University of California*, *El Centro*.

Eight cannulated Holstein steers (251 kg) were used in a split plot design involving two 4 x 4 Latin squares to test effects of processing method [dry rolled (DR) vs steam flaked (SF); main plot], and vitreousness (V, %; sub-plot) of yellow dent corn (V55, V61, V63 and V65) on site of digestion of diets containing 73.2% grain. No V by processing method interactions on ruminal digestion were detected, but ruminal starch digestion was less (14.4%, P < 0.01) while ADF digestion was greater (77%, P < 0.05) for DR than SF. Interactions (P < 0.10) between V and processing method on post-ruminal and total tract digestion were detected. Post-ruminal digestion of OM and starch digestion was greater for the least vitreous DR (V55) sample but no impact of V on digestion was detected with SF corn. Averaged across V, post-ruminal digestion of OM (25.7%, P < 0.05) starch (94.3%, P < 0.10) and N (10.7%, P < 0.01) were greater for SF than for DR corn. Steam flaking increased total tract digestion of OM (11%, P < 0.05), starch (16%, P < 0.01), N (8.4%, P < 0.05), and energy (13.8%, P < 0.05), but decreased total tract ADF digestion (26.7%, P < 0.01). With DR, total tract starch digestion was lower for V65 than for V55 (6.2%) and V63 (5.6%). With SF, total tract starch digestion was not affect by V. Fecal starch (FS) and total tract starch digestion were inversely related (starch digestion, % = 101 - 0.65 FS; $r^2 = 0.94$, P < 0.01). Ruminal pH was greater for steers fed DR than for steers fed SF (7.3%, P < 0.05). Steam flaking decreased (P < 0.01) the acetate:propionate ratio (55%), and estimated methane production (37.5%). Differences in corn vitreousness can impact site of digestion of corn components, but the impact of vitreousness was minimized or even reversed when corn was flaked.

Key Words: Corn, Vitreous, Digestion

M161 Corn or soybean hull incorporation into haylage-based backgrounding diets; effect on growth and efficiency during the backgrounding and finishing phases. M. Ko*, C. J. Mader, and K. C. Swanson, *University of Guelph*, *Guelph, Ontario, Canada*.

This experiment was conducted to evaluate the effects of corn or soybean hull incorporation into haylage-based diets on backgrounding calf performance and subsequent feedlot performance. Cross-bred steers (n=48, initial BW=302.5±3.4 kg) were individually fed for ad libitum intake using Calan gates. Dietary treatments included: 1) haylage (17.4% CP, DM basis; control), 2) haylage+20% (DM basis) cracked corn (CC), and 3) haylage+20% (DM basis) soybean hulls (SBH) during a 112-d backgrounding phase. Feed refusals were collected weekly and BW were recorded every 28 d throughout the experiment. During the backgrounding phase, blood samples were obtained every 28 d and analysed for plasma urea nitrogen (PUN). After the backgrounding phase, all steers were adapted to a common high moisture corn-based finishing diet. Steers were slaughtered when ultrasound estimated backfat thickness reached 7 mm. Means were compared using contrast statements (conrtol vs. CC+SBH, CC vs. SBH). During the backgrounding phase, steers fed CC or SBH had greater (P<0.01) average daily gain (ADG), dry matter intake (DMI) and gain:feed (G:F) as compared to controls (0.96, 0.91 vs. 0.55 kg/d; 7.02, 6.95 vs. 6.14 kg/d; 0.13, 0.13 vs. 0.08, respectively). Steers fed CC or SBH had lower (P<0.01) PUN concentration as compared to controls (12.8, 12.8 vs. 13.7 g/dl). ADG, DMI and G:F did not differ between steers fed CC or SBH. During the finishing phase, steers fed SBH had lower (P<0.07) ADG and finished BW than steers fed CC (1.59 vs. 1.76 kg/d; 617.9 vs. 648.7 kg). DMI (10.9 kg/d), G:F (0.16) and days required to finish (139 d) did not differ between steers fed CC or SBH. Including CC or SBH at 20% of the diet in haylage-based backgrounding diets improved growth performance suggesting that either CC or SBH could be included to improve growth and efficiency. However, when finished on a common high-concentrate diet, steers previously fed CC had greater ADG than those fed SBH suggesting that source of supplemental energy during the backgrounding phase may influence subsequent feedlot performance.

Key Words: Beef Cattle, Growth Performance, Energy Supplementation

M162 Withdrawn.

M163 Energy required by beef calves was more accurately predicted by effective energy than net energy calculations. J. W. Golden* and M. S. Kerley, *University of Missouri*, *Columbia*.

The efficiency in which cattle use nutrients for tissue accretion influences profitability in the feedlot. Individual feed intake measurements in group-fed cattle has allowed measurement of the feed conversion ratio (FCR) phenotype. Realized from this phenotypic measurement was the genetic variation among animals and the moderate heritability of this trait. This genetic variation has resulted in the development of expected progeny differences and targeting genetic markers to guide selection for this trait. Interestingly, less emphasis has been placed on targeting nutritional management strategies that impact FCR, even though optimizing rumen degradable protein (RDP) and absorbable amino acids (IAA) in the diet has been shown to improve FCR. To understand how nutritional modifications impact FCR, it is imperative that energy expenditure can be accurately calculated. The net energy system (NE) was not capable of characterizing the measured FCR in cattle (n = 14 animals per treatment) fed diets balanced for RDP and IAA. However, characterization of energy expenditures by the effective energy (EE) system agreed with measured FCR and growth data in calves. When maintenance energy expenditure was corrected for calculated vs measured values (EE_{adj}), measured FCR was in agreement with effective energy calculations of energy requirements. In this experiment EE calculations agreed with FCR and actual energy intake measurements whereas NE calculations underpredicted energy requirement for maintenance and/or growth.

Diet[1]	BMN	BMH	SBM-PF	SBM-H
NE[2]	0.63	0.75	0.82	0.83
EE[3]	0.9	1.03	1.04	1.05
EE_{adj}[4]	0.98	1.13	1.15	1.15
FCR	3.9	4.8	5.1	5.0
BWI (kg)[5]	313	317	329	328
BWF (kg)[6]	501	474	420	488
ADG (kg)	2.2	1.9	1.7	1.9

[1]Corn-based diets with bloodmeal (BM) and no hay (BMN), BM and 10% hay (BMH), soybean meal (SBM) and hay pair fed to BMN (SBM-PF), or fed ad lib (SBM-H). [2]NE consumed:NE required. [3]EE consumed: EE required. [4]Adjusted EE maintenance. [5]Initial body weight. [6] Final body weight

M164 Evaluating the prediction of dry matter intake and average daily gain in backgrounding cattle. M. S. Whetsell*[1], E. B. Rayburn[1], J. P. S. Neel[2], J. P. Fontenot[3], and W. M. Clapham[2], [1]*West Virginia University*, *Morgantown*, [2]*United State Department of Agriculture- Agriculture Researchg Service, Apalachian Farming System Research Center*, *Beaver, WV*, [3]*Virginia Tech*, *Blacksburg*.

On a farm, historical experience is used to develop a forage-livestock system considered the optimum for the farm by the farmer. Computer models allow extension staff and farmers to evaluate alternative farming systems or system components without investment of capital or exposure to risk. In this study we evaluated the accuracy of the 2000-update National Research Council "Nutrient Requirements of Beef Cattle" computer model for predicting calf performance during backgrounding. Seventy-two British or British cross stocker steers were used to measure performance during the fall 2001 and spring 2002 in Morgantown, West Virginia. The calves were randomly assigned to one of the three forage based wintering diets, designed to provide three distinct production levels (0.25, 0.50 and 0.75 kg per animal). The treatments were timothy hay supplemented with soybean meal or soybean meal and soybean hulls at two different levels. The National Research Council model was used to predict average daily gain (ADG) of the cattle using dry matter intake (DMI) calculated using the NRC 2000 calf DMI equation and also the observed DMI. Model DMI error was measured by calculating the model DMI residuals, the difference between predicted DMI minus observed DMI. Model error was also measured for ADG. Results showed that the predicted DMI was similar to that observed and slightly lower than that predicted by the calf DMI equation based on ration NEM (P<0.001). However, ADG using either equation (estimated DMI or observed DMI) was about 0.3 kg animal^{-1} day^{-1} lower than observed ADG (P<0.001). Results indicate that the model did not accurately predict animal performance of the cattle on feed but it did predict the increase in performance across treatments as energy content of the diet increased.

Acknowledgements: This study was conducted as part of the USDA/ARS funded project "Pasture-Based Beef Systems for Appalachia", a multi-institutional project conducted by the ARS Appalachian Farming System Research Station at Beaver WV, West Virginia University, Virginia Tech, and the University of Georgia.

Key Words: Beef Cattle, Computer Model, Perfomance

M165 Application of Lineweaver-Burk data transformation to explain animal and plant performance as a function of nutrient supply. R. P. Lana*[1,2], R. H. T. B. Goes[3], L. M. Moreira[1], A. B. Mâncio[1], and D. M. Fonseca[1], [1]*Universidade Federal de Viçosa-DZO*, *Viçosa, MG, Brazil*, [2]*CNPq*, *Brasília, DF, Brazil*, [3]*Universidade Estadual de Maringá*, *Umuarama, PR, Brazil*.

The efficiency of using concentrate supplements on daily weight gain of growing cattle under tropical pasture during the dry season and nitrogen fertilization on growth rate of tropical pasture (ton of dry herbage mass/hectare/110 days) and consequently stocking rate and cattle growth rate exclusively under pasture during the rainy season (kg of body weight gain/hectare/110 days) were evaluated. The animal and plant responses to the increasing amount of nutrient supply were curvilinear and were related to the saturation kinetics typical of enzymatic systems; therefore, the animal and plant growth rates follow a Michaelis-Menten relationship. The Lineweaver-Burk data transformation efficiently explained the animal and plant responses to the nutrient supply. This methodology consists in evaluating linear regressions of the reciprocal of animal and plant responses as a function of the reciprocal of nutrient supply. The half maximum plant and animal growth rate responses to the nutrient supply were verified with 5.3% nitrogen fertilization and 5.6% concentrate ration supplementation, respectively. From the curvilinear response, it can be verified that the marginal increase in animal and plant growth rate reduce as the amount of nutrient supply increase. The 1996 beef NRC, based on the Californian net energy system and the metabolizable protein system, does not consider the curvilinear relationship of animal growth rate as a function of concentrate supply, for both energy and protein. Therefore, more research needed to be done to better understand this effect, because of its economical and environmental importance.

Key Words: Cattle, Michaelis-Menten, Pasture

M166 Screening for the effects of natural plant extracts at two pH levels on in vitro rumen microbial fermentation of a high-concentrate beef cattle diet. P. W. Cardozo[1], S. Calsamiglia*[1], A. Ferret[1], and C. Kamel[2], [1]*Universidad Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*Axiss France SAS*, *Bellegarde-sur-Valserine, Cedex, France*.

Six natural plant extracts and 3 secondary plant metabolites were tested at 5 doses (0, 0.3, 3, 30, and 300 mg/L) and 2 levels of pH (7.0 and 5.5) in a duplicate 9 × 5 × 2 factorial arrangement of treatments to determine their effects on in vitro microbial fermentation using rumen fluid from heifers fed a high concentrate finishing diet and incubated for 24 h at 39 C. Treatments were: extracts of garlic (GAR), cinnamon (CIN), yucca (YUC), anise (ANI), oregano (ORE), and capsicum (CAP), and pure cinnamaldehyde (CDH), anethole (ATL) and eugenol (EUG). Each treatment was tested in triplicate and in two periods. Samples were collected for ammonia N and volatile fatty acid (VFA) concentrations. Differences were declared at P < 0.05. The high doses of all plant extracts decreased total VFA concentrations in both pH. When pH was 7.0, ATL, GAR, CAP and CDH reduced total VFA concentration, and ANI, ORE, CIN, CAP and CDH increased the acetate to propionate ratio. The CIN, GAR, CAP, CDH, ORE, and YUC reduced, and EUG, ANI and ATL increased ammonia N concentration. The effects of plant extracts on the fermentation profile when pH was 7.0 were not favorable for improving the efficiency of rumen microbial fermentation. In contrast, when pH was 5.5, no changes (ATL, ANI, ORE, and

CIN) or increases (EUG, GAR, CAP, CDH and YUC) in total VFA were followed by lower acetate to propionate ratio (ORE, GAR, CAP, CDH, and YUC) which would be favorable for beef production. Ammonia N (ATL, ANI, CIN, GAR, CAP, and CDH) and BCVFA (ATL, EUG, ANI, ORE, CAP, and CDH) concentrations were also reduced, suggesting that deamination was inhibited. Results indicate that the effects of plant extracts on rumen fermentation in beef cattle diets may differ depending on rumen pH. When pH was 5.5 GAR, CAP, YUC and CDH can alter rumen microbial fermentation in favor of propionate, more efficient in terms of energy.

Key Words: Rumen pH, Fermentation, Plant Extracts

M167 Treatment of ground wheat with tannins: Effects on VFA production during in vitro ruminal incubation. T. F. Martinez[1,2], Y. Wang[1], T. Reuter*[1], and T. A. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Departamento de Biologia Aplicada, Universidad de Almeria*, *Almeria, Spain*.

The potential for condensed (CT) and/or hydrolyzable (HT) tannins to improve ruminant utilization of protein from starchy, high-concentrate feeds, as has been observed with forages, was studied in vitro. Ground wheat (1.0-mm sieve) was pretreated with 0 (as a control, CON) or 50 g/kg DM of commerically available Quebracho extract (as a source of CT) or tannic acid (as HT), freeze-dried, and incubated at 39°C for up to 48 h in ruminal inoculum (strained ruminal fluid + two volumes of anaerobic salts solution). Gas production and VFA accumulation in 125-mL serum vials (200 mg substrate + 20 mL inoculum, plus blanks containing inoculum only) were determined (n = 3). Tannins markedly reduced ($P = 0.033$) accumulation of VFA during the first 12 h of incubation, from 39.9 mM at 0 h to 124.3, 104.3 and 91.6 mM in CON, CT and HT, respectively. Moderate ($P = 0.61$) inhibition of VFA production by tannins was evident at 24, 36 and 48 h. From 0 to 12 h, the acetate:propionate ratio decreased from 4.5 to 2.6 in CON, compared with lesser reductions of 4.5 to 3.3 with CT ($P = 0.021$) and 4.5 to 3.8 with HT ($P = 0.001$). At 24 h, treatment effect on A:P was present but diminished (HT > CT > CON; $P < 0.05$), and at 36 and 48 h, it was no longer evident ($P = 0.781$). Initial effects on A:P (4 to 24 h) were more pronounced with HT than CT ($P < 0.05$). Tannins (CT and HT) decreased branched-chain fatty acid (BCFA) concentrations by 56.8 to 73.9% ($P = 0.009$) at all time points. The observed alterations in VFA production (18% decrease in acetate and 40% decrease in propionate, particularly during the first 12 h of incubation, and markedly decreased BCFA accumulation throughout the 48 h) suggest that CT and HT applied to ground wheat substrate suppressed protein hydrolysis in vitro, and may have value for regulating ruminal hydrolysis of readily fermentable cereal grains fed to livestock.

Key Words: Condensed Tannin, Concentrate Feed, In Vitro Fermentation

M168 Effect of mixed culture of *Lactobacillus paracasei* and *Lactobacillus lactis* and their fermentation products on ruminal fermentation of a barley grain/barley silage diet. Y. Wang*, J. Baah, L. J. Yanke, and T. A. McAllister, *Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*.

Two in vitro experiments were conducted to evaluate the effects on ruminal fermentation of a mixed culture of *Lactobacillus* spp. marketed as a direct-fed microbial for cattle. Ground barley grain/barley silage-based backgrounding (BKG) and finishing (FIN) diets were used in Exps. 1 and 2, respectively, both as substrates for the incubations and as feed for ruminal fluid donor cattle. Inoculum was ruminal fluid diluted with two volumes of mineral buffer. In 125-mL serum vials (15 per treatment; triplicates per time point), 40 mL inoculum were added to 300 mg of substrate, together with a liquid formulation containing *L. paracasei* and *L. lactis* cultures (4.6×10^7 cfu/mL) and their fermentation products (RE3®; Basic Environmental Systems and Technology Inc. Sherwood Park, AB). The RE3® was added at 0, 1.2, 2.4, 3.6, or 4.8 µL/vial, and autoclaved RE3® was also added at 2.4 µL/vial. One set of vials containing inoculum only was also incubated and assayed for correction of measured values. Gas production was measured periodically over 48 h, as well as apparent DM disappearance (DMD) and accumulated VFA after 0, 6, 12, 24 and 48 h of incubation at 39°C. The variables measured were all numerically greater with FIN than with BKG. With BKG, gas production and DMD were unaffected by RE3® at any level; with FIN, DMD was increased ($P < 0.01$) by RE3® at ≥2.4 µL/vial, and by autoclaved RE3® at 2.4 µL/vial. Including RE3® in the incubation increased total VFA at 6 h and 12 h (both $P < 0.001$) with BKG, and at 12 h ($P = 0.03$) with FIN. Acetate:propionate ratios at 24 h were higher with RE3® than without, both with BKG ($P < 0.001$) and with FIN ($P = 0.004$). Greater VFA concentrations at 24 h suggests that the mixed microbial product improved in vitro ruminal fermentation of barley grain/barley silage-based diets.

Key Words: Direct Fed Microbial, Volatile Fatty Acid, Cattle

M169 Effect of Lactobacilli on performance and carcass characteristics of finishing beef steers. J. Baah*, Y. Wang, D. J. Gibb, L. J. Yanke, F. H. Van Herk, and T. A. McAllister, *Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*.

The effects of feeding a mixed culture of *Lactobacillus paracasei* and *Lactobacillus lactis* (Basic Environmental Systems and Technology Inc., Sherwood Park, AB) to finishing cattle was assessed using 100 individually fed Hereford × Angus steers in a 140-d trial. The steers (378 ± 4.5 kg; mean BW ± SE) were balanced by weight and allocated to four dietary treatments, in which a barley-based diet (76% grain, 20% silage, 4% supplement; DM basis) was supplemented with the direct-fed microbial (DFM) at levels of 0 (T1, control), 40 (T2), 80 (T3), or 120 (T4) million cfu/kg (as-fed). The steers had ad libitum access to feed and water, and were weighed every 28 d. Data were analyzed using the MIXED models procedure, with linear and quadratic effects of DFM tested by orthogonal contrasts. Average 28-d calculations of DMI, ADG, and G:F did not differ ($P > 0.10$) among treatments, except from d 29 to 56, when ADG was greater ($P = 0.036$) for groups T2 and T4 than for the controls (1.92 and 1.91 kg, respectively, vs. 1.72 kg), and G:F was improved in group T2 (0.166 vs. 0.139; $P = 0.062$). Overall DMI averaged 10.96 kg/d and was similar ($P = 0.15$) across treatments, but ADG (d 1 to 140) was lower ($P = 0.07$) for steers in T4 (1.56 kg) than for those in T1, T2, or T3 (average of 1.66 kg). The T4 steers also had poorest ($P = 0.004$) overall G:F (0.132 vs. 0.143, averaged across T1, T2 and T3). Overall ADG and G:F were better ($P < 0.10$) in group T2 than in group T4, but neither of these differed from T1 or T3. Carcass weight and grade, dressing percentage and marbling score were unaffected ($P > 0.1$) by treatment, but saleable meat was lower ($P = 0.04$) from steers fed DFM (average 56.4%) than from controls (59.4%). Feeding the mixed *Lactobacillus* culture at the lower dose (40 million cfu/kg) improved ADG and G:F during the first 56 d of the finishing period, but there may not be any economic benefit to feeding the product for the entire 140 d.

Key Words: Direct Fed Microbial, *Lactobacillus*, Cattle

M170 Withdrawn.

M171 Evaluation of the incidence of liver abscess in feedlot cattle fed a dietary antioxidant (Agrado®). M. Vazquez-Anon*[1], F. Scott[1], B. Miller[1], and T. Peters[2], [1]*Novus International, Inc*, *St Louis, MO*, [2]*Dekalb Feeds*, *Rock Falls, IL*.

Liver abscesses commonly occur in feedlot cattle when fed a finishing diet and is associated with lower performance. Four studies were conducted using over 50,000 feedlot cattle to evaluate the effect of feeding the antioxidant 6-ethoxyl-1, 2, 2, 4-trimethylquinoline (Agrado® feed antioxidant) on the incidence of liver abscesses. Study 1: At OSU, 75 crossbred steers (326 kg BW) were fed a ground corn diet with 0 or 135 PPM of Agrado (DM basis) the last 28 d prior to harvest. The incidence of liver abscesses was low for all cattle, but was 34% lower (4.4% vs. 6.7%) for those fed with Agrado. Study 2: At CRF, Lamar, CO, 128 crossbred yearling steers (350 kg BW) were fed a steam-flaked corn diet

with 0 or 150 PPM of Agrado (as-fed basis) for the last 123 d prior to harvest. The incidence of liver abscesses was 25% lower for cattle supplemented with Agrado (14.06% vs.18.75%). Study 3: At Texas Research Feedlot Inc, 1991 beef steers (566 lb BW) were fed a steam flaked corn with none, 125 IU vit E/day or 125vit E +150 PPM Agrado during the finishing phase. Incidence of liver abscess in cattle fed 125 IU vit E was slightly reduced from 13.8 to 12.0%, but was further reduced to 10.2% when fed 125 IU vit E+150 PPM Agrado. Study 4: Liver abscess from 485 beef cattle raised in 9 feedlots fed daily with 500 IU vit E + 150 PPM Agrado during the finishing period were compared to 803 beef cattle raised in 12 feedlots fed daily with 1000 IU vit E. Incidence of liver abscess in groups of cattle fed Agrado averaged 4.9% and ranged from 0 to 7.5% and cattle not fed Agrado averaged 20.5% and ranged from 0 to 37%. Therefore, cattle with diets containing Agrado had 15.3% less liver abscesses than those fed diets not treated with Agrado. From the results of the four studies, the addition of antioxidants such as Agrado to feedlot cattle diets appears to reduce the incidence of liver abscesses.

Acknowledgements: AGRADO is a trademark of Novus International

Key Words: Antioxidants, Agrado®, Liver abscess

M172 Response by steers fed high-forage diets to oral doses of a polyclonal antibody preparation against *Streptococcus bovis* on target bacteria populations and rumen fermentation products. N. DiLorenzo*, R. K. Gill, F. Diez-Gonzalez, J. E. Larson, and A. DiCostanzo, *University of Minnesota*, *St. Paul*.

Five rumen cannulated steers were used in a Latin square design to test effects of an avian-derived polyclonal antibody preparation against *Streptococcus bovis* (PAPSb) on rumen counts of target bacteria and fermentation products. Steers were fed a common diet comprised (DM basis) of 96% corn silage and 4% supplement (supplied 300 mg monensin/hd/d). Diet supplied 0.91 Mcal NEg/kg DM, 11% CP, 0.65% Ca, and 0.35% P. The PAPSb was top-dressed in increasingly concentrated doses (0, 2.5, 5.0, 7.5 or 10 ml PAPSb/hd/d) once daily at 0900 for 7 d. Samples were collected on the 7th d, and steers were permitted to consume a common diet without treatment for 10 d before initiating the next treatment period. Rumen fluid samples were collected pre-feeding, and at 0.5, 2 and 4 h post-feeding for *S. bovis* enumerations, pH and VFA measurements. There was a cubic response ($P < 0.05$) by counts of *S. bovis* to increasing doses of PAPSb. Reductions ($P < 0.05$) in rumen *S. bovis* counts were observed when feeding 2.5, 7.5 or 10 ml PAPSb/hd/d, but not when feeding 5.0 ml PAPSb/hd/d. An interaction between PAPSb dose and sampling time was observed ($P = 0.10$) for rumen *S. bovis* counts. Feeding 7.5 ml PAPSb/hd/d reduced ($P < 0.05$) *S. bovis* counts at 2 h post-feeding; feeding 2.5 ml PAPSb reduced ($P < 0.05$) *S. bovis* counts at 0.5 and 2 h post-feeding; and feeding 10 ml PAPSb reduced ($P < 0.05$) *S. bovis* counts at all sampling times. Feeding PAPSb had no effect ($P > 0.05$) on DMI, rumen pH, VFA or lactate or their molar proportions. Rumen pH decreased ($P < 0.05$) while rumen butyrate, acetate and the acetate: propionate ratio increased ($P < 0.05$) over time ($P < 0.05$). Results indicate that an avian polyclonal preparation against *S. bovis* reduced target bacteria populations without further effects on rumen fermentation products.

Key Words: *Streptococcus bovis*, Steer, Antibodies

M173 Effect of receiving diet on early feedlot health, growth performance and subsequent carcass traits of Angus X Continental cross steer calves. P. Walker*[1], K. Earing[2], J. Ringler[2], A. Antas[3], and R. Hall[4], [1]*Illinois State University*, *Normal*, [2]*University of Kentucky*, *Lexington*, [3]*University of Illinois*, *Urbana*, [4]*Animal Feed and Nutrition Consulting*, *Richmond, IN*.

One hundred seventy-six Angus-Continental crossbred steers (mean wt. = 264±10.3kg) were assigned to 24 pens containing 6 or 10 steers per pen in a randomized complete block design (BW) consisting of a 4 x 3 factorial arrangement (4 dietary treatments in each of 3 blocks) to evaluate the influence of four receiving diets on pre-finishing performance and subsequent finishing performance, and carcass characteristics. The receiving diets consisted of mixed grass hay (brome, orchard and blue grass) fed ad libitum and a supplement fed at 1% BW containing either wheat midds and soy hulls (D1), corn gluten feed and ground shelled corn (D2), corn gluten feed and soy hulls (D3) or corn gluten feed (D4). The receiving period (P1) was 53d. The steers were harvested following a finishing period (P2) of either 195d or 204d. All steers were fed the same shelled corn-soybean meal-corn silage based diet ad libitum during P2. Diet 1 contained 14.7% CP, 2.8% ether extract (EE), 52.8% NDF and 25.9% ADF. Diet 2 contained 15.2% CP, 4.4% EE, 32.6% NDF and 8.7% ADF. Diet 3 contained 14.1% CP, 3.4% EE, 60.8% NDF and 36.8% ADF. Diet 4 contained 24.0% CP, 4.3% EE, 35.5% NDF and 12.1% ADF. The P2 diet contained 15.6±3.2% CP, and 10.2±4.8% ADF. No differences ($P>0.05$) between dietary treatments were observed in number of steers treated for respiratory disease during P1 though the D1 and D3 steers had more numeric pulls for medicinal treatment than D2 and D4 steers. No significant differences were observed between dietary treatments for ADG, ADFI, DMI or G:F during P1. No differences ($P>0.05$) in P2 ADG, ADFI, DMI, G:F or any of the carcass traits were observed. Supplementing grass hay receiving rations with various combinations of wheat midds, soy hulls, corn gluten feed and ground shelled corn can result in similar steer performance during the receiving period with no effect on finishing performance or carcass characteristics.

Acknowledgements: This study was partially funded by Cooperative Research Farms, Richmond, VA.

Key Words: Receiving Rations, Corn Gluten Feed, Soy Hulls

M174 Efficiency of use of concentrate ration for growing animals, under tropical pastures. R. H. T. B. Goes*, R. P. Lana, A. B. Mancio, and D. D. Alves, *Universidade Federal de Viçosa-DZO*, *Viçosa, MG, Brazil*.

The effect of supplementation of tropical pasture (Brachiaria brizantha cv Marandu) was evaluated, considering the performance and the efficiency of the use of concentrate by growing animals. Fifty-five steers, with initial weight of 226 kg, were distributed in five paddocks of five hectares. The treatments were based on increasing supplies of supplements based on corn and soybean meal (0, 0.35, 0.70, 1.40 and 2.90 kg of supplement containing 24% CP/animal/day). The supplement levels affected positively the average daily gain of the animals, presenting a curvilinear behavior ($y = 0.7919x^2 + 1.1906x + 0.3162$, r^2=0.71); but the response was only in the order of 0.10 kilo of gain per each kilo of supplement. The following linear equation of the reciprocal of daily gain (y) as a function of the reciprocal of supplement level (x) was obtained: $y = 0.2639x + 1.3268$, $r^2 = 0.97$. The lowest level of supplementation presented the best result with a conversion of 1.5:1 (kg of supplement/kg of gain). By altering the level of supply from 1.40 to 2.90 kg/animal/day the conversion became 36:1. The maximum response to the supply of nutrients for weight gain (ADGmax) was of 0.75 kg/animal/day (ADGmax = 1/a = 1/1.3268), and the amount of supplement for the animals to respond with 50% of this gain (0.38 kg/day) was 0.20 kg/day (SUPL50%ADG = b/a = 0.2639/1.3268). More research is necessary to understand the effects of the increasing supplementation of nutrients for growing animals under tropical pastures.

Key Words: Cattle, Growth Rate, Tropical Weather

M175 A computing system for adjustment and simulation of growth models and estimation of nutrient requirement for grazing Brahman cattle. M. Pereda-Solís[1], S. González*[2], E. Arjona-Suárez[2], G. Bueno-Aguilar[2], and G. Mendoza-Martínez[2], [1]*Universidad Juárez del Estado de Durango*, *Durango, Durango, México*, [2]*Colegio de Postgraduados*, *Montecillo, Estado de México, México*.

Mathematical models have been used to analyze and predict growth patterns for cattle. A computing system that allows adjustment and simulation of growth models, as well as an estimation of nutrient requirement for Brahman cattle grazing in the humid tropics (Aldama municipality, State of Tamaulipas, Mexico), was developed in our study. The models used are representative of those reported in the literature and may require one to four parameters for their adjust-

ment. Our system was developed using Visual Basic 6.0 under Windows 98. Also, NRC prediction equations for cattle were applied to the growth simulation, in order to calculate intake of DM, NE for gain, Ca and P, emphasizing diet nutrient supply and cattle requirement. Data for birth season (dry or rainy), body weight changes and feeding (Stargrass pastures) for 100 female and 68 male Brahman cattle (first 365 d of age), were obtained from the Mexican Association of Zebu Breeders (Tampico, Tamaulipas). The data were used to adjust four models utilizing Richards equation (Richards, F. J. 1959. A flexible growth function for empirical use. J. Exp. Bot. 10:290-300) and a residual analysis. Calculation of nutrient requirement to obtain the estimated growth for Brahman cattle, was performed with those models. After 120 d growth curves changed according to sex and birth season, and BW gain was larger for males born in the rainy season. Pattern of nutrient requirement showed a shape similar to that of cattle BW calculated with the adjusted models. A posteriori management of estimated results makes a difference between our computing system and others. Results from this study suggest that our system might be a useful tool for analyzing factors affecting productive efficiency, as well as for sensitivity analysis of nutrients required to obtain estimated growth, for grazing cattle in tropical pastures.

Key Words: Simulation and Growth Models, Grazing Brahman, Humid Tropics

M176 Quantitative assessment of visceral energy metabolism in beef steers consuming graded levels of forage. N. Elam*, C. Taylor, S. Kitts, K. McLeod, D. Harmon, and E. Vanzant, *University of Kentucky*, *Lexington*.

Eight multi-catheterized Angus steers (328 ± 40 kg BW) were used to determine the relationship between forage ME supply and visceral metabolism. Experimental design consisted of a replicated 4 x 4 Latin square with four equally spaced forage intakes which provided ME ranging from 0.117 to 0.234 Mcal ME • (kg $BW^{0.75}$ • d)$^{-1}$, approximately 1 to 2 x maintenance energy requirements. Experimental periods were 28-d, and on d 27 or 28 simultaneous arterial, portal, and hepatic blood samples were obtained hourly for 6 h. Blood flows (**BF**) across the portal drained viscera (**PDV**) and hepatic (**HEP**) tissue beds were determined by continuous infusion of P-aminohippurate. Net nutrient flux and oxygen consumption were calculated as the product of BF and venous-arterial concentration differences. Heat production (**HP**) was calculated as 4.89 Kcal/L O2 consumed. Regression analyses were performed to test the effects of ME intake (**MEI**) on visceral energy metabolism. Linear, quadratic and cubic models were fitted using the maximum r^2 selection process. In all instances, quadratic and cubic functions were not significant and were subsequently removed from the model. Metabolizable energy intake accounted for 46, and 32% of the total variation in PDV, and HEP BF, respectively. Moreover, MEI accounted for 52, 39, and 56% of the total variation in PDV, HEP, and total splanchnic (**TS**) HP, respectively. Net nutrient fluxes of glucose, lactate, glutamate, and glutamine across the PDV, HEP, and TS vascular beds were not affected ($P \geq 0.28$) by MEI. These data indicate that both BF and HP by visceral tissues of beef steers fed a forage diet are a function of the level of dietary intake.

Effect of level of metabolizable energy intake on blood flow and visceral heat production

Item[a]	Regression Equation	b_0	b_1
PDV BF	162.09 + MEI(37.56)	0.105	<0.0001
HEP BF	437.72 + MEI(23.21)	0.003	0.029
PDV HP	0.375 + MEI(0.181)	0.369	<0.0001
HEP HP	0.951 + MEI(0.125)	0.101	0.013
TS HP	1.692 + MEI(0.269)	0.063	0.001

[a]PDV = Portal Drained Viscera; HEP = Hepatic; TS = Total Splanchnic; BF = Blood Flow; HP = Heat production

Key Words: Forage Intake Level, Visceral Metabolism, Heat Production

M177 Effect of alternate diets containing corn straw or corn silage as roughage on growth performance of growing bull calves. R. Barajas*[1], B. J. Cervantes[1], R. J. Virgilio[2], J. C. Barraza[1], and P. A. Castro[2], [1]*FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [2]*Tecnologia de Maxima Produccion, S.A. de C.V.*, *Culiacan, Sinaloa, Mexico*.

To determinate the effect of alternate diets containing corn straw or corn silage as roughage on growth performance of growing bull calves, sixty bull calves (Brahman crosses; BW = 207.1 ± 2.7 kg) were used in a 97 feeding experiment. On day 1 the animals were weighed and in agreement with a complete randomized experiment design, in groups of five, were placed in 12 ground pen (6 x 12 m), and randomly designated to one of three treatments: 1) Fed growing diets containing corn straw as roughage (CTR); 2) Fed growing diets containing corn silage as roughage (SL); and 3) Fed straw-diets during the first 28 days and then switched to corn silage-diets (SS). The diets were similar in NEm and CP content. Ending weight (d 97) of SS calves was 5.8% higher (P = 0.03) than others treatments (346, 342 and 363 kg by CTR, SL and SS, respectively). ADG of complete experiment tended (P = 0.10) to be higher for SS respect to SL (1.40 vs. 1.59 kg/d). Silage diets diminished (P < 0.01) DMI respect to CTR. SS diets enhanced (P = 0.05) in 15% feed/gain ratio respect to CTR (5.65 vs. 4.91). SS had the highest NEm (P = 0.02) retained from the diet (1.73, 1.86, and 1.95 Mcal/kg by CTR, SL and SS, respectively). Usage of NEm (Observed/expected ratio) was 11% higher (P = 0.02) for SS (1.10) respect to CTR (0.99), both treatments were not different (P > 0.10) to SL (1.04). NEg of SS was higher (P = 0.02) than CTR, and similar (P > 0.10) to SL. It is concluded, that feeding corn straw-based diet by 28 days and switching to corn silage-based diets, improves the performance of growing bull calves.

Acknowledgements: The authors aknowledge to Ganadera Los Migueles Feedlot by support for this experiment

Key Words: Corn Silage, Growth Performance, Bull Calves

M178 Effect of feed restriction during the growth phase on performance of Aberdeen Angus steers fed different concentrate levels during finishing. E. R. Prates*[1], J. R. P. Rosa[1], J. Restle[2], J. Lopez[1], J. O. J. Barcellos[1], and L. F. G. Menezes[1], [1]*Universidade Federal do Rio Grande do Sul*, *Porto Alegre, RS, Brazil*, [2]*Universidade Federal de Santa Maria*, *Santa Maria, RS, Brazil*.

The objective of the work was to evaluate the effect of feed restriction during growth on the performance of Angus steers fed different concentrate levels during the finishing period. The experiment was conducted 2 phases: growth in pastures (84 days) and finishing in feedlot (84 days). Thirty-two yearling steers were used (240 kg live weight) and randomly assigned to two treatments - cultivated pasture or native pasture (growth phase) - after which the steers were designated at random to one of the four diets (25, 40, 55 and 70% of concentrate in the diet based in corn silage). The experimental design was a factorial 2 x 4 arrangment (2 feeding systems x 4 concentrate levels) with four replicates per treatment. Data were analyzed (ANOVA & Tukey) using the SAS package. During the growth phase steers in the cultivated pasture had an ADG of 0.87 kg vs. 0.09 kg for steers in native pasture. There was no interaction between feeding system and concentrate level (P>0.05), in the finishing phase. The diet with 25% of concentrate presented lower ADG (1.223 kg) as compared to diets containing 40, 55 and 70% of concentrate (1.567; 1.448 and 1.664 kg, respectively) due to the lowest concentration of energy in the ration (P<0.05). As to the feeding system there was a significant difference (P<0.01), with higher gains for the animals growing in native pasture with feed restriction as compared to those maintained in the cultivated pasture (1.586 vs. 1.365). These results agree with literature which shows that yearlings are the category that best responds in terms of compensatory gains. In intensive production systems, growth and finishing phases should be considered together, since the weight gain rates during the growth phase influences weight gain during finishing.

Acknowledgements: The authors thank CNPq for financial support

Key Words: Compensatory Growth, Pasture, Concentrate

M179 Delaying daily feed delivery time: intake, water consumption, ruminal pH and stress response. L. González*, A. Ferret, X. Manteca, J. de la Torre, and S. Calsamiglia, *Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*.

Four rumen fistulated Holstein heifers (134 ± 1 kg initial BW) were used in a 4 x 4 Latin square design to determine the effects of delaying daily feed delivery time. Feedbunks were all cleaned at 0800 and feed offered at: 0800 (T0, no delay), 0900 (T1), 1000 (T2) and 1100 (T3). Each experimental period lasted 3 wk with 1 additional wk after each period in which all animals were fed at 0800. Intake and water consumption were recorded daily during wk 1 and 3. Concentrate (15% CP, 18% NDF) and barley straw were both offered once a day and on ad libitum basis. At d 3 and 17 of each experimental period, ruminal pH and salivary cortisol levels were measured at pre-feeding (0800, 0900, 1000 and 1100 for T0, T1, T2 and T3, respectively), and at 4, 8 and 12 h post-feeding; daily means were calculated to analyze both variables. Data were analyzed with the PROC MIXED of SAS using the SLICE option to test effects of individual or combined factors. No treatment by week interaction effects were observed. Total DMI was not affected by treatments (P>0.10), but the increase observed at wk 3 compared with wk 1 was significant for T1, T2 and T3 (P<0.05). Straw intake was not affected and resulted in a mean forage to concentrate ratio of 9 to 91. Water consumption increased at wk 3 in T0 (P<0.05). Ruminal pH was not affected by treatments, values being 6.27 ± 0.06, 5.59 ± 0.08 and 7.29 ± 0.05 for mean, lowest and highest pH, respectively. At wk 3, there was a significant decrease in mean, lowest and highest ruminal pH compared with wk 1, for T1 (P<0.05) and T3 (P<0.10), probably related to the increase in DMI. Daily mean salivary cortisol concentration did not reflect any significant change in overall stress response (2.51 ± 0.17 ng/mL) due to the delay in feed delivery time although, within T1, wk 1 was higher (P<0.05) than wk 3 (3.44 vs. 1.92 ± 0.67 ng/mL, respectively). Delaying feed delivery time has minor effects on the productive variables analyzed and on salivary cortisol concentration, and they may be compensated in three weeks.

Key Words: Heifers, Feed Delivery Time, Animal Welfare

M180 Performance, carcass traits and feed efficiency in Nellore bulls, steers and heifers. P. V. R. Paulino*[1], S. C. Valadares Filho[1], M. I. Marcondes[1], M. A. Fonseca[1], A. M. Araújo[1], D. M. Oliveira[1], E. Detmann[1], and R. D. Sainz[2], [1]*Universidade Federal de Viçosa*, *Viçosa, Minas Gerais, Brazil*, [2]*University of California*, *Davis*.

Nellore cattle comprise more than 80% of the Brazilian herd. However, little information is available regarding differences in performance, carcass traits and feed efficiency among Nellore bulls, steers and heifers. Thus, forty seven animals (16 bulls, 15 steers and 16 heifers from the same herd and 21 months of age) were used to assess that. The animals were housed and fed in individual pens for 78 days, in a complete randomized design. The diet (13% CP) consisted of corn and elephant grass silages in a 70:30 ratio (85%) and a concentrate (15%). The feed offered and orts were weighed daily and animals were weighed every 28 days. Carcass ultrasound measurements were taken by an AUP-certified technician at the end of the trial. Residual feed intake was calculated by a regression of dry matter intake on metabolic mid-test weight, average daily gain and sexual condition. A significance level of 0.05 was used to detect treatment differences. Bulls gained faster (0.82 kg/d), than heifers (0.64 kg/d) while steers were intermediate in ADG (0.70 kg/d). Therefore, bulls were heaviest at the end of the trial (340 kg) compared to the heifers (295 kg) and steers (318 kg), whose final weights were not significantly different. Bulls ate 9.5% more than the heifers and 5.3% more than the steers, whereas the steers consumed 4.7% more than the heifers. The heifers were the fattest (3.0 mm of subcutaneous fat at the 12th-13th rib) and the bulls were the leanest (2.3 mm), while steers were intermediate (2.7 mm). The fat depth over the rump though was not different among the groups (5.9 mm). Ribeye areas were greatest in bulls (67.27 cm^2), while the steers and heifers did not differ (61.20 cm^2). No significant difference was noted for residual feed intake. It is worth noting that the RFI difference between the most and least efficient animals was 1.26 kg/d, but within each group this difference reached 1.19 kg/d. We speculate that the animals were quite homogeneous and that the differences in residual feed intake were barely noticeable. Sexual class seems not to explain variation in feed efficiency in Nellore cattle at young age.

Key Words: Nellore Cattle, Residual Feed Intake, Feed Efficiency

M181 Conjugated linoleic acid content in meat of crossbreed bulls grazing in tropical Mexico. M. Montero[1], F. Juarez*[1,2], and H. Garcia[3], [1]*INIFAP*, *Veracruz, Ver. México*, [2]*Facultad de Medicina Veterinaria y Zootecnia, Universidad Veracruzana*, *Veracruz, Ver. México*, [3]*UNIDA-ITV*, *Veracruz, Ver. México*.

The aim was to determine the intramuscular content of conjugated linoleic acid (CLA) in crossbreed European x Zebu bulls under grazing conditions as compared with feedlot at the tropical Gulf Coast of Mexico. Fifty two bulls in a factorial arrangement 2 x 2 were classified by genetic group, defining as Indicus (I) those animals with 50% or more of Zebu, and Taurus (T) those with more than 50% of either Holstein or Brown Swiss. Half of the animals of each group was finished on Stargrass (Cynodon plectostachyus) pasture (P) and the other half in feedlots (F) fed with 60% corn grain, 10% soybean meal, 15% hay, 4% tallow, 5% molasses, 1% urea and minerals. Bulls were slaughtered at 500 kg live weight. Samples of Longissimus dorsi muscle at T12 were taken and frozen; lipids were extracted, methylated and analyzed by gas chromatography using a 100 m capillary column. Water content was 73%, crude protein 22%, fat 2.2% and minerals 1.2%. The major fatty acid (mg/g of fat) was the unsaturated C18:1 (381) followed by C16:0 (250) and C18:0 (201). The CLA content averaged 16.3 of which 6.1 corresponded to 9-cis, 11-trans C18:2. The 11-trans C18:1 content was 1.6. P vs. F comparison showed that CLA, 9-cis, 11-trans C18:2, and 11-trans C18:1 were similar (P>0.05) while C14:0 and C16:0 were higher in F and C18:0 was higher in P (P<0.01). CLA levels were 18.8a in I and 12.4b in T (P<0.05); also C14:0, C16:0 and C18:2 were higher in I (P<0.01). The interaction showed differences (P<0.05) in CLA for

FI, PI, FT and PT (20.3a, 17.4ab, 13.4b and 11.5b) respectively. The intramuscular CLA content in meat of bulls finished with pasture in the Gulf Coast of Mexico was elevated, and the genetic group associated with the diet contributed to the variation.

Acknowledgements: The financial suppport of CONACyT from Mexico is appreciated

Key Words: CLA, Grazing, Beef Cattle

M182 Improvement of omega 3 fatty acid content of meat from young Holstein bulls receiving a high-concentrate diet. N. Mach*[1], M. Devant[1], A. Bach[2,1], I. Diaz[3], M. Font[4], M. A. Oliver[4], and J. A. Garcia[3], [1]*Unitat de Remugants-IRTA (Institut de Recerca i Tecnologia Agroalimentàries)*, *Barcelona, Spain*, [2]*ICREA (Institució Catalana de Recerca i Estudis Avançats)*, *Barcelona, Spain*, [3]*Unitat de Quhímica Alimentària-IRTA*, *Girona, Spain*, [4]*Unitat de Qualitat de la Canal i Carn-IRTA*, *Girona, Spain*.

The objective of this study was to improve the content of omega 3 fatty acids (n-3) of beef meat from young Holstein bulls. Fifty four young Holstein bulls were blocked by initial BW and randomly assigned to 6 treatments following a 3x2 factorial design with three concentrate lipid levels (5, 8, and 11% of DM) and two lipid sources (whole canola seed and whole linseed). Dietary treatments were isonitrogenous and isocaloric. Animals (initial BW= 300 ± 25.5 kg) were fed barley straw and concentrate ad libitum for 76 to 128 d until reaching slaughter weight (443 ± 12.48 kg). Concentrate intake (7.1 ± 0.18 kg), ADG (1.3 ± 0.13 kg), and carcass quality were not affected by dietary treatments. The n-3 content of *Longissimus thoracis* (LT), mainly in the form of C18:3 n-3, increased linearly (P < 0.001) with concentrate lipid levels, and tripled (P < 0.001) in animals receiving linseed (1.31%) compared with those receiving canola seed (0.41%). Similarly, the n-3 content of the entire rib quadrupled (P < 0.001) in animals fed linseed (1.56%) compared with those fed canola seed (0.32%), and increased quadratically (P < 0.001) with concentrate lipid levels.

The ratio between omega 6 and omega 3 fatty acids decreased ($P < 0.01$) in the LT and entire rib of animals fed linseed (10 and 8, respectively) compared with those fed canola seed (26 and 25, respectively). Also, the percentage of *cis*-9, *trans*-11 CLA in the entire rib of animals fed linseed (0.39%) tended ($P = 0.09$) be greater than in animals receiving canola seed (0.30%). Contents of n-3 and CLA in meat in high-concentrate fed young male bulls can be enhanced by linseed supplementation without affecting animal performance and carcass quality.

Key Words: Beef, CLA, Linseed

M183 The effect of feeding sunflower oil alone or in combination with fish oil on the expression of the Δ9-desaturase gene in the liver and subcutaneous adipose tissue of heifers. F. Mulligan*[1], K. Thornton[1], T. Sweeney[1], and A. Moloney[2], [1]*Department of Animal Husbandry and Production*, *Belfield, Dublin, Ireland*, [2]*Teagasc, Grange Research Centre*, *Dunsany, Co. Meath, Ireland*.

The concentration of CLA in ruminant meat is highly dependent on the conversion of vaccenic acid to CLA by the Δ9-desaturase enzyme. The objective of this experiment was to examine dietary effects on the expression of the Δ9-desaturase gene in the liver and adipose tissue of cattle. Sixty Charolais or Limousin cross heifers were blocked on age and weight and assigned to one of five treatments: (G), unlimited access to perennial ryegrass (*Lolium Perenne*)-based pasture; (S1), restricted pasture allowance and 2.5 kg/day of concentrate containing 116 g/kg of sunflower oil; (S2), restricted pasture allowance and 2.5 kg/day of concentrate containing 166 g/kg of sunflower oil; (FS1), restricted pasture allowance and 2.5 kg/day of concentrate containing 116 g/kg of sunflower oil + 34 g/kg of fish oil; or (FS2), restricted pasture allowance and 2.5 kg/day of concentrate containing 166 g/kg of sunflower oil + 34 g/kg of fish oil. After 150 days animals were slaughtered and samples of liver and subcutaneous adipose tissue were harvested. Following extraction of total RNA and c-DNA synthesis, quantities of mRNA were determined relative to 18SrRNA by real time quantitative PCR and analysed using the DDCT method. Heifers fed diet S2 had higher ($P<0.05$) relative quantities of Δ9-desaturase mRNA in liver (2.87 ± 0.572) than animals fed diets G (1.54 ± 0.430), S1 (1.52 ± 0.284), and FS2 (1.57 ± 0.257) and tended to have higher ($P=0.09$) relative quantities of Δ9-desaturase mRNA than animals fed diet FS1 (1.95 ± 0.430). Dietary treatment did not affect the relative quantities of Δ9-desaturase mRNA in subcutaneous adipose tissue. This work demonstrates that dietary manipulations can alter the expression of the Δ9-desaturase gene in bovine liver.

Key Words: Conjugated-Linoleic Acid, Beef Cattle, Δ9-Desaturase

M184 The effects of feeding saponified fatty acids on duodenal fatty acid flow. D. O. Alkire*, M. S. Kerley, and J. H. Clark, *University of Missouri*, *Columbia*.

Five dually cannulated steers (430 kg) were used to determine the effects of saponified fatty acids (SFA) on duodenal fatty acid flow. Steers were used in a 5 x 5 Latin square design to evaluate five dietary treatments: 1) negative control (CON), no added fat; 2) positive control (SO), soybean oil; 3) calcium salts of soybean oil (CAS); 4) calcium salts of fish oil (CAF); and 5) magnesium salts of soybean oil (MGS). All fat supplements were fed to provide approximately 2 % EE of the total diet. Animals received a basal diet (1.3% BW, 5.7 % EE) consisting of 89 % corn, 6.6 % fish meal, and sufficient minerals to meet or exceed NRC recommendations. Steers were fed at a restricted intake of 5.5 kg/d. As expected, supplementing SFA increased EE intake compared to CON ($p < 0.05$). The saponified soy oil (CAS and MGS) produced a duodenal fatty acid profile similar to CON ($p > 0.05$) for 14:0, 16:0, 16:1, 18:0, 20:0, 21:0, 24:0, 20:5, and 24:1. The lack of differences in saturated fatty acids would suggest that saponification provided limited protection from ruminal biohydrogenation. In addition, MGS seemed to offer less protection from rumen degradation because it resulted in significantly more 18:0 in the duodenum compared to other treatments ($p < 0.05$). The CAF treatment produced a greater flow of 21:0, 20:5, and 24:1 to the duodenum compared to the other treatments ($p < 0.05$), suggesting some protection from biohydrogenation. The SO treatment depressed duodenal flow of 14:0, 16:0, 20:0, 21:0, 24:0, and 20:5 compared to all other treatments. Across all treatments, there was no difference in duodenal flow of 18:1, 18:2, 18:3, or 22:6. Also, there was no difference in total saturated, total monounsaturated, or total polyunsaturated fatty acids flowing to the duodenum ($p > 0.05$). We concluded that saponification of fatty acids may provide only limited protection from ruminal biohydrogenation at restricted intakes.

Key Words: Rumen-Protected Fat, Saponified Fatty Acids, Beef Cattle

M185 Effect of high oil corn on finishing cattle performance. G. J. Depetris*[1], F. J. Santini[1,2], E. L. Villarreal[1], E. E. Pavan[1], and D. H. Rearte[1], [1]*INTA EEA Balcarce*, *Argentina*, [2]*Fac. Cs. Agrarias. UNMdP*, *Argentina*.

Forty-two British cross finishing steers (360 ±25 kg BW) and 42 Angus females calves (FC; 160 ± 12 kg BW) were used in independent trials to evaluate the effect of high oil (HOC) and conventional corn grain (CC) on the growth performance of feedlot beef cattle. Within each category animals were blocked by weight (light, medium, heavy) and randomly assigned to one of two dietary treatments: T1: HOC + sunflower meal (SM) and T2: CC + SM. Whole corn grain and SM proportions in the diets were 84-16 and 75-25% for steers and FC respectively. Quality parameters evaluated were: IVDMD:79.7 and 82.9 %; CP: 9.25 and 7.6 %; starch: 60.2 and 64.5 %; lipid: 7.7 and 4.63 % to HOC and CC respectively. Total CP content of SM was 35.3 %. Diets were offered *ad libitum* once a day for 70-d. Steers dry matter intake (kg/d) was lower in T1 than in T2 (7.45 vs 8.45; $P <0.01$), but was similar in FC (4.9 ± 0.15; $P = 0.92$). No diet effect was observed in the daily gains (kg) of the steers (1.27 ± 0.05; $P = 0.44$), or the FC (1.177 ± 0.03; $P=0.88$). Feed efficiency (gain/feed) and final rib eye area (cm^2) were neither affected by diets either in steers (0.161 ± 0.011; $P = 0.43$: 65.1 ± 1.83 cm^2; $P = 0.89$) or in FC (0.237 ± 0.007; $P = 0.47$: 41.07 ± 0.85 cm^2; $P=0.17$). Even though there was no diet effect ($P > 0.25$) for rate of back fat thickness (BFT) increase (mm/30d) for either category (steers, 1.541 ± 0.13; FC, 1.284 ± 0.084); steers had different initial BFT (T1, 3.56 and T2, 4.00 mm; $P = 0.06$) but similar final BFT (7.71 ±0.33 mm; $P = 0.65$), whereas FC had similar initial BFT (2.70 ± 0.09 mm; $P = 0.8$) and tended to have different final BFT between diets (T1, 6.10 and T2, 5.28 mm; $P = 0.09$). These data suggest that substituting high oil corn for conventional corn in feedlot diets did not improve gains, but tended to increase BFT in both categories evaluated.

Key Words: High Oil Corn Grain, Beef Cattle, Feedlot Performance

M186 Performance and serum glucose, insulin, IGF-1, and NEFA concentrations of calves nursing beef cows consuming high-linoleate or high-oleate safflower seed supplements. S. Lake[1], E. Scholljegerdes[1], V. Nayigihugu[1], R. Atkinson[1], G. Moss[1], E. Van Kirk[1], D. Hallford[2], D. Rule[1], and B. Hess*[1], [1]*University of Wyoming*, *Laramie*, [2]*New Mexico State University*, *Las Cruces*.

Three-year-old Angus × Gelbvieh beef cows nutritionally managed to achieve a BCS of 4 or 6 at parturition were used in a 2-yr experiment (n = 36/yr) to determine the effects of dietary lipid supplementation on suckling calf ADG and calf serum concentrations of glucose, insulin, IGF-1, and NEFA. Beginning 3 d postpartum, cows within each BCS were randomly assigned to be fed hay and a low-fat control supplement or supplements with either high-linoleate cracked safflower seeds or high-oleate cracked safflower seeds until d 60 of lactation. Rations were formulated to be isonitrogenous and isocaloric, and safflower seed diets contained 5% DMI as fat. Calf BW and blood samples were taken immediately prior to suckling and 2 h postprandial on d 30 and 60 of lactation. Maternal BCS at parturition did not influence calf ADG ($P = 0.48$), serum glucose ($P = 0.16$), insulin ($P = 0.35$), IGF-1 ($P = 0.81$), or NEFA ($P = 0.92$) concentrations. Maternal postpartum dietary treatment did not affect calf ADG ($P = 0.81$), serum insulin ($P = 0.78$), IGF-1 ($P = 0.92$), or NEFA ($P = 0.86$); however; serum glucose concentrations were greater ($P < 0.01$) in calves from lipid-supplemented cows. Day of lactation did not affect calf serum glu-

cose ($P = 0.73$) or insulin ($P = 0.34$) concentrations; however, serum IGF-1 concentrations were greater ($P < 0.01$) at d 60 compared with d 30, whereas serum NEFA was greater ($P = 0.01$) at d 30. Calf serum NEFA ($P < 0.01$) and glucose ($P < 0.01$) concentrations were greater preprandial than postprandial; however, serum insulin was greater ($P < 0.01$) postprandial. Although calves nursing cows supplemented with lipid appeared to be less sensitive to insulin, calf ADG was not affected by altering cow diet.

Acknowledgements: This project was supported by National Research Initiative Competitive Grant no. 2002-35206-11632 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Beef Calves, Lipid Supplementation, Metabolites

M187 Mammary lipid metabolism in primiparous beef cows fed high-linoleate safflower seeds. C. Murrieta*[1], E. Scholljegerdes[1], B. Hess[1], D. Rule[1], T. Engle[2], and K Hossner[2], [1]*University of Wyoming*, *Laramie*, [2]*Colorado State University*, *Fort Collins*.

The objective of this study was to evaluate mammary gland fatty acid metabolism in lactating beef cows fed a high-linoleate supplement. Eighteen primiparous beef cows (BW = 411 ± 24.3 kg.; BCS = 5.25) were fed Foxtail millet hay at 2.13% of BW and either a low-fat control (n = 9) or a cracked high-linoleate (67%, 18:2 n-6) safflower seed supplement (n = 9). Diets were isonitrogenous and isocaloric and the high-linoleate diet contained 5% of DMI as fat. At slaughter (d 37 ± 3 postpartum) mammary and milk samples were immediately frozen in liquid N2 and stored at -80°C. Fatty acid composition of milk fat preparations was determined using GLC. Ribonuclease protection assay was used to quantify mRNA for acetyl-CoA carboxylase (ACC), fatty acid synthase (FAS), lipoprotein lipase (LPL) and stearoyl-CoA desaturase (SCD). Weight percentage of milk fatty acids indicative of de novo synthesis (10:0, $P < 0.001$; 12:0, $P < 0.001$; 14:0, $P = 0.002$; 16:0, $P = 0.02$) were less for cows fed linoleate. Desaturation products $14{:}1^{cis9}$ ($P = 0.001$), $15{:}1^{cis9}$ ($P = 0.002$), and $16{:}1^{cis9}$ ($P = 0.01$) decreased in milk fat of cows fed the linoleate diet; however, weight percentage of $18{:}1^{cis9}$ was greater ($P = 0.01$) in milk fat of linoleate cows. Biohydrogenation intermediates $18{:}1^{trans9}$ ($P = 0.03$), $18{:}1^{trans10}$ ($P = 0.03$), $18{:}1^{trans11}$ ($P = 0.01$), and $18{:}2^{cis9,trans11}$ ($P = 0.02$) were greater in milk fat of linoleate compared with control cows. Weight percentage of 18:0 was greater ($P = 0.01$) in cows fed linoleate than control cows. Dietary treatment did not affect ACC ($P = 0.21$) or FAS ($P = 0.40$) mRNA concentrations; however, relative abundance of mRNA for LPL decreased ($P = 0.03$) whereas SCD mRNA tended to increase ($P = 0.11$) in the mammary glands of cows fed linoleate. Supplementing diets of lactating beef cows with high-linoleate safflower seeds altered fatty acid composition of milk fat and may affect lipid metabolism at the genetic level of the mammary gland.

Acknowledgements: Funded by a University of Wyoming Faculty Grant-in-Aid.

Key Words: Beef Cows, Lipid Metabolism, Mammary Gland

M188 Age, body condition, and calf sex effects on maternal conversion and circulating NEFA levels. E. Felton* and J. Warren, *West Virginia University*, *Morgantown*.

Forty-nine spring calving beef cows (avg. initial BW = 530 kg) with calf at side (avg. initial BW = 107 kg) were used in an 87-d experiment to examine the effect of cow age (2, 3 & >5 yrs old), initial cow body condition (< 4.5, 4.5-5.5 & > 5.5) and sex of calf on feed intake, gain, conversion of feed resources, and concentration of NEFA in maternal plasma over the experimental period. The "GrowSafe 4000E ™" system was used to measure individual feed intake from June 7th to September 2nd, 2004. Animals were fed ad libitum a total-mixed-ration containing 10% crude protein. For the first 45-d, the ration contained 90% fine chopped grass hay (hay; 8.53% CP) and 10% of a corn/urea based grain mix. For the remaining 42-d, the ration contained 73.5% hay and 26.5% of a corn/urea based grain mix. Plasma NEFA concentrations were analyzed by a repeated measures ANOVA with four time points spaced across the experiment. Performance variables were analyzed by the GLM procedures of SAS. Concentration of NEFA decreased ($P < 0.05$) across time, but at differing rates ($P < 0.05$) due to age of dam, sex of calf, and body condition of the dam. There were no interactions of sex of calf or body condition within age category across time. Residual feed intake decreased ($P < 0.05$) with increasing age of dam but was unaffected by calf sex or gain, or dam body condition. Amount of offered feed consumed was greater ($P < 0.05$) in calves of 2-yr-old cows and their dams than in calves or dams of other age groups. Sex of calf or body condition of the dam had little effect on amount consumed. Efficiency of feed conversion (cow and calf weight gain/cow and calf intake of feed offered) were unaffected ($P < 0.05$) by age or body condition of dam, or sex of calf. These data demonstrate that as lactation progresses in the beef herd, first and second calf heifers and mature cows handle the demand for lactation differently. These animals do so with different efficiencies when measured as residual feed intake.

Acknowledgements: The authors would like to acknowledge that this project was made possible thru a USDA grant - USDA-CSREES 2003-38881-02005.

Key Words: Feed Efficiency, Cows, Lactation

M189 Effects of trace mineral source and growth implants on trace mineral status and immune response of steers. K. Dorton*, T. Engle, and R. Enns, *Colorado State University*, *Fort Collins*.

Three hundred and seventy-three steers were utilized to determine the effects of growth implants and trace mineral (TM) supplementation and source on TM status and immune response. Steers were stratified by initial body weight and were randomly assigned to one of 36 pens, which were then randomly assigned to treatments. Treatment consisted of: 1) control (no supplemental Cu, Zn, Mn, and Co), 2) inorganic (INORG) TM ($CuSO_4$, $ZnSO_4$, $MnSO_4$, and $CoCO_3$), and 3) organic (ORG) TM (iso-amounts of ORG Cu, Zn, Mn, and Co). On d 28 of the experiment, steers from 6 pens per treatment received a growth implant containing 200 mg progesterone and 20 mg estradiol benzoate, while the remaining steers within the same treatment (6 pens) did not receive a growth implant. Steers were fed a corn silage-based growing diet for 56d and were then gradually switched to a high-concentrate finishing diet. At the beginning of the finishing phase, only steers receiving growth implants during the growing phase were re-implanted with 80 mg trenbolone acetate and 16 mg estradiol. During the 140d finishing phase, all minerals excluding Zn, were fed at NRC recommended concentrations in INORG form. Treatments during the finishing phase consisted of: 1) control (no supplemental Zn), 2) INORG Zn (30 mg Zn/kg DM from $ZnSO_4$), and 3) ORG Zn (iso-amounts of ORG Zn). At the end of the growing phase, implanted steers had greater ($P < 0.01$) plasma Cu concentrations than non-implanted steers and steers receiving supplemental TM had higher liver Cu ($P < 0.01$) and plasma Zn concentrations ($P < 0.02$) than controls. Steers receiving ORG TM had greater ($P < 0.02$) total IgM concentrations than INORG-supplemented steers. On d 56 of the growing phase, implanted steers tended ($P < 0.07$) to have higher IgG antibody titer concentrations specific for pig red blood cells than non-implanted steers. In the finishing phase, steers supplemented with ORG TM had higher ($P = 0.04$) ovalbumin antibody titer concentrations than steers supplemented with INORG TM. These results indicate that TM supplementation, source, and growth implants may impact TM status and immune response in steers.

Key Words: Steer, Trace Minerals, Growth Implants

M190 Phosphorus metabolism in steers fed high grain diets. N. Meyer*, A. Trenkle, D. Pingel, and K. Barrett, *Iowa State University*, *Ames*.

Samples were analyzed from two metabolism trials to evaluate the effects of dietary phosphorus (P) intake on P excretion in beef steers fed corn-based finishing diets. In trial one, six steers were fed three diets over three time periods. Treatments consisted of three levels of protein to meet 70%, 80%, and 100% of the DIP requirements for growing steers. In experiment two, ten steers were fed five diets over five time periods. Treatments were: control, 4% or 8% distillers

solubles, and 10% or 20% wet distillers grains. For both experiments, total urine, feces, feed intake, and orts data were collected during a 5-d collection period, following 10 and 14-d dietary adaptation. Dietary P concentration (% DM) and P intake (g/d) ranged from 0.27 to 0.29 and 12.54 to 26.30 and .27 to .42 and 17.07 to 47.25 in Exp I and II, respectively. Total P excretion was significantly related to P intake, but there was considerable variation among steers in partitioning excretion of P in urine or feces. Urinary P excretion ranged from .66 to 7.03 and .20 to 12.17 g/d in Exp I and II, respectively. These studies indicate some steers fed corn-based finishing diets excrete large quantities of P in the urine. The data were analyzed using linear regression, y = a + bx (y = P excretion, x = P intake).

Experiment I	y	a	b	R^2	P-value
	Urine	8.11	.1151	.242	.89
	Fecal	17.34	.2129	.618	.11
	Total	25.45	.3280	.636	.09
Experiment II	Urine	58.92	-.1509	.251	.53
	Fecal	-33.12	.6874	.475	.01
	Total	-25.81	.5366	.810	.0001

Key Words: Cattle, Phosphorus, Phosphorus Excretion

Ruminant Nutrition: Dairy I

M191 Effect of level of encapsulated vitamin C in starters fed to Holstein calves. J. Garrett*[1], D. Putnam[1], T. Hill[2], J. Aldrich[2], and R. Schlotterbeck[2], [1]*Balchem Encapsulates*, *New Hampton, NY*, [2]*Akey*, *Lewisburg, OH*.

The objective of this trial was to evaluate encapsulated vitamin C (EVC) (Vitashure® C; Balchem Corporation, New Hampton, NY) added to complete calf starters fed to Holstein calves. The EVC (70% ascorbic acid) is designed to be stable during feed processing and ruminal fermentation. Fifty-one calves (17 calves per treatment) were housed in individual pens bedded with straw. Calves were fed pelleted 18% CP starters that contained 59% corn, 23% soybean meal, 0.0025% decoquinate with 0, 0.05%, or 0.10% EVC. Starter and water were offered ad lib daily from 0 to 56 d. A common milk replacer powder (20% all milk protein, 20% fat, 0.005% decoquinate) was fed in two equal feedings at the rate of 454 g/d, reconstituted with water to 3.8 L liquid volume per head from 0 to 40 d. On d 41 and 42 the milk replacer was only fed in the morning (227 g of powder/d/head). Starter feed offered and refused was weighed daily. Calves (3 to 5 d old) were weighed initially and weekly thereafter. Data were analyzed as a completely randomized design in SAS® using linear and quadratic contrasts. Significance was declared at $P \leq 0.05$, trends at $P \leq 0.15$. Initial calf body weight did not differ. There were linear trends for calves fed starters with EVC to grow faster preweaning and be more efficient post-weaning. Cumulative starter intake from 0 to 8 weeks tended to respond quadratically to level of EVC, averaging 687, 787 and 750 g/d for calves fed 0, 0.05% and 0.10% EVC, respectively. Cumulative feed efficiency tended to respond linearly to level of EVC from 0 to 8 weeks, averaging 0.514, 0.526, and 0.540 (kg gain:kg feed) for calves fed 0, 0.05%, and 0.10% EVC, respectfully, and responded linearly through week 5. Change in hip width improved quadratically between 2 to 4 weeks and 2 to 6 weeks. Fecal scores and medical treatments did not differ. In summary, calves fed 0.05% and 0.10% EVC tended to gain 3.5 kg more body weight in 8 weeks than controls while tending to have higher intake of starter and improved feed efficiency.

Key Words: Calf, Encapsulated, Vitamin C

M192 Effect of feeding medium chain triglycerides on calf growth, insulin responsiveness and body composition. J. K. Mills*, M. E. van Amburgh, and D. A. Ross, *Cornell University*, *Ithaca, NY*.

The objective of this study was to determine the effects on the growth, body composition, and response to an insulin challenge in calves fed isocaloric, isonitrogenous diets that varied in the amount and type of fatty acid. Thirty-six calves were assigned to a randomized block design with three dietary treatments, ten calves per treatment and a baseline group of six calves. Animals were reared from birth to 88.1 kg live bodyweight (BW). Three different milk replacer-based diets were designed to deliver less than 2% of the lipid as medium chain triglycerides (MCT) (Control; diet contained no MCT), 32% MCT in the form of caprylate (MCT Oil) and 32% of fatty acids primarily in the form of laurate from coconut oil (CO). From d 1 to 7, calves were offered 0.28 Mcal intake energy/ kg BW0.75, adjusted weekly for BW, and 0.32 Mcal intake energy/ kg BW0.75 from d 8 to slaughter. Dry matter, energy, crude protein (CP) and fat intakes were 53.7 kg, 281.8 Mcal, 14.6 kg and 13.0 kg; 56.6 kg, 297.2 Mcal, 15.8 kg and 14.2 kg; and 53.8 kg, 280.4 Mcal, 15.4 kg and 13.3 kg for the Control, MCT Oil and CO treatments, respectively. Dry matter intake (DMI), energy, protein and fat intakes did not differ among treatments (P = 0.50, 0.45, 0.29 and 0.22, respectively). Empty body gains were 0.92, 0.79 and 0.87 kg/d for Control, MCT Oil and CO diets respectively and the MCT Oil diet significantly lower than the Control. Empty body CP, ash and water were not different among treatments (P = 0.40, 0.88 and 0.45, respectively). Empty body retained energy and fat tended to be 5.6 and 8.7% greater for calves consuming the CO diet than for those fed the Control diet (P = 0.06 and 0.11, respectively). The liver weight of calves consuming the CO diet was 330 g heavier and contained 15% more fat than the liver of the Control and MCT Oil calves (P = 0.04 and 0.002, respectively). Plasma glucose was not different among treatments during an insulin challenge (P = 0.23), however, the decrease in plasma glucose concentration was significantly greater for the calves fed the MCT Oil diet compared to the Control and CO diets (P = 0.001).

Key Words: Lipid, Body Composition, Calves

M193 The effect of milk replacer protein, fat content and feeding amount on performance of Holstein heifer calves. B. Ziegler*[1], J. Linn[2], D. Ziegler[3], H. Chester-Jones[3], C. Soderholm[1], and S. Hayes[4], [1]*Hubbard Feeds*, *Mankato, MN*, [2]*University of Minnesota*, *St. Paul*, [3]*University of Minnesota*, *Waseca*, [4]*Milk Products*, *Chilton, WI*.

Two day-old calves from 3 commercial dairies were randomly assigned to one of 5 all-milk protein milk replacer (MR) treatments by farm source and body weight (BW). Calves were housed in 2.29 x 1.17 m individual calf pens within a frame-steel curtain side-wall naturally ventilated calf barn. Average BW across treatments at day 2 of-age was 40.7 kg ± 0.34 kg. Treatments were: 1) 20% Protein:20% Fat MR fed at 0.28 kg (as-fed) in 1.77 L water; 2) same as 1 except acidified MR; 3) 28:16 MR fed at 0.34 kg in 1.77 L water; 4) 28:16 MR fed at 0.34 kg in 2.41 L water; and 5) 28:16 MR fed up to 0.51 kg in 2.56 L water. Treatments 1, 2, 3, and 4 were fed 2X for the first 35 days and then 1X daily from day 36 to 42. Treatment 5 was fed 2X daily for the first 42 days and 1X from day 43 to 49. Calves assigned to treatments 1 and 2 were fed a calf starter (CS) containing 18% CP, and those on treatments 3, 4 and 5, a CS containing 22% CP ad libitum for 56 days. Fresh water was available daily at all times. Calves fed treatment 5 had the highest ($P < 0.01$) daily gain (0.81 kg) to 56 days followed by calves fed treatment 3 (0.73 kg), treatment 4 (0.68 kg), treatment 1 (0.65 kg) and treatment 2 (0.61 kg). Total DM intake (MR + CS) to 56 days was highest ($P < 0.01$) for calves fed treatment 5 (76.8 kg) and 3 (75.6 kg) compared to treatments 1 (69.5 kg) and 2 (67.9 kg) with treatment 4 intermediate (71.3 kg). Calves fed treatment 5 were more efficient (gain/DM intake) over 56 days

than calves fed treatments 1, 2, 3, or 4 (0.59 vs 0.52, 0.51, 0.54, and 0.53 kg, respectively. Feeding an intensive MR program (treatment 5) resulted in the best gain and highest DM intake, however, a modified intensive program (treatment 3) increased CS intake and resulted in the second best calf performance to 56 days. Calf health was not affected by treatments.

Key Words: Dairy Calves, Milk Replacers, Performance

M194 The effect of milk replacer feeding programs on calf growth and health. B. L. Miller*, T. E. Johnson, H. B. Perry, and M. A. Fowler, *Land O' Lakes, Inc.*, *Webster City, IA*.

Nutrient level and feeding rate were evaluated in all milk protein calf milk replacers to determine effect on performance, scour data and growth indices of Holstein bull calves. A total of 72 calves with an initial weight of 46.8 kg were randomly assigned according to body weight and gamma globulin concentration to three milk replacer treatments: 1) 20% CP / 20% Fat fed at 0.45 kg per day; 2) 22% CP / 20% Fat fed at 0.57 kg per day; or 3) 28% / 20% Fat fed at 1.14 kg per day. Milk replacers were not medicated. Calves were individually housed in elevated stalls and fed milk replacer two times daily at 700 and 1615 hours. A common 18% CP texturized starter (90 g lasalocid / 909 kg) was fed to calves assigned to the 20 and 22 % CP milk replacers. A 22% CP texturized starter (60 g lasalocid / 909 kg) was fed to calves fed the 28 % CP milk replacer. Weight gain, daily starter consumption, feed efficiency and daily scour scores (1-4 scale: 1=normal, 2=loose, 3= water separation, 4= 3 with severe dehydration) were calculated weekly and for the seven week trial period. Specific growth indices were taken and summarized for the test period. Calves fed the 28 % CP milk replacer at the 1.14 kg per day feeding rate gained more weight, were more efficient and had a greater total body volume.

Treatment

Item	1	2	3	C.V.
Feed / gain	2.32^{b}	2.16^{b}	1.69^{a}	18.60
Scour score	1.21^{ab}	1.16^{a}	1.24^{b}	7.79
Body volume gain, l	77.44^{a}	84.28^{b}	114.32^{c}	20.37

^{a,b,c}Means within a row differ (P<0.05)

Key Words: Calves, Milk Replacers, Feeding Rate

M195 Psyllium in milk replacer increases intestinal volatile fatty acids and tissue mass in neonatal dairy calves. S. J. Cannon*[1], B. L. Miller[2], G. C. Fahey[1], L. L. Bauer[1], and J. K. Drackley[1], [1]*University of Illinois*, *Urbana*, [2]*Land O'Lakes, Inc.*, *Webster City, IA*.

Inclusion of psyllium in milk replacers might improve gastrointestinal development and function. Male Holstein calves were fed a milk replacer (22% protein, 20% fat) either without or with psyllium (1.1%) from 2 d through 4 wk of age. Milk replacer was reconstituted to 12.5% DM and fed at 12% of calf BW, adjusted weekly. Water was offered ad libitum but no starter was fed. Three calves per treatment were harvested weekly for measurements of gastrointestinal tract mass and length and to sample digesta from the rumen, abomasum, jejunum, proximal colon, and distal colon for analysis of volatile fatty acid (VFA) concentrations. Average daily gain tended to be greater (P=0.08) for control calves at wk 4. Inclusion of psyllium increased weight of the duodenum (P<0.01), jejunum (P<0.05), and colon (P<0.05) and tended (P=0.09) to increase rumen weight. Density (g/cm length) of intestinal tissue was increased in the jejunum (P<0.01) and ileum (P<0.05), and tended to increase in the duodenum (P=0.06) and colon (P=0.06) in psyllium-fed calves. Total VFA concentrations were increased in psyllium-fed calves in the proximal (P<0.001) and distal colon (P<0.001), and tended (P=0.07) to increase in the jejunum. Acetate and propionate concentrations increased (P<0.001) in the proximal and distal colon, and butyrate was increased in the proximal colon (P<0.05) in psyllium-fed calves. Acetate concentrations tended to increase in the jejunum (P=0.06). Apparent DM digestibility (93.1 vs. 94.4%) and fecal DM content (18.0 vs. 22.1%) were lower (P<0.01) for psyllium-fed calves. Water intake did not differ between treatments. Pre-feeding plasma glucose concentration tended (P=0.06) to be higher for psyllium-fed calves but urea N, total protein, BHBA, and cholesterol did not differ. Inclusion of psyllium in the milk replacer of neonatal calves may stimulate development of the gastrointestinal tract, which might benefit health.

Key Words: Psyllium, Calves, Milk Replacer

M196 Number of lactations have no effect on immunoglobulin G concentration of heifer and cow colostrum. S. I. Kehoe*, M. L. Moody, A. J. Heinrichs, and M. R. Long, *The Pennsylvania State University*, *University Park*.

Many factors affect colostrum quality and older research has indicated that colostrum quality is related to lactation number and thus heifer colostrum should not be fed to neonatal calves. To evaluate immunoglobulin differences due to parity and first milking colostrum production, colostrum samples were obtained from 2 dairy herds in central Pennsylvania from September through December 2004. Samples were milked from cows within 4-6 h of calving and refrigerated until pick up every 2-3 d. Data for each sample included cow number, lactation number, colostrum volume and calving date. Each colostrum sample was subsampled and frozen for later analysis of immunoglobulin G. Two hundred seventy three samples were utilized, including 91 first lactation, 76 second, 51 third, 28 fourth and 18 fifth lactation or greater. Data were analyzed using the general linear model of SAS 8.2. IgG means in g/L of colostrum by parity were not significant (P > 0.20) and were 25.9±1.9 for first lactation, 29.6±2.1 for second, 28.3±2.6 for third, 24.8±3.5 for fourth and 25.0±4.5 for fifth and greater. Colostrum volume for first milking was not affected by parity (P > 0.20) however did have a significant effect on IgG concentration (P < 0.01). Total volume of IgG in first milking colostrum in g was not significantly different between parities (P > 0.20) and included 184.0±18.0 for first lactation, 206.8±19.5 for second, 199.7±25.3 for third, 172.8±33.7 for fourth and 184.5±43.9 for fifth and greater lactations. From these data, concentration of IgG is = 32.021 – 2.263*volume; we conclude that colostrum IgG concentration is only affected by volume of first milking and not by number of lactations.

Key Words: Colostrum, Immunoglobulin G, Parity

M197 A mechanistic model on glucose and lipid metabolism in periparturient cows. J. Guo*, R. Peters, and R. Kohn, *University of Maryland*, *College Park*.

A mechanistic model was developed to quantitatively describe glucose and lipid metabolism in periparturient cows. The objectives were to use the model to study the interrelationship between glucose and lipid metabolism, to identify the critical metabolic events for ketosis development, and to determine the relative importance of dry matter intake (DMI), body condition score, and milk production to nutrition management of periparturient cows. The driving variables of the model were DMI, feed composition, calf birth weight, milk production, and milk components. The response variables were body fat content and concentrations of plasma glucose, glycerol, nonesterified fatty acids (NEFA) and total ketone bodies (KB). Fetal growth and milk synthesis were assigned to the highest priority for glucose demand in the model. The rate of fat mobilization was expressed as a function of glucose deficiency. The model assumed first order kinetics for utilization of NEFA and KB. Comparison of model predictions to data collected in an independent experiment revealed that the model over-predicted glucose and KB concentrations by 0.62 and 0.37 mM respectively. The rate of glucose consumption by peripheral tissues and the rate of NEFA utilization had greater impact on KB concentrations in periparturient cows than the other parameters tested in the model. Calf birth weight, DMI, milk yield, and body condition score were increased by one standard deviation to estimate the response in ketone body formation. The responses to the increases in the model parameters (e.g. the rate of fat mobilization) were evaluated to identify the critical control points in the model. It was concluded that

glucose deficiency is closely related to the rate of fat mobilization. The excessive KB could result from elevated fat mobilization for glycerol to compensate for the negative glucose balance in periparturient cows. The model shows it is important to avoid overfeeding during the pre-lactation period to prevent ketosis development.

Key Words: Mechanistic Model, Periparturient Cow, Ketosis

M198 Effects of supplementation with propylene glycol or protected fats containing low or high ratio of unsaturated fatty acids to transition cows on production and metabolism. M. Katz*[1,2], H. Lehrer[1], L. Livshits[1], D. Sklan[2], and U. Moallem[1], [1]*ARO*, *Israel*, [2]*Hebrew University*, *Israel*.

Forty-two multiparous cows were used to test the effects of supplementation with dry propylene glycol, or protected fatty acids containing high or low ratio of unsaturated fatty acids to transition cows on production and blood metabolites. Dry cows (250 d pregnant) were housed in an open barn with electronic individual feeding system and were divided on the basis of previous milk production and parity to one of six treatments: 1) CTL - control, fed prepartum dry cow diet and postpartum lactating cow diet (NRC requirements); 2) PGLY - supplemented with 909 g of dry propylene glycol (ProGlyc 55, KIMTEC) from 21 d prepartum to 21 DIM; 3) PrFA:CTL - supplemented with 230g of Energy Booster (Milk Specialties, Inc) 21 d prepartum and postpartum fed CTL diet; 4) PrFA:PrFA - supplemented with 230 g of Energy Booster 21 d prepartum to 100 DIM; 5) CaLFA:CTL - supplemented prepartum with 215 g of Megalac-R (Church & Dwight, Inc) and postpartum fed CTL diet; 6) CaLFA:CaLFA - supplemented with 215 g of Megalac-R 21 d prepartum to 100 DIM. Prepartum DMI was decreased 7.8% by PGLY and 15-16% by both supplemental fats compared to CTL (P<.0001). Milk yield was enhanced by 7% in PrFA:PrFA and CaLFA:CaLFA compared to CTL (P<.0001). Both fat supplements enhanced plasma NEFA concentrations pre and postpartum over PGLY and CTL (P<.002). In an opposite manner, pre and postpartum plasma insulin concentrations were decreased by fat supplementation compared to PGLY and CTL (P<.0001). No differences in prepartum glucose plasma concentrations were observed between treatments, but postpartum glucose in PrFA:PrFA and CaLFA:CaLFA were lower compared to PGLY and CTL (P<.002). No metabolic disorders were observed. In conclusion, pre and postpartum fat supplementation increased milk production, but seems not to improve the metabolic status of transition cows.

Key Words: Transition Cow, Propylene Glycol, Protected Fat

M199 Absorption and metabolism of propylene glycol, propanal, and n-propanol in dairy cows dosed intraruminally with propylene glycol. B. Raun, B. Røjen, and N. Kristensen*, *Danish Institute of Agricultural Sciences*, *Tjele, Denmark*.

Four lactating Holstein cows fitted with a ruminal cannula and chronic indwelling catheters in the mesenteric artery (n=4), mesenteric vein (n=4), hepatic portal vein (n=4), and hepatic vein (n=3) were used to study portal absorption and hepatic metabolism of propylene glycol (PG) and metabolites of ruminal fermentation of propylene glycol. The cows were fed 90% of ad lib intake (14 ± 1 kg DM/d; diet composition in % of DM): corn silage, 56; grass hay, 17; rapeseed cake, 12; sugar beet pulp, 12; minerals and vitamins, 2; urea, 1. The cows were milked 0600 and 1600 and fed 0800 and 2000. Cows were given 650 g of PG in 10 L of warm tap water at 0830 via the ruminal cannula. Blood samples were collected from the artery, hepatic portal vein, and hepatic vein 0.5 h before as well as 0.5, 1.5, 2.5, 3.5, 5, 6.5, 8, 9.5 and 11 h after PG dosing. Portal and hepatic blood flows were measured by down stream dilution of p-aminohippurate infused into the mesenteric vein. The peak concentrations of PG (79 ± 14 mM), propanal (2 ± 1 mM), and n-propanol (8 ± 4 mM) in the rumen were obtained 0.5, 2.5, and 3.5 h after the PG dose, respectively. The arterial concentration of PG peaked 2.5 h after dosing (6.9 ± 0.5 mM) and remained greater (0.6 ± 0.1 mM; P = 0.02) compared with control 11 h after PG dosing. The arterial concentration of propanal was not affected (P > 0.10) by PG. The arterial concentration of n-propanol increased (P = 0.03) and was 2.1 ± 0.5 mM, 3.5 h after PG dosing. The net portal flux of PG, propanal, and n-propanol increased (P < 0.05) after the PG dose and accounted for 33 ± 12% of the PG dose. The net hepatic uptake of PG, propanal, and n-propanol accounted for 55 ± 25% of the PG dose. The fast initial absorption rate of PG limited the accuracy of determining the net portal flux of PG and the net hepatic flux is probably a more reliable estimate of the availability of PG to the cow. The present study indicates that propanal and n-propanol are quantitatively important products of ruminal PG fermentation and that primarily n-propanol is absorbed to the portal vein and taken up in the liver.

Key Words: Cattle, Propylene Glycol, Metabolism

M200 Plasma concentration of glucagon-like peptide-1 (7-36) amide (GLP-1) increases after calving in dairy cows. A. Relling* and C. Reynolds, *The Ohio State University*, *Wooster*.

The gut peptide GLP-1 is an anorexic glucose-dependent secretagogue of insulin in non-ruminants. Plasma GLP-1 concentration is higher in lactating than in dry sheep, but the effects of transition on GLP-1 concentration have not been measured in cattle. The objective of our study was to determine the effects of transition on plasma concentrations of GLP-1, insulin and glucose in 32 Holstein cows selected on the basis of calving date. Cows were fed a prefresh ration to meet nutrient requirements and long hay ad libitum before calving, and a lactation TMR ad libitum after calving. Concentrations of GLP-1 and insulin (pmol/ml) and glucose (mmol/L) were measured in plasma from coccygeal vein samples taken at an average of 11 d before and 5, 12 and 19 d after calving. DMI was 14.4, 17.7 and 19.9 kg/d on day 5, 12 and 19 of lactation, respectively. Plasma concentration of insulin and glucose decreased after calving, but did not differ among samples taken after calving. In contrast, plasma concentration of GLP-1 increased linearly after calving (P <0.01). The increase in GLP-1 observed may be attributable to increased feed intake and gut mass after calving. In contrast to work in non-ruminants, we observed an uncoupled relationship between plasma concentrations of GLP-1 and insulin. This suggests that insulin secretion may be refractory to the effects of GLP-1 in early lactation cattle, perhaps as a consequence of the relatively low plasma concentration of glucose in ruminants compared with non-ruminants.

Day from calving	-11	5	12	19	SEM	$P <$
Milk yield, kg/d	-	30.6	36.6	39.7	1.5	0.001
Insulin	0.084	0.056**	0.057**	0.061**	0.006	0.006
Glucose	3.56	2.61**	2.73**	2.60*	0.11	0.001
GLP-1	0.011	0.019**	0.023**	0.025**	0.001	0.001

*P <0.01, **P < 0.001: Values differ from means for d -11 relative to calving

Key Words: Glucagon-Lke Peptide-1, Insulin, Transition

M201 Metabolic profile of transition dairy cows from northwestern Portugal. J. A. A. Pires*[1], P. L. Ruegg[1], M. D. Salgueiro[2], and A. Dias-da-Silva[3], [1]*University of Wisconsin*, *Madison*, [2]*AGROS*, *Vila do Conde, Portugal*, [3]*CECAV-UTAD*, *Vila Real, Portugal*.

The productivity of dairy farms in northwestern region of Portugal, has been steadily increasing. The objective of this study was to assess the occurrence of disease and metabolic disorders in periparturient dairy cows in this region. Data were collected between Jan-Jun 2002 from randomly selected Holstein cows (n = 349) located on commercial dairy farms (n = 25). The RHA (8489 kg) and herd size (60 cows/farm) were characteristic of the region. Blood samples were collected weekly from each cow, starting 2 weeks before expected calving until 3 to 4 weeks postpartum. Serum was analyzed for glucose, NEFA, BHBA and Ca. Data were analyzed with PROC MIXED (SAS) using repeated measures, with cow and farm defined as random variables. Categorical data were analyzed using PROC LOGISTIC. The critical thresholds for [NEFA] were defined as: >325 µEq/l when < -14 DIM, >400 µEq/l from -14 to -2 DIM, and >700

μEq/l when > 3 DIM. Sub-clinical ketosis (**SK**) was defined using [BHBA] > 14.4 mg/dl and sub-clinical hypocalcaemia (**SCa**) for [Ca] < 8 mg/dl. The prevalence of elevated NEFA was 37%, 64%, 44%, 23% and 13% in the dry period, 1st, 2nd, 3rd and 4th weeks of lactation, respectively. The prevalence of SK was 24%, 21%, 12% and 8.2% for the 1st, 2nd, 3rd and 4th weeks of lactation, respectively. The overall prevalence of SCa within 2 d post-calving was 9%, 37% and 52% for cows in 1st, 2nd and >3rd lactations. The incidence of retained placenta (**RP**), displacement of abomasum (**DA**) and clinical hypocalcaemia were 12.5%, 5.3% and 2%, respectively. The prevalence of clinical mastitis (**CM**) was 13.7%. Cumulative milk yield at 100 days was reduced by 241 kg, 352 kg and 384 kg for RP, CM and DA, respectively ($P < 0.01$). Elevated levels of NEFA before calving were associated with increased risk of DA (OR = 4.6; $P < 0.05$). Overall, there was high prevalence of elevated NEFA, starting before calving, which may have impaired liver function and explain the high prevalence of SK observed post-partum.

Key Words: Dairy Cow, Transition Period, Metabolic Profile Survey

M202 Effect of anionic salt source on peripartal dry matter intake, milk production, and blood mineral concentrations in Holstein cows. D. B. Carlson*, J. W. McFadden, and J. K. Drackley, *University of Illinois*, *Urbana*.

Our objective was to compare two anionic salt sources on DMI, milk production, and blood mineral concentrations in periparturient cows. Multiparous cows (n=56) were balanced by parity and assigned to prepartum diets containing either 1) a commercially formulated, sulfur-based anionic salt pellet (PEL), or 2) a blend of individual anionic salts (IND). Prepartum diets differed only in anionic salt source and were balanced to achieve a dietary cation-anion difference of -10 mEq/100 g DM and to provide 150 g of calcium per cow per day. Cows were fed their respective prepartum diets from d 21 before expected calving date until calving. After calving, all cows were fed a lactation diet until d 56 in lactation. Prepartum DMI was not different (P=0.31) between cows fed PEL or IND (13.0 vs. 12.2 kg/d). Postpartum DMI was not influenced (P=0.25) by prepartum treatments. Prepartum urine pH was lower (P<0.01) for IND (7.1) than for PEL (7.97). Cows fed PEL had lower (P=0.03) blood Ca concentration on d -3 to +3 relative to calving compared with IND (9.27 vs. 9.49 mg/dl). Concentrations of P, Na, K, and Cl in plasma and Mg in serum did not differ (P>0.05) around calving between prepartum treatments. From d -3 to 0 relative to calving, serum NEFA was higher (treatment x time; P<0.01) in cows fed PEL than in those fed IND, although postpartum NEFA was not different (P=0.95) between treatments. Prepartum treatment had no effect on milk yield, milk fat, milk protein, body weight, or body condition score. Cows fed PEL had a lower (P=0.04) milk lactose concentration than cows fed IND (4.73 vs. 4.80%). The individual anionic salt blend reduced urine pH and increased blood Ca around calving more than the sulfur-based pellet. However, cows fed PEL maintained sufficient blood Ca concentration around calving (>9 mg/dl); therefore, PEL was effective in maintaining Ca homeostasis and preventing hypocalcemia.

Key Words: Anionic Salt, DCAD, Periparturient Period

M203 Effect of growth conditions on mineral composition of rumen microbes. N. Singh*, E. Ungerfeld, and R. Kohn, *University of Maryland*, *College Park*.

Uptake of cations and anions by rumen microbes may affect rumen strong ion difference (SID) and pH. An in vitro study was conducted to determine the macro-mineral composition of solid and liquid-associated bacteria in rumen fluid. Effect of buffer strength, pH, feed type, and length of incubation were evaluated. Buffer concentration was 0.5x, 1x, 2x normal concentration at pH 6.8 or adjusted to pH 5.8 at normal concentration of buffer. Media with rumen fluid (4:1 v/v) was incubated with alfalfa hay or corn grain for 4, 14, or 24 h. Values were reported as g/100g and m Eq/100g dry microbial pellet for minerals and SID respectively. Differences are noted at P < 0.05. Ash content was lower for solid than liquid-associated bacteria (10.86, 15.37) but SID was not different between bacterial pellet because of a decrease in mineral concentration of Na^+, Cl^-, S, PO_4^{2-}, Mg^{2+}, K^+ and Ca^{2+}. Buffer strength increased ash content (11.99, 13.36, 15.31) but SID was not affected because of an increase in Na^+ (2.34, 3.39, 4.13), Cl^- (0.46, 0.7, 1.24), PO_4^{2-} (1.76, 1.01, 2.48) while, Mg^{2+} was lower for 0.5x than 2x (0.23, 0.32) media concentration. Ash content (13.95, 12.28) was higher for alfalfa hay than corn grain but SID was not affected (2.01, 1.48) because K^+ (1.63, 1.22), Cl^- (1.22, 0.97), Mg^{2+} (0.26, 0.22), Ca^{2+} (0.36, 0.14) and S (0.29, 0.16) concentration were higher for alfalfa hay than corn grain. Over the length of incubation ash content decreased, while SID was unchanged as Na^+ (3.61, 2.79, 3.07), K^+ (1.57, 1.41, 1.31), and Cl^- (1.48, 0.91, 0.89) decreased from 4 to 14 to 24 h of incubation. Low buffer pH decreased ash (11.80, 13.36), and SID (0.75, 2.35) by increasing Cl^- ion (0.70, 1.97), S (0.12, 0.27), PO_4^{2-} (1.01, 1.79) and decreasing Na^+ (3.39, 2.76), and Ca^{2+} (0.28, 0.19). On average microbes took up more cations than anions from the media. Calculated SID of the microbial pool decreased with pH but was not affected by other treatments due to a similar change in uptake of cations and anions. The results enable us to predict change in SID due to microbial growth and this change would further affect rumen pH.

Key Words: Strong ion Difference, Microbes, Mineral Composition

M204 Relationship among ruminal strong ions and ruminal pH. C. S. Mooney* and M. S. Allen, *Michigan State University*, *East Lansing*.

The objective of this study was to investigate relationships among strong ion concentrations in the rumen and ruminal pH. Eight ruminally cannulated Holstein cows (55 ± 16 DIM; mean ± SD) were used in an experiment with a duplicated 4 x 4 Latin square design. A 2 x 2 factorial arrangement of treatments was used with main effects of dietary starch percentage (32% vs. 21%) and conservation method of corn grain (dry, 90% DM or high-moisture, 63% DM). Ruminal fluid samples were collected through the ruminal cannula every twenty minutes for 24 h per period during which feeding behavior and ruminal pH were monitored continuously. Dietary Na, K, and Cl concentrations were 0.5%, 1.2%, and 0.3%, respectively for the 32% starch diets and 0.5%, 1.4%, and 0.4%, respectively for the 21% starch diets. Across treatments, ruminal Na, K, and Cl concentrations averaged 96.3 ± 14.7, 40.7 ± 9.3, and 12.0 ± 2.3 meq/L, (mean ± SD) respectively. Across all samples (n > 2230), ruminal pH was positively correlated with ruminal Na concentration (r = 0.65, $P < 0.0001$) and negatively correlated with ruminal K concentration (r = -0.46, $P < 0.0001$). Ruminal pH was only slightly negatively related to ruminal Cl concentration (r = -0.09, $P < 0.0001$). Ruminal Na and K concentrations were strongly negatively correlated (r = -0.67, $P < 0.0001$). Treatment affected daily mean ruminal concentrations of Na, K, and Cl. Low starch diets increased ruminal concentrations of Cl (12.8 vs. 11.1 meq/L, $P < 0.01$) and K (43.0 vs. 38.3 meq/L, $P < 0.01$) proportional to dietary concentrations of these ions and decreased ruminal concentrations of Na (94.2 vs. 98.5 meq/L, $P < 0.001$), which did not reflect the uniform concentration of Na across diets. The reduction in Na concentration by the low starch diets was also not consistent with the expected increase in saliva flow from a 13% increase in total chewing time per day. The sum of ruminal Na and K was similar across treatments (136.9 meq/L, $P > 0.28$). These results suggest that strong ion difference and charge balance in the rumen are regulated through Na flux across the ruminal epithelium.

Key Words: Ruminal pH, Strong Ions, Sodium

M205 Evaluation of a dynamic mechanistic model of phosphorus metabolism in dairy cows. E. Kebreab*, J. France, N. Odongo, V. R. Osborne, and B. W. McBride, *University of Guelph*, *Guelph, Ontario, Canada*.

Phosphorus (P) is an essential nutrient involved not only in bone development, growth and productivity, but also in most metabolic processes of the body. Quantitative aspects of P metabolism in ruminants have so far been considered mostly empirically or kinetically. A new dynamic model of P partition being developed at the University of Guelph, Canada was used to simulate P metabolism in dairy cows and was challenged with P data from the literature. The model consists of

10 state variables representing P pools in the rumen, small intestine, large intestine, and extra-cellular fluid. A database of experiments that measured P balance was constructed and statistical comparisons made with model simulations. The difference between overall observed (46.2 g/d) and predicted mean (46.3 g/d) fecal P output was 0.12 g/d. The root MSPE was 4.02 g per day, which was 8.7% of observed mean. Almost all of the calculated error (99%) was due to random variation. Milk P output was also well predicted with root MSPE of 1.08 g/d (6.1% of observed mean). Phosphorus output in urine was negligible within the ranges of P intakes of the experiments (60 to 84 g/d) and simulations reflected observed values. Not only were observed and simulated fecal P in good agreement ($r^2 = 0.87$), but also trends of change in the experiments were represented well in simulated fecal P outputs. For example, in both observed and predicted fecal P outputs, cows fed low-degradable starch diets showed better P utilization than those fed high-degradable starch diets due to greater energy availability for milk production and greater P absorption to blood. Although the major factor influencing P excretion is P intake, the model showed that energy availability and milk production also affected P excretion.

Acknowledgements: The authors thank Dairy Farmers of Ontario for funding the project.

Key Words: Phosphorus, Mechanistic Model, Pollution

M206 Quantification of net splanchnic inorganic phosphate recycling in lactating dairy cows. N Kristensen*, B Røjen, B Raun, P Lund, and J Sehested, *Danish Institute of Agricultural Sciences*, *Tjele, Denmark*.

Three Holstein cows fitted with a ruminal cannula and chronic indwelling catheters in the mesenteric artery, mesenteric vein, hepatic portal vein, and hepatic vein were used to study net recycling of inorganic phosphate (IP). The feed intake of the cows was 6, 14, and 15 kg DM/d, respectively. The diet had the following composition (% of DM): fresh clover grass cut daily, 43; soy hulls, 20; flaked barley, 20; corn silage mixed with minerals and vitamins, 16; barley straw, 1. Barley was fed at 0700 and fresh clover grass was fed at 0800. Orts were removed at 1545 and the cows were fed soy hulls and corn silage mix. The cows were milked at 0600 and 1600. Blood samples were collected every 1.5 h from the mesenteric artery, hepatic portal vein, and hepatic vein for 24h. Feces were collected during the same 24 h period. Portal blood flow was determined by down stream dilution of p-aminohippurate infused into the mesenteric vein. Plasma IP concentrations were determined using a Cobas Mira analyzer and a commercial kit (Phosphorus CP; ABX Diagnostics, Montpellier, France). Recycling of IP (mmol/d) was determined as the net portal flux of IP - absorbed P, where absorbed P = feed P - feces P. The total P intake with feed was 623, 1382, and 1644 mmol/d, respectively and the feed - fecal P difference was 213, 445, and 555 mmol/d, respectively. The arterial IP concentration was similar between cows (1.43 ± 0.08 mM). However, the portal - arterial concentration difference differed apparently between cows (mean of 16 samples within cow 0.022 ± 0.004, 0.101 ± 0.012, and 0.127 ± 0.021, respectively). The net portal flux of IP was 538, 2863, and 2829 mmol/d, respectively and the net portal flux rate was stable across the 24 h collection period. The cows recycled 325, 2418, and 2274 mmol/d of IP representing 122 ± 36% of the dietary P intake. The multicatheterized animal model is a promising model for studying recycling of IP in cattle.

Key Words: Cattle, Phosphate, Recycling

M207 Effect of manganese level in water on the performance of dairy calves from birth to 70 days of age. M. L. Raeth-Knight*, K. M. Steffenhagen, and J. G. Linn, *University of Minnesota*, *St. Paul*.

Thirty three Holstein or Holstein-Montebeliarde crossbred calves, born from November 2003 to April 2004, were blocked by sex and randomly assigned to 1 of 3 treatments for 70 days. Treatments were control water (0.003 ppm Mn), 0.25 ppm Mn in water and 0.75 ppm Mn in water. The control water was supplemented with manganese carbonate to achieve 0.25 and 0.75 ppm Mn levels. Colostrum was fed twice daily the first two days following birth, for a minimum of 4 feedings. Milk replacer, containing 20% crude protein and 20% fat, was mixed with treatment water to contain 11% solids and fed twice daily until weaning at 42 days of age. Starter (18% CP) and treatment water were offered ad libitum day 7 to day 70. Feed and water intake were recorded daily. Body weight (BW) and hip height (HH) were recorded at birth, day 28, 42 and 70. Calves were housed individually in calf hutches from day 3 to day 70. Growth and intake data were analyzed as repeated measures using PROC MIXED and birth weight within sex was included in the statistical model as a covariate. There was no significant effect (P>.1) of calf sex on performance therefore, only treatment means are presented. Manganese level of water mixed with milk replacer or offered ad libitum had no significant effect on milk replacer or starter intake or growth of calves. Free water intake averaged 2.65, 2.71, and 2.68 L/day pre-weaning (day 3-42) and 10.80, 11.83 and 11.46 L/day post-weaning (day 43-70) for control, 0.25, and 0.75 treatments, respectively. For all calves, total dry matter intake averaged 1.75 kg/day pre-weaning and 3.55 kg/day post weaning. Calf body weight for control, 0.25 and 0.75 treatments averaged 50.1, 46.8 and 50.0 kg at birth and 104.3, 99.8, and 104.4 kg at the end of trial. Manganese carbonate in water up to 0.75 ppm Mn did not significantly impact calf performance or health.

Key Words: Calf, Water, Manganese

M208 Effect of Sel-Plex™ supplementation on milk production, composition and somatic cell count of lactating dairy cows in commercial dairy herds. G. A. Harrison*, J. M. Tricarico, and S. A. Elliott, *Alltech Biotechnology, Inc.*, *Nicholasville, KY*.

Field trials with a selenium yeast supplement (Sel-Plex™, Alltech Biotechnology Inc., Nicholasville, KY) were conducted during 2003 and 2004 in 14 commercial dairy herds. Days in milk (DIM), milk production, and composition were collected from downloaded Dairy Herd Improvement (DHI) test records. Fat-corrected (FCM) and energy-corrected milk (ECM) were calculated from milk yield and composition measurements. The dataset included 1444 cows with two consecutive DHI tests and initial DIM>30. After the first monthly DHI test, Sel-Plex was included in the diet to provide 0.3 ppm added Se (DM basis) and replaced inorganic selenium. Cows were fed Sel-Plex, on average, for 20 d before the second monthly DHI test. No adjustments were made for change in DIM (191 days for initial test month and 226 days for the second month). A two-stage analysis was used. The first stage evaluated individual herd responses and the second stage evaluated the overall response from variation among herds. Cows averaged 33.6 and 33.3 kg milk per d during the pre-Sel-Plex and Sel-Plex test month, respectively. Milk yield and composition were similar between the two test months. Actual somatic cell count (SCC) was lower on the Sel-Plex test month (252,653 vs. 213,173 cells/ml; $P<0.10$). Somatic cell count expressed on the linear score scale was also lower after Sel-Plex supplementation (4.34 vs. 4.09; $P<0.10$). Replacing inorganic Se with organic Se from Sel-Plex did not affect milk production and reduced SCC in commercial dairy herds.

Key Words: Organic Selenium, Dairy Cows, Field Study

M209 Effect of chromium on intravenous glucose tolerance test results in growing dairy heifers. J. Sumner*[1], J. McNamara[1], and F. Valdez[2], [1]*Washington State University*, *Pullman*, [2]*Kemin Agri Foods North America, Inc*, *Des Moines, IA*.

The objective was to determine the effect of chromium propionate on glucose metabolism in growing dairy heifers. Three doses (5, 10, and 15 mg chromium/d) were fed to heifers of 11 to 14 mo of age. Twenty heifers were used in a replicated Latin Square with a two-week adaptation period, followed by four periods of two weeks each with a two-week flush out period between treatments. Treatments, including a 0 mg/d control, were allotted to periods in a design balanced for potential carryover effects. Chromium propionate was supplied in 0.25 kg/d of ground corn individually and heifers were observed to consume the entire dose. After 14 days on each treatment, animals were fitted with an indwelling jugular catheter and an intravenous glucose tolerance test

was conducted the following morning. Body weights increased throughout the experiment, but weights and conditions scores were unaffected by treatment. Chromium supplementation increased ($P < 0.05$) basal glucose (72.9 mg/dl for 0 mg Cr/day; 73.7, 79.2, and 78.0 mg/dl for the 5, 10 and 15mg/d treatments). Treatment decreased ($P < 0.05$) basal insulin (8.6, 6.0, 6.3 and 7.4 uU/ml for control, 5, 10 and 15mg/d treatments). Area under the curve for glucose was 891, 662, 381 and 561 mg/dl*min for 0, 5, 10, and 15 mg Cr/d (SEM 94); half-life (t1/2) was 87.9, 67.6, 66.9 and 72.3 (SEM 4.3) for control, 5, 10 and 15 mg Cr/d. Peak insulin response was 74, 76, and 82% of control for 5, 10, and 15 mg/d ($P<0.05$). Area under the curve for insulin was not different: 262, 274, 257 and 259 uU/ml*min (SEM 30.3). Serum NEFA were negatively correlated with glucose, such that treated animals with increased glucose had lower NEFA overall, but there was no treatment effect. Chromium supplementation to growing dairy heifers fed a grass and alfalfa based ration increases whole-body insulin sensitivity. This helps to confirm biological activity of supplementation of chromium in dairy animals.

Key Words: Chromium, Glucose Tolerance, Insulin

M210 Effects of rumen protected choline and dry propylene glycol on feed intake and blood metabolites of Holstein dairy cows. Y.-H. Chung*[1], T. W. Cassidy[1], I. D. Girard[2], P. Cavassini[3], and G. A. Varga[1], [1]*The Pennsylvania State University*, *University Park*, [2]*Probiotech International Inc.*, *Québec, Canada*, [3]*Ascor Chimici s.r.l.*, *Via Piana, Italy*.

Three trials were conducted simultaneously using a 6 x 6 Latin Square design (multiparous=6 with average dry matter intake (DMI) =16.6 kg/d and milk yield=38.3 kg/d) to study: (1) additive effects of rumen protected choline (RPC) and dry propylene glycol (PG) (trial I), (2) RPC dose-dependent effects (trial II) and (3) effects of dry PG feeding method (trial III). Treatments for trial I were: (1) control, (2) 50 g RPC top dressed, (3) 250 g dry PG mixed in the TMR and (4) the combination of (2) and (3). Treatments for trial II were: (1) control, (2) 25 g RPC top dressed and (3) 50 g RPC top dressed. Treatments for trial III were: (1) control, (2) 250 g dry PG top dressed and (3) 250 g dry PG mixed in the TMR. Daily DMI was recorded and jugular blood samples were taken every 20 min for the first 4 h and again at 8 and 12 h relative to feeding on the last day of each experimental period. In trial I, effects of treatment were observed on DMI, plasma insulin and blood nonesterified fatty acids (NEFA). Dry matter intake was higher ($P<.01$) in cows receiving either RPC or dry PG only, however, blood glucose did not differ among treatments. Plasma insulin was highest ($P<.05$) for cows receiving the combination of RPC and dry PG. Blood concentration of NEFA was reduced ($P<.01$) in cows receiving either RPC only or the combination of RPC and dry PG. In trial II, increasing RPC dosage increased DMI ($P<.01$) and linearly decreased NEFA ($P<.01$). In trial III, cows receiving dry PG mixed in the TMR had the highest DMI compared to cows receiving no dry PG or dry PG top dressed ($P<.01$). Blood concentrations of glucose, insulin and NEFA were not affected by different feeding methods. Rumen protected choline appeared to have dose-dependent effects on reducing NEFA with 11% and 23 % reduction for cows provided 25 g and 50 g RPC vs. control, respectively.

Key Words: Dry Matter Intake, Insulin, Nonesterified Fatty Acids

M211 Effects of rumen protected choline and dry propylene glycol on production responses of periparturient Holstein dairy cows. Y.-H. Chung*[1], T. W. Cassidy[1], I. D. Girard[2], P. Cavassini[3], and G. A. Varga[1], [1]*The Pennsylvania State University*, *University Park*, [2]*Probiotech International Inc.*, *Québec, Canada*, [3]*Ascor Chimici s.r.l.*, *Via Piana, Italy*.

Two trials were conducted simultaneously to study additive effects of rumen protected choline (RPC) and dry propylene glycol (PG) (trial I) and RPC dose-dependent effects (trial II) on production performances of 74 multiparous Holstein dairy cows (lactation number=2.4 and 305ME=12716 kg). Trial I included treatments of (1) control (n=18), (2) 50 g RPC (n=12), (3) 250 g dry PG (n=14) and (4) the combination of (2) and (3) (n=15). Trial II included treatments of (1) control, (2) 25 g RPC (n=15) and (3) 50 g RPC. Treatments of RPC were top dressed on the TMR once daily starting from 21 days before to 21 days after parturition. Dry PG was mixed into the TMR postpartum only until 21 days in milk (DIM). Dry matter intake (DMI) and milk yield (MY) were recorded daily and MY was recorded until 42 DIM. Body condition score (BCS), body weights and milk components were measured weekly. Calf birth weights were also recorded. Tail vein blood samples were taken weekly from -21 to +21 DIM and analyzed for blood metabolites. Additional blood samples were taken every other day one week before the expected calving date. Prepartum and postpartum data were analyzed separately except for calf birth weights. There were no significant treatment effects observed for DMI, MY, milk composition, BCS, body weights and blood glucose concentrations in either the prepartum or postpartum period. Calf birth weights were also not affected by treatments. Based on results obtained in the present study, neither RPC nor dry PG appeared to affect intake, blood glucose concentration or production responses of multiparous periparturient Holstein dairy cows.

Key Words: Blood Glucose

M212 Secretion of choline in milk is depressed in dairy cows in early lactation. J. R. Newbold*[1], E. C. L. Bleach[2], P. C. Aikman[2], and D. E. Beever[2], [1]*Provimi Research and Technology Centre*, *Sint-Stevens-Woluwe, Belgium*, [2]*University of Reading*, *Reading, Berkshire, United Kingdom*.

Milk choline concentration was measured in 24 Holstein-Friesian cows 15, 30, 60 and 90 days after calving. Cows were offered one of four TMR based on maize silage, grass silage and concentrate containing between 11.7 and 12.2 MJ ME/kg DM and 150 and 180 g CP/kg DM. Neither the lactation diets nor the pre-calving diet contained supplemental choline and diet was not expected to influence choline supply. Milk choline concentration (mg/l) increased with advancing lactation (7.8, 14.2, 25.6, 31.1 for days 15, 30, 60 and 90, respectively, s.e.d. = 2.59, $P < 0.001$), with no effect of diet. Milk choline yield (mg/d) increased in a similar manner (278, 604, 1086, 1264 for days 15, 30, 60, 90, respectively, s.e.d. = 104.6, $P < 0.001$). For all cows, milk choline concentration was correlated positively with milk fat concentration ($r = 0.36$, $P < 0.001$) and milk fat yield ($r = 0.44$, $P < 0.01$), but not with milk yield (overall mean = 41.1 kg/d), milk protein, body condition score or calculated energy balance. However, there was a significant negative correlation between milk choline concentration and calculated energy balance at day 15 ($r = 0.63$, $P < 0.01$). The biological significance of low milk choline concentration in very early lactation is unclear, but could indicate a general choline deficiency at this time.

Key Words: Choline, Milk, Cow

M213 Plasma α-tocopherol levels during the transition period in grazing Jersey cows. J. M. l. Sanchez*[1,2] and A. Zuniga[1,2], [1]*Universidad de Costa Rica*, *San Jose, Costa Rica*, [2]*Centro de Investigacion en Nutricion Animal y Escuela de Zootecnia*, *San Jose, Costa Rica*.

The objective of this study was to measure changes in plasma α-tocopherol concentration in periparturient cows consuming fresh pastures. A total of 143 blood samples were taken in a commercial Jersey herd grazing Kikuyu grass in the highlands of Costa Rica. Samples were taken twice weekly during a one month period from 22 cows. At the time of sampling, cows were within -21 and +21 d relative to calving. Cows were supplemented with grain and mineral mixtures without added vitamins. Estimated grass intake was 66% of the total DM consumption in dry cows and 50% in fresh cows. Basal plasma α-tocopherol levels during d -20 to -11 showed minor variations and were approximately 6.50 µg/ml, thereafter levels decreased to a minimum average value of 5.13 µg/ml, 95% confidence interval of 7.37 to 2.90 µg/ml at d +2. By d +20, plasma α-tocopherol concentrations increased rapidly and steadily to 8.07 µg/ml. The comparison between basal plasma α-tocopherol values in heifers and older cows did not show significant differences ($P=0.113$). Incidence of diseases related a vitamin E deficiency, such as clinical mastitis and retained placenta during the first month of lactation were 0.6 and 0.3%, respectively (479

registered parturitions during a 30 month period). Plasma α-tocopherol levels obtained were higher than 3.0 µg/ml (minimum suggested value for proper neutrophil function). Results of this study suggest that dairy cows grazing fresh grasses probably do not require vitamin E supplementation.

Plasma a-tocopherol mean values and 95% Conf. Int. (CI) (µg/ ml)

	Days relative to calving					
	-8	-5	-2	0	+2	+5	+8
Average	6.39	6.16	6.49	5.56	5.13	5.72	6.24
95% CI	4.81-8.17	4.44-7.88	3.61-9.17	3.42-7.70	2.90-7.37	4.16-7.28	3.92-8.56

Key Words: α-Tocopherol, Grazing Cattle, Peripartum

M214 Meta-analysis of dietary niacin supplementation trials in lactating dairy cows. E. Schwab*, D. Caraviello, and R. Shaver, *University of Wisconsin, Madison*.

Recent reviews regarding niacin supplementation of lactating dairy cow diets only report across- study means or percentage responses versus controls. A meta-analysis of literature data was conducted to statistically examine the response of lactating dairy cows to supplemental dietary nicotinic acid (NA). The data set comprised 27 studies published between 1980 and 1998 where lactation performance responses to 6 and 12 g/d supplemental NA were reported. Data were analyzed with the MIXED procedure of SAS to evaluate animal response to NA, expressed as the difference from control. The linear model included NA supplementation level as the fixed effect and study as the random effect. Responses to NA supplementation were weighted by the number of animals used to test the response. Response variables evaluated were DMI, milk yield and composition, feed efficiency, and plasma BHBA, NEFA, and glucose concentrations. No efficacy of 6 g/d supplemental NA was found. Supplementation with 12 g/d NA did not affect DMI, milk fat or protein percentages, or plasma metabolites. Yields of 3.5% FCM, milk fat, and milk protein were increased (P≤0.10) 0.5 kg/d, 25.8 g/d, and 17.4 g/d, respectively, and 3.5% FCM feed efficiency was increased (P≤0.10) by 0.03 units. A Type I/Type II error economic analysis of 3.5% FCM yield response showed that frequencies of the observed response being greater than the break-even response were 54% and 57% when NA costs were $0.01 and $0.005/g, respectively. Although results of our meta-analysis show that 12 g/d NA improved lactation performance, tenuous economic benefits may dissuade routine inclusion in lactation diets. Results suggest that further research focusing on dairy cows in the transition period and metabolic disorders, higher NA dosage amounts, and ruminally-protected NA products may be warranted.

Key Words: Niacin, Dairy Cow, Milk Production

Sheep Species

M215 Estimation of the apparent digestibility of soybean hulls in diets containing increasing concentrations of soybean hulls to replace corn fed to growing lambs. T. Johnson*[1] and J. Rekhis[2], [1]*Purdue University, West Lafayette, IN*, [2]*Manouba University, Sidi Thabet, Tunisia*.

The objective of this study was to determine apparent digestibility of organic matter, N, fiber, and efficiency of nutrient utilization of diets containing increasing levels of soy hulls in replacement of corn in diets fed to growing lambs. Basal diet contained 65% ground corn, 25% soybean hulls, and 10% hay crop silage (Diet D). Soy hulls replaced corn at 25%, 50%, 75% or 100% of the concentrate. All lambs were fed ad libitum concentrate (1450 - 1800 g DM/ day). Twelve wether lambs (27-34 kg BW) were assigned to a 3-period switchback. Period contained 21 d, 14 d adaptation, and 7 d total collection of urine and feces. Composition of diets A, B, C, D, and soy hulls were respectively, DM %: 84.1, 83.8, 84.9, 82.7, and 90.5; OM %: 90.5, 93.02, 93.9, 94.2, and 95.1; GE, Kcal/g: 3.95, 3.82, 3.85, 3.84, and 3.78; N %: 3.23, 3.16, 3.01, 2.68, and 2.57; ADF %: 39.9, 36.5, 27.6, 17.1, and 44.1. Intake of DM, GE, and DE were not different between treatments (Table 1). Apparent DMD of diet A with 100% replacement of corn by soy hulls was lower than the basal diet D ($P < 0.05$). Intake of ADF was increased as soy hulls replaced corn ($P < 0.01$). However, apparent digestibility of ADF was also increased as soy hulls replaced 75% of dietary corn (diet B) as compared to basal diet D ($P < 0.05$). Although GE and DE consumed by lambs fed all diets were not different, fecal-E tended to be greater in lambs fed diet A (100% replacement of corn by soy hulls) as compared to fecal-E of lambs fed diet D. Presumably greater ADF digestibility of diet B as compared to basal diet D can be attributed to an improved rumen environment for fiber digestion in lambs fed this diet.

Table 1.

Diet-replacement of corn by soy hulls	A-100%	B-75%	C-50%	D-25%	SE	Significance
DM-intake, g/d	1489.0	1514.3	1388.2	1436.5	63.5	ns
DMD, %	67.4	72.2	70.6	76.5	2.8	A vs. D, $P < 0.05$
OMD, %	69.2	73.7	75.3	74.9	3.0	ns
ADF-Dig., %	60.5	64.8	56.8	53.7	3.0	B vs. D, $P < 0.05$; B vs. C, $P = 0.10$
GE-intake, kcal/d	6.21	6.20	5.59	5.86	0.30	ns
Fecal-E., kcal/d	1.89	1.73	1.70	1.52	0.12	A vs. D, $P = 0.10$
DE, kcal/d	4.31	4.47	3.90	4.33	0.28	ns

Acknowledgements: Supported by Fulbright Scholars Program CIES, and Purdue International Programs in Agriculture

Key Words: Soyhulls, Lambs, Digestion

M216 Effect of substitution of alfalfa hay with dehydrated pig manure on apparent digestibility of growing diets for sheep. A. Estrada-Angulo*, A. Terrazas, J. F. Obregon, A. B. Perez, C. H. Ramos, and E. Vazquez-Garcia, *FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico*.

With the objective of determining the effect of substitution of alfalfa hay with dehydrated pig manure (DHPM) on apparent digestibility of growing diets for lambs, a total fecal collection experiment was conducted. Pelibuey lambs (n = 4 males; BW= 20.12 kg) were used in a crossover design experiment. The sheep were assigned to one of two diets: 1) 10% sudan grass hay, 30% alfalfa hay,

29.5% cracked corn, 13% soybean meal, 1% hydrolyzed animal fat, 14% sugar cane molasses, 2.5% mineral premix (Control; 18.0% CP and 3.10 Mcal of DE/kg) or, 2) Control diet substituting alfalfa hay with DHPM (18.1% of CP and 2.3 Mcal of DE/kg). Sheep were placed in individual metabolic crates (0.6 x 1.2 m). Experimental periods consisted of a 10 d of adaptation period and 4 d of sample collection. From each diet and period 1 kg of diet was taken as sample and all feces were collected for DM and CP analysis. Mean daily intake of DM and CP were 737 g and 125 g, respectively. Fecal DM (179.3 vs. 201.5 g/d) and organic matter (149.4 vs. 170.9 g/d) were affected by inclusion of DHPM (P = 0.01) but CP excreted in feces (29.6 vs. 30.8 g /d) was not affected by diets (P = 0.36). The inclusion of DHPM diminished (P = 0.01) apparent DM digestibility (75.6 vs. 73.0%), organic matter (77.2 vs. 74.8%) and apparent digestibility of CP (78.3 vs. 73.2%). Diet DE was altered (3.23 vs. 3.12 Mcal/kg for Control and DHPM respectively, P = 0.01). It is concluded that the inclusion of DHPM in complete diets for growing lambs compared with alfalfa hay decreased digestibility and DE content.

Acknowledgements: La fama swine farm

Key Words: Alfalfa Hay, Pig Manure, Apparent Digestibility

M217 The effects of feeding dried poultry manure on weight gain, feed conversion rates and some blood values in lambs. F. S. Hatipoglu*[1], M. S. Gulay[1], F. Karakas Oguz[1], N. Oguz[1], U. R. Fidanci[2], and G. Yildiz[2], [1]*Akdeniz University*, *Antalya, Turkey*, [2]*University of Ankara*, *Ankara, Turkey*.

The effects of feeding diets containing different concentrations of poultry manure (PM) on some blood parameters [red blood cells (RBC), packed cell volume (PCV), hemoglobin (Hb), white bood cells (WBC)], weight gain and feed conversion rates were examined in 5 to 6 month old Akkaraman male lambs for 90 d. Lambs were divided into control (n = 8) and three treatment groups (n = 6/group). The dietary treatments included 0% (control; C), 10% (TRT-I), 20% (TRT-II) and 30% (TRT-III) dried poultry manure of total diet. All blood samples were collected from jugular vein prior to morning feeding. Lambs were weighed two consecutive days every other week before the morning feeding. No significant effects of PM concentration in the diet fed were observed for mean RBC count (C = 9.05 ± 0.33, TRT-I = 9.04 ± 0.38, TRT-II = 10.19 ± 0.38, and TRT-III = 9.8 ± 0.38x10^6/µL), PCV (C = 29.20 ± 0.82, TRT-I = 28.06 ± 0.95, TRT-II = 31.30 ± 0.95, and TRT-III = 30.13 ± 0.95%), Hb (C = 9.59 ± 0.35, TRT-I = 9.37 ± 0.41, TRT-II = 10.65 ± 0.41, and TRT-III = 10.37 ± 0.41 g%) or WBC count (C = 7.48 ± 0.16, TRT-I = 7.27 ± 0.16, TRT-II = 7.93 ± 0.16, and TRT-III = 7.77 ± 0.16x10^3/µL). Mean daily weight gains did not differ and were 0.160 ± 0.02, 0.176 ± 0.01, 0.168 ± 0.01, and 0.178 ± 0.01 kg for lambs in C, TRT-I, TRT-II, and TRT-III groups, respectively. Moreover, no differences were detected on average feed conversion rates (C = 7.97, TRT-I = 7.40, TRT-II = 7.70, and TRT-III = 7.23 kg/kg live weight gain). In conclusion feeding lambs up to 30% PM had no negative effects on the blood parameters, weight gain or feed conversion rates.

Key Words: Poultry Manure, Blood Parameters, Feed Conversion Rate

M218 Effect of Zilpaterol clorhidrate on growth performance and carcass traits in finishing sheep. A. Felix, A. Estrada-Angulo*, F. G. Rios, C. H. Ramos, and A. B. Perez, *FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

With the objective of determining the effect of Zilpaterol clorhidrate (Zilmax, Intervet Lab.) on growth performance and carcass traits in sheep, 48 Pelibuey sheep (males; BW = 23.5 ± 1.5 kg) were used in a complete randomized block experimental design. The animals were weighed and blocked by weight in 12 groups of four, were placed in 12 ground floor pens (2x3 m), and assigned to consume a control diet for 28 d. On d 29 one of three diets was fed: 1) diet with 14.5% CP, 3.6 Mcal of DE/kg containing 6.5% corn straw, 51% ground corn, 11.5% polished rice, 15% canola meal, 12% sugarcane molasses, 1.5% hydrolyzed animal fat, 2.5% mineral premix, and no zilpaterol clorhidrate (Control); 2) Control with 45 ppm of Zilpaterol clorhidrate (45ppm) or, 3) Control with 67 ppm of Zilpaterol clorhidrate (67ppm). Animals were weighed on d 1, 28 and 56. Feed was offered twice daily free choice. On d 56 they were killed in a slaughterhouse; carcass traits were recorded and main carcass cuts were measured. Treatments did not affect live weight (36.92, 37.58 and 37.33 kg for Control, 45ppm and 67ppm, respectively, P = 0.45), average daily gain (0.237, 0.217 and 0.237 kg/d, respectively), daily feed intake (1.307, 1.297 and 1.310 kg/day), and feed/gain (5.554, 6.030 and 5.560 kg of DM, respectively). Cold carcass weight, carcass length and width, carcass dressing percent, rib eye area, back fat, and leg circumference were similar (P = 0.64) among treatments. Long loin, short loin, rib, leg, shoulder and neck cuts were not affected by treatments (P = 0.74). In conclusion, the inclusion of Zilpaterol clorhidrate at 45 ppm or 67 ppm during the last 28 d of finishing did not affect growth performance, carcass traits, or carcass cutability of hair sheep.

Acknowledgements: Bonanza Beef Cattle Ranch

Key Words: Zilpaterol Clorhidrate, Carcass Sheep, Growth-Performance

M219 Effect of joint chromium and zinc supplementation on performance of growing Pelibuey hair sheep. L Almeida and R. Barajas*, *FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

The objective was to determine the effect of joint chromium and zinc supplementation on performance of growing Pelibuey hair sheep (n = 40 males; BW = 20.05 ± 0.03 kg). Animals were weighed, blocked by weight and placed in 12 ground floor pens (2 x 3 m). The design was a completely randomized block with a 2 x 2 factorial arrangement. Lambs received one of four treatments for 28 d. All diets were 16% CP and 1.8 Mcal of NEm/kg with no chromium methionine (Cr) or zinc methionine (Zn; Control), 1.0 ppm Cr, 60 ppm Zn, or both Cr and Zn (Cr+Zn). Animals were weighed on d 1, 14 and 28. During the first 28 d, Zn supplementation increased (P < 0.05) BW, ADG, and DMI. Over 28 d, Cr increased (P < 0.05) final weight by 3.2% (24.79 vs. 25.58 kg). Cr improved (P < 0.05) ADG by 12% (0.173 vs. 0.194 kg/d). Cr supplementation tended (P = 0.06) to increase DMI (0.708 vs. 0.807 kg/d). Zn increased (P < 0.05) final weight by 3.7% (24.23 vs. 25.65 kg), and enhanced (P < 0.01) ADG by 22% (0.164 vs. 0.202 kg/d). Zn improved (P < 0.05) DMI (0.698 vs. 0.817 kg/d). Feed/gain ratio of the experiment (mean 4.15 ± 0.26 kg feed/kg gain) was not affected (P > 0.49) by treatments. Interactions between Cr and Zn were not observed (P > 0.25). It is concluded, that both chromium methionine and zinc methionine supplementation improved growth performance of growing hair sheep, but joint supplementation has no advantage over individual supplementation.

Key Words: Chromium, Zinc, Sheep

M220 Carcass traits of hair breed ram and wether lambs on moderate or high level of supplement. J. Burke*[1] and J. Apple[2], [1]*USDA, Agricultural Research Service*, *Booneville, AR*, [2]*University of Arkansas*, *Fayetteville*.

The objective was to determine growth and carcass traits of ram (**R**; n = 27) and wether (**W**; n = 22) hair breed lambs (Katahdin, **KA**, n = 15 or Dorper, **DO**, n = 34) on a moderate (**M**) or high (**H**) level of supplement. Lambs were weaned at 84 d of age (d 0), blocked by breed and sex and randomly assigned to a M (n = 24) or H (n = 25) level of corn-SBM supplement (15% CP) with free choice bermudagrass hay. Lambs were fed in three phases: d 0 to 42, 226 g/454 g; d 43 to 84, 226 g/680 g; d 85 to 126, 454 g/680 g for M/H groups. ADG was greater for H than M-fed lambs during phases 1 and 2, but not 3 (P < 0.001) and greater for R than W lambs during phases 2 and 3 (P < 0.01). Lambs were slaughtered at 210 d of age weighing 43.0 (R) and 36.4 ± 1.2 kg (W; P < 0.001) and 36.8 (M) and 42.5 ± 1.2 kg (H; P < 0.002). Pelt removal from R (P < 0.05) and H-fed (P < 0.003) was more difficult than W and M-fed lambs. Carcass quality and cutability data were collected after a 7 d aging period at 2°C. Carcass traits between DO and KA were similar. Carcasses from R lambs were heavier than W (P < 0.009) and H-fed were heavier than M-fed carcasses (P < 0.001), whereas, fat thickness and yield grades of H-fed were greater than M-fed lambs (P < 0.001). Kidney fat weights and percentages were greater from H-fed than M-

fed ($P < 0.01$) and W than R ($P < 0.001$) carcasses, resulting in a greater cooler shrinkage in R carcasses ($P < 0.01$). Lean maturity was similar among diet and sex groups; however, skeletal and overall maturities were greater from M-fed carcasses ($P < 0.05$). Carcasses from M-fed ($P < 0.001$) and R ($P < 0.02$) lambs had lower flank streaking scores than H-fed and W lambs. Conformation scores from H compared with M-fed carcasses were higher ($P < 0.01$), resulting in higher ($P < 0.001$) quality grades. LM areas of H-fed were greater than that of M-fed lambs ($P < 0.003$). Chops were more tender from W than R carcasses ($P < 0.009$) and there was less cooking loss in chops from H than M-fed lambs ($P < 0.04$). In summary, hair breed lambs benefit from a high level of supplement and carcass quality was improved by castration similar to that found in wool breeds.

Key Words: Carcass Traits, Growth, Hair sheep

M221 Cholesterol, CLA and fat content of lamb loin chops by breed type. S. Duckett*[1], S. Greiner[2], and D. Notter[2], [1]*University of Georgia*, *Athens*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Cholesterol, CLA and fatty acid content of loin chops were measured for 60 lambs of five breed groups (12 lambs/group). Lambs were straightbred Katahdin (KT), Barbados Blackbelly x St. Croix (HH), crosses of Dorper (DPX) or Dorset (DOX) rams to crossbred (1/2 Dorset, 1/4 Rambouillet, 1/4 Finnsheep) ewes, or crosses of Suffolk sires to KT, DPX, and DOX ewe lambs (SUX). Lambs were weaned at 90 d of age, grazed, and fed a high-concentrate diet prior to slaughter. One loin chop (13th rib) was used for cholesterol and fatty acid analyses via GLC. Data were analyzed by ANOVA and contrasts were used to test differences between SUX vs. others, DPX vs DOX, DPX and DOX vs. HH and KT, and HH vs. KT. Cholesterol content averaged 68.7 mg/100 g of fresh tissue and ranged from 57.5 to 80.2 mg/100 g. Cholesterol content did not differ ($P = 0.29$) among breeds. Fatty acid content averaged 2.31 g/100 g of fresh tissue and ranged from 1.0 to 6.3 g/100 g. Total fatty acid content was greater ($P = 0.05$) for SUX than for other breeds. Chops from DPX and DOX contained more ($P = 0.04$) total fatty acids than chops from HH and KT. CLA (cis-9 trans-11 isomer) content was greater for KT than HH ($P = 0.02$). DPX and DOX chops contained greater ($P = 0.01$) amounts of saturated and monounsaturated fat than chops from HH and KT. Saturated and monounsaturated fat content was greater ($P = 0.05$) for SUX than other breeds. Omega-6 fatty acid content did not differ ($P > 0.14$) among breeds. Omega-3 fatty acid content was greater ($P < 0.01$) for KT than HH. DPX chops tended ($P = 0.09$) to have greater amounts of omega-3 fatty acids than DOX. Even though the total fatty acid content was higher, the ratio of omega-6 to omega-3 fatty acids was lower ($P < 0.01$) and therefore more desirable from a human health standpoint for DPX and DOX than HH and KT and also lower ($P < 0.01$) for KT than HH. Breeds did not differ in cholesterol content but did show variation in total fat and fatty acid content of lamb loin chops.

Key Words: Lamb, Cholesterol, Fatty Acid

M222 Growth and parasite resistance of pasture-raised purebred Katahdin and Katahdin crossbred lambs. D. J. Jackson*[1], N. C. Whitley[1], J. W. Lemaster[2], and S. Schoenian[2,3], [1]*University of Maryland Eastern Shore*, *Princess Anne*, [2]*Maryland Cooperative Extension*, *College Park, MD*, [3]*Western Maryland Research and Education Center*, *Keedysville, MD*.

The objective of the study was to compare growth performance and parasite resistance of pasture-raised Katahdin and Katahdin crossbred lambs. Katahdin ewes were mated to a single White Dorper (n = 40), Texel (n = 37), Suffolk (n = 35) or Katahdin (n = 21) ram. Lamb body weights were measured at birth (d 0), d 33 ± 0.8, 62 ± 0.5, 84 ± 0.5, 120 ± 0.6, 144 ± 0.6 and 165 ± 0.6 (adjusted to d 30, 60, and 90, 120, 140 and 160, respectively). Fecal egg counts (FEC) were determined at days corresponding to adjusted d 60, 90, 120, 140, and 160 and all lambs were administered anthelmintics at weaning (d 90). There was no influence of sire breed on number of lambs born per ewe lambing (2.0 ± 0.05) or lamb birth weight (4.3 ± 0.2 kg). At all time points measured, Suffolk-sired lambs (SK) were heavier ($P < 0.01$) than Katahdin- (KA), Texel- (TK) and Dorper-sired lambs (DK). On d 60, 90, 120, 140 and 160, TK lambs were heavier ($P < 0.05$) than KA lambs, while DK lambs were intermediate. At weaning and on d 160, SK, TK, DK and KA lambs weighed 34.7 ± 0.5 and 43.1 ± 0.6, 30.9 ± 0.6 and 39.7 ± 0.6, 30.0 ± 0.6 and 37.9 ± 0.6, and 28.4 ± 0.7 and 37.2 ± 0.7 kg, respectively. Overall, average daily gain was highest ($P < 0.01$) in SK lambs (0.31 ± 0.01 kg/d), followed by DK (0.28 ± 0.01 kg/d) and TK (0.28 ± 0.01 kg/d) lambs, and was lowest in KA lambs (0.26 ± 0.01 kg/d). On d 60 and 90, FEC were similar among the breeds. On d 120, TK lambs had the highest ($P < 0.02$) FEC, but on d 140 FEC were higher ($P < 0.04$) for SK compared to KA and TK while DK lambs were intermediate. At d 160, both KA and DK lambs had lower ($P < 0.04$) FEC than TK lambs while SK FEC was intermediate. Overall, in this study, SK lambs raised on pasture grew faster than KA, DK, and TK lambs but there seemed to be few biologically relevant differences in FEC.

Key Words: Sustainable, Parasite, Crossbred Lambs

M223 Effects of deworming hair sheep, wool sheep and meat goats with avermectin and herbs. H. Swartz*[1], F. Wulff[1], A. Stewart[1], and M. Ellersieck[2], [1]*Lincoln University*, *Jefferson City, MO*, [2]*University of Missouri*, *Columbia*.

This study was carried out to investigate the effects of herbs as a dewormer on sheep and goats compared to the commercial dewormer, avermectin (Ivomec). Katahdin hair sheep (K), Dorset wool sheep (D) and Boer/cross goats (B) were used to determine the effects of breed of sheep and Boer/cross goats on deworming agents. Fecal egg counts (FEC) using the modified McMasters procedure were measured as eggs/g on three treatments: control (n = 19), Ivomec (n = 20) and herbal (n = 20). The herbs were a blend of wormwood (*Artemesia sp.*), fennel (*Foeniculum vulgare*), gentian (*Gentian sp*), psyllium (*Plantago sp.*), and quassia (*quassia sp.*). The K, D and B animals grazing at the Carver Farm were divided into the three treatment groups. Animals were weighed and dewormed on May 4, 2004 and FEC were performed on all sheep and goats on May 13, June 28, July 20, and August 9, 2004. FEC data were analyzed as a 3x3 factorial split/plot in time mixed model procedure of SAS and converted to a log10 to evaluate the effects of breed of sheep and goats to dewormers. The control groups of K, D and B on May 13, was 0.0, 0.19, and 0.28, respectively. The Ivomec groups of K, D, and B were 0.0, 0.0, 0.85 and the herbal groups of K, D, and B were 0.0, 0.0, 0.0. June 28, control groups of K, D and B were 0.43, 0.19, 2.62. Herbal groups of K, D and B were 0.46, 0.0, and 1.83. July 20, controls of K, D, B were 2.01, 0.49, 2.61; Ivomec groups K, D, B, 0.92, 2.14, 2.75; herbal groups K, D, B were 0.76, 0.34, 2.74, respectively. FEC data collected on August 9, control groups K, D, B were 2.42, 0.96, 2.62; Ivomec groups, K, D, B were 1.02, 0.60, 1.25; herbal groups, K, D, B were 0.40, 1.04. 2.64. A significant difference ($P < 0.01$) was seen in the breeds of sheep and goats over time between the treatments. Breeds of sheep and goats, influenced by the commercial dewormer (Ivomec) compared to herbal treatment, exhibited a 3-way interaction. The data indicated that different breeds of sheep and goats are reacting differently to the commercial Ivomec and herbs over time.

Key Words: Anthelmintics, Herbs, Sheep and Goats

M224 Survival analysis from birth to slaughter of Ripollesa lambs. J. Casellas*, J. Piedrafita, G. Caja, and A. Ferret, *Universitat Autònoma de Barcelona*, *Bellaterra,Spain*.

Ripollesa sheep produce a 'pascual' type light lamb (24 kg BW at slaughter) which is typically consumed in Catalonia (Spain). Lambs are intensively reared indoors with a short suckling period and fed ad libitum with concentrate and straw. Age of survivability (wk) up to slaughter of 1,487 Ripollesa lambs from a fall lambing flock mainly (Christmas harvesting), was studied under the proportional hazards framework, assuming a Weibull distribution for the baseline hazards function. A sire frailty model including the common environment received by the lamb as an additional random source of variation was fitted. The common environment was considered time dependent, characterized by the ewe

and the contemporary group during the pre-weaning and fattening periods, respectively. The significant fixed effects studied were: linear and quadratic effect of birth BW ($P < 0.001$), relative position of the delivery within the birth distribution of the lambing season ($P < 0.001$), and presence of stillbirths or mummified fetuses within litter ($P < 0.05$). Birth type and parturition number of the ewe affected lamb survival only when birth BW was removed from the model ($P < 0.001$ and $P < 0.05$, respectively). Notwithstanding, the model including birth BW was preferable, according to the Akaike's Information Criterion. The hazard ratio (HR) was greater for both small and large birth BW, although the survival variation was less than 2% within the 3.3 to 5.4 kg BW range, showing an optimum birth BW range for lamb survival. The HR increased for births which occurred during the last third of the lambing period (HR = 1.70; $P < 0.05$), and increased more markedly for replacement ewe-lambs that lambed from December to January (HR = 5.36; $P < 0.001$). Furthermore, survival probability decreased for lambs from litters with one or more stillbirths or mummified fetuses (HR = 1.61; $P < 0.05$). The estimate of the sire variance (0.07) was markedly lower than that of the common environment (1.87).

Acknowledgements: Conveni DARP-ANCRI-UAB

Key Words: Lamb Survival, Proportional Hazard, Ripollesa Breed

M225 Analysis of associations between genotypes at codon 171 and 136 of the prion protein gene and production traits in a survey of market lambs. J. M. Evoniuk*[1], P. T. Berg[1], M. L. Johnson[1], C. L. Stoltenow[1], C. S. Schauer[1], K. I. O'Rourke[2], and D. A. Redmer[1], [1]*North Dakota State University*, *Fargo*, [2]*USDA, ARS, ADRU*, *Pullman, WA*.

The objective of this study was to conduct a preliminary survey of Northern Plains market lambs (N=824) to analyze associations between prion protein genotypes and production traits. Trait parameters included age, live/carcass wt, dressing %, back fat thickness, body wall thickness, rib eye area (REA), flank streaking, and percent boneless closely trimmed retail cuts (BCTRC). Genotyping at codon 136 and 171 was done using commercially available testing or SNP assay. Lambs were slaughtered at a common location and one experienced evaluator collected carcass data without prior knowledge of genotype. Lambs were marketed for slaughter based on weight and condition. No differences ($P > 0.2$) were observed between lambs with codon 136AA or 136AV for live wt, carcass wt, back fat, body wall thickness, REA, flank streaking, or BCTRC. However, 136AV lambs were older than 136AA lambs (195.9 ± 5.7 vs 171.7 ± 2.7 days, $P < 0.05$). Codon 171RR live lambs weighed less than 171QR ($P < 0.01$) and 171QQ ($P < 0.07$) lambs (51.7 ± 0.7, 53.6 ± 0.7, and 53.6 ± 1.0 kg, respectively). 171RR lambs had lower carcass wt than 171QR ($P < 0.001$) and 171QQ ($P < 0.001$) lambs (26.0 ± 0.4, 27.4 ± 0.3, and 28.1 ± 0.4 kg, respectively). No differences in dressing % were seen between 171RR and 171QQ ($P = 0.74$) lambs. 171QQ lambs tended to have more back fat than either QR ($P < 0.06$) or RR ($P = 0.19$) lambs (0.48 ± 0.03, 0.43 ± 0.03 and 0.43 ± 0.03 cm, respectively). Body wall thickness was less in 171RR lambs vs 171QR ($P < 0.01$) or 171QQ ($P < 0.001$) lambs (1.78 ± 0.05, 1.90 ± 0.05 and 2.21 ± 0.08 cm, respectively). REA (square cm) was larger for 171QQ lambs as compared to 171QR ($P < 0.002$) and 171RR ($P < 0.001$) lambs (15.8 ± 0.3, 15.0 ± 0.2 and 14.5 ± 0.2). 171QR lambs also had larger REA than 171RR lambs ($P < 0.01$). As expected, 171RR lambs had a larger ($P < 0.03$) BCTRC (47.4 ± 0.2) as compared to 171QQ (47.0 ± 0.2). In conclusion, these data suggest associations between prion protein genotypes and production traits and a need for further study.

Acknowledgements: Hatch Proj. ND1705 and USDA, ARS, ADRU.

Key Words: Sheep Scrapie, Prion Genotype, Production

M226 Impact of nutrition and body condition score at conception on gestation length. D. Brake* and J. Daniel, *South Dakota State University*, *Brookings*.

To test the impact of nutritional status around conception on lamb survival, crossbred ewe lambs were assigned to be undernourished (U; n = 34) or well-fed (W; n = 34). At 30 days before breeding, U ewes were fasted for 2 days, and then group fed 50% of requirements of replacement ewe lambs (NRC, 1985). W ewes were fed concentrates at 3 - 4% of body weight/day. Ewes were exposed to a teaser ram by fence-line contact for two weeks prior to exposure to semen-tested rams fitted with marking harnesses. Twenty-four hours after marking, one-half of the U ewes were switched to the W group, and one-half of the W ewes were switched to the U group and fed the restricted diet for 30 more days, for a total of four treatment groups: UU (U pre- and post-breeding), WU (W pre-breeding and U post-breeding), UW (U pre-breeding and W post-breeding), and WW (W pre- and post-breeding). Ewe's body condition score (BCS; scale 1 - 5) was recorded at the initiation of the study and at conception. Gestation length was calculated as the number of days from the ewe's breeding mark until the lamb's birth date. Gestation length and lamb birth weight were analyzed as a 2 X 2 factorial using GLM procedures for SAS. Effect of treatment on morbidity and mortality was tested by chi-square. U pre or post conception did not alter gestation length ($P > 0.60$). Undernourishment before or after conception did not affect lamb birth weight ($P > 0.38$). Mortality and morbidity were not affected by treatment ($P > 0.15$). Since BCS at conception varied within treatment groups, effect of BCS at conception on gestation length was tested. Thin ewes (BCS < 3) had a shorter gestation length than good or fat condition ewes (BCS 3 and ≥4, respectively; $P = 0.0212$). There was a tendency for an interaction of BCS at conception with post conception nutrition ($P = 0.0624$) such that thin U post conception ewes had shorter gestation lengths than all other groups. Lamb birth weight, morbidity or mortality was not affected by BCS at conception ($P > 0.17$). These results indicate poor body condition at conception can result in shortened gestation length.

Key Words: Sheep, Undernourishment, Gestation

M227 The effect of Bio-Mos supplementation on the performance of ewes in late pregnancy and on subsequent lamb performance. M. Foley[1], T. M. Boland[1], M. Guinan[1], S. Andrieu*[2], and T. F. Crosby[1], [1]*University College Dublin*, *Belfield, Dublin, Ireland*, [2]*Alltech Ireland*, *Dunboyne, Co. Meath, Ireland*.

Twenty-four individually fed, twin bearing ewes were used to determine the effects of Bio-Mos (Alltech Ltd) supplementation of the ewe diet for the final seven weeks of pregnancy on colostrum yield, lamb serum immunoglobulin (IgG) levels and lamb growth rate to weaning. All ewes were offered a grass silage diet ad libitum which was supplemented with 500-700 g of concentrates in the final seven weeks of pregnancy. The concentrate supplement was fortified with 0 (T1, control) or Bio-Mos (T2) at the rate of 1g/ewe/day. The ewes were hand milked completely at 1, 10 and 18 h post-partum to evaluate colostrum yield and immunoglobulin (IgG) concentration. Blood samples were taken from lambs at 24 h post-partum to determine serum IgG levels. Lamb growth rate to weaning was recorded. There was no effect of treatment on forage or total DM intakes, crude protein intake, ewe weight change, gestation length or litter birth weight ($P > 0.05$). Total colostrum yield to 18 h tended to be higher in the Bio-Mos treatment (2193 ml vs. 1694 ml, SEM 183; $P = 0.053$). There was no treatment effect in colostrum yield at 1 h or 18 h; however, T2 ewes had a higher colostrum yield at 10 h (571 vs. 831 ml, SEM 70; $P < 0.05$) which was reflected in a higher IgG yield at this time (28.4 g vs. 42.0 g, SEM 4.70; $P = 0.052$). Lambs in the Bio-Mos treatment (T2) had higher serum IgG levels than T1 lambs (16.9 vs. 13.8 g/l; SEM 0.89: $P < 0.05$). Similarly, lambs from T2 absorbed a higher percentage of colostral IgG than lambs from T1 (17.4% vs. 14.7%, SEM 0.94; $P < 0.05$). There was a tendency for lambs in the bio-Mos treatment to have higher growth rates from birth to weaning at 105 days (262g vs. 233g, SEM 12.4; $P = 0.098$). We conclude that the addition of Bio-Mos to the pregnant ewe diet results in increased lamb serum IgG status, with a likelihood for increased colostrum yield and lamb growth.

Acknowledgements: The authors wish to thank Alltech Ireland for funding this project

Key Words: Sheep, Bio-Mos, Immunoglobulin

M228 The effects of dietary inclusion of organic selenium (Sel-Plex) on ewe milk selenium level and lamb growth. M. Foley[1], T. M. Boland[1], S. Andrieu*[2], M. Guinan[1], and T. F. Crosby[1], [1]*University College Dublin, Belfield, Dublin, Ireland*, [2]*Alltech Ireland, Dunboyne, Co. Meath, Ireland*.

Fifty ewes were used to determine the effects of the inclusion of organic selenium (Sel-Plex; Alltech, Inc.) in the concentrate supplement during the final seven weeks of pregnancy on ewe performance, milk selenium level and lamb growth rate to weaning. The ewes were estrus synchronized and randomly allocated to one of the two treatments at 98 d post-mating. All ewes were offered a grass silage diet ad libitum which was supplemented with 500 g (98 - 133 d) or 700 g (134 d - 24 h post-partum) of concentrate. The concentrate supplement was fortified with either 0.875 mg/kg sodium selenite (T1) or 0.875 mg/kg Sel-Plex (T2). Ten ewes from each treatment were kept indoors for 10 d post-partum and offered the same experimental concentrates as given prior to lambing. These ewes were hand milked at 10 d and the milk selenium content determined. Ewe liveweight was recorded at the beginning of the trial and 24 h post-partum and lamb growth rate was measured up to weaning at 105 d. Ewe liveweight loss from 98 d of gestation to 24 h post-partum was higher in T1 (-5.5 vs. -3.4 kg; SEM 0.8; $P = 0.07$). Sel-Plex supplementation increased the level of selenium in the milk at 10 d (60 vs 98 µg/l; SEM 4.9; $P < 0.001$). There was no treatment effect on mean lamb birth weight ($P > 0.05$), with birth weights of 4.9 kg (T1) and 5.0 kg (T2) recorded. Lambs from the Sel-Plex treatment had a higher growth rate in the first 35 d post-partum (292 vs. 326 g/d; SEM 9.9; $P < 0.05$). Overall lamb growth rate from birth to weaning tended to be higher in T2 (231 vs. 249 g/d, SEM 7.0; $P = 0.08$) and this was reflected in lambs on the Sel-Plex treatment being 2 kg heavier at weaning (29.1 vs 31.1 kg; SEM 0.77; $P = 0.07$). We conclude that Sel-Plex supplementation of the pregnant-lactating ewe diet will result in higher milk selenium levels, improved ewe performance and a positive effect on lamb growth and weaning weight relative to inorganic selenium.

Acknowledgements: The authors wish to thank Alltech and Enterprise Ireland for funding this project

Key Words: Sel-Plex, Sheep, Milk Selenium

M229 Milk yield and milk composition of Santa Ines ewes. I. Susin*, A. V. Pires, C. Q. Mendes, I. U. Packer, and R. C. Araujo, *ESALQ/University of São Paulo, Piracicaba, SP, Brazil*.

Milk yield estimates for the Brazilian, non seasonal, hair sheep called Santa Ines are scarce. One hundred and thirty lactating Santa Ines ewes (55 kg BW) were used to estimate milk production and composition. Data were collected using the same protocol in three lambing seasons (years). All ewes were confined and had free access to a TMR to meet or exceed nutrient requirements for lactation. Milk yield was determined once a week (test-day), from second to eighth week of lactation. Ewes were milked twice in a 3 h interval using i.v. oxytocin for stimulation. Milk produced at second milking was weighed, recorded and sampled for composition determination by infrared analysis. A total of 910 test-day records were divided in five groups: G1- ewes rearing twin lambs (ERTL) in 2002; G2- ewes rearing single lamb (ERSL) in 2002; G3- ERSL in 2003; G4- ERTL in 2004 and G5- ERSL in 2004. Data of repeated measurement were analyzed with Proc Mixed of SAS, by a model including fixed effects of the contemporary groups above (year and type of rearing), parity, test-day, group x test-day, and random effect of ewe within group. Covariance structure used was the AR (1) type. There was a significant interaction between group and test-day for milk production, milk fat, protein and total solids. Milk production increased linearly from first to fifth lactation (1.26, 1.23, 1.35, 1.41 and 1.5 kg/d, respectively). Differences in milk production were observed for ERTL compared to ERSL only in early lactation. Milk yield of ERTL was 28% and 23% higher ($P < 0.05$) at second and third week of lactation, respectively in 2004 and 2002. Milk yield was adjusted as a quadratic equation in relation to days in milking, which indicated maximum production (peak) at 23, 26, 25, 16 and 34 d of lactation for G1, G2, G3, G4 and G5, respectively. Daily milk production using all data was 1.3 kg, and the average composition was 8.0% fat, 4.4% protein, 5.1% lactose and 18.6% total solids. These results indicate the importance of research efforts to increase milk production in this breed adapted to tropical conditions.

Key Words: Hair Sheep, Lactation, Performance

Swine Species: Swine Nutrition and Management

M230 The use of a modified farrowing pen: Effects on lactation performance of heat-stressed sows. C. Farmer*[1], T. Widowski[2], and D. Massé[1], [1]*Agriculture and Agri-Food Canada, Lennoxville, QC, Canada*, [2]*University of Guelph, Guelph, ON, Canada*.

The impact of using a modified farrowing pen (MOD) allowing evaporative cooling on lactation performance of heat-stressed sows was evaluated. Primiparous Yorkshire x Landrace sows were housed at 21 or 29°C from farrowing until the end of lactation (day 22). Animals from each group were assigned to a standard farrowing crate (STD; 21°C = 17, 29°C = 16) or a MOD pen (21°C = 19, 29°C = 19). The MOD pen consisted of a STD crate with a 1.5 x 1.6 m comfort zone in the back, equipped with rubber floor mats, a feeder and a nipple waterer. Litter size was standardized to 10 or 11. No creep feed was provided and piglets were weighed weekly. Sows were weighed on days 2 and 22. Feed intake of sows was monitored daily, a milk sample was obtained on day 21 (to measure DM) and jugular blood samples were collected on days 2 and 21 to measure prolactin, IGF-I and urea. Heat-stressed sows consumed less feed (3.4 vs 4.7 ± 0.1 kg/d, $P < 0.001$) than control sows and, at 29°C, sows in MOD pens consumed more feed (3.9 vs 3.0 ± 0.2 kg/d, $P < 0.01$) than sows in STD pens. Lactation weight loss was greater (-26.4 vs -19.1 ± 1.9 kg, $P < 0.05$) for sows in STD than MOD pens at 29°C. The reduction in prolactin concentrations from days 2 to 22 of lactation tended to be greater ($P = 0.08$) at 29°C for sows in STD pens. Concentrations of urea and IGF-I increased as lactation advanced ($P < 0.01$) and IGF-I was lower at 29°C than at 21°C on both days ($P < 0.01$) whereas urea was greater at 29°C on day 2 only ($P < 0.01$). Milk DM was less at 29 than at 21°C ($P < 0.01$). Average piglet weight gain was reduced at 29°C compared to 21°C during the second week of lactation ($P < 0.05$) and this reduction was less in MOD than STD pens during the third week of lactation ($P < 0.01$). From days 2 to 21 of lactation, heat stress reduced average piglet weight gain by 6.0% in MOD pens compared to 9.7% in STD pens.

Acknowledgements: Sincere thanks to Ontario Pork and Équipements Laliberté for financial assistance

Key Words: Farrowing Pen, Heat Stress, Lactation

M231 Effect of low energy diets fed to high lean pigs slaughtered at 115 kg of body weight. I. Moreira*, T. Voorsluys, D. Paiano, I. M. Sartori, M. A. A. Silva, and G. Jacob, *Universidade Estadual de Maringá, Maringá, Paraná, Brazil*.

An experiment was carried out to study the effect of low energy diets on performance and carcass traits of pigs slaughtered at 115 kg of BW. Thirty-six high lean pigs (1/2 female and 1/2 male) with 69.18 ± 6.44 kg initial BW were used. Treatments consisted of three diets (3,200, 2,900 and 2,720 kcal of ME/kg). The reduction of diet energy level was obtained by adding rice hulls (bran). Pigs, with free access to water and diets during experimental period, were allotted in treatments with four replicates of three pigs per replicate, in a completely randomized block design. Performance variables (feed intake, weight gain and feed: gain ratio), carcass traits (carcass yield, ham yield, loin muscle area and meat: fat ratio) and plasma urea nitrogen (PUN) were analyzed. When pigs reached 115.41 ± 6.20 kg BW, five pigs per treatment were slaughtered for carcass traits. Data were analyzed as a polynomial regression and performance data were estimated taking a pen with three pigs as experimental unit. In the

case of PUN and carcass traits each pig was considered an experimental unit. No effect of energy level reduction on performance, carcass traits and PUN was detected, although a numeric better (8.5%) feed: gain ratio was obtained at lower ME level. Results suggest that energy levels of diets, between 3,200 and 2,720 kcal of ME/kg, fail to influence performance and carcass traits of high lean pigs slaughtered at 115 kg BW.

Acknowledgements: CNPQ, UEM

Key Words: Energy, Fiber, Feed Restriction

M232 Pig manure production (qualitative and quantitative) of finishing pigs fed on diets containing different levels of energy and fiber. I. Moreira*, R. M. Martins, D. Paiano, A. C. Furlan, E. N. Martins, and L. S. Perdigão, *Universidade Estadual de Maringá*, *Maringá, Paraná, Brazil*.

A digestibility trial was carried out to evaluate the effects of energy restriction by using dietary fibers on manure quantity and quality and to assess the ensuing environmental impact. Thirteen barrows, initial average weight 84.8±4.5 kg, were used. Treatments consisted of three diets with different metabolizable energy (ME) levels (3,200, 2,960 and 2,720 Kcal of ME/kg). A corn-soybean meal diet, supplemented with dicalcium phosphate, limestone, vitamin-mineral premix, salt, lysine and rice hull as fiber source, was used. The three diets contained 12.73% CP, 0.68% lysine, 0.69% calcium, 0.46% phosphorous. Crude fiber levels were 2.51, 5.60 and 8.64%, related to decrease in ME levels. Diets and water were provided three times a day during 13 days. Total feces and urine were collected during the last five days. Decrease in the metabolizable energy by an increase of crude fiber level on finishing pig diets resulted in an increase ($p \leq 0.05$) of total feces production (dry matter and organic matter) without increasing the total excretion of nitrogen and phosphorus. There has also been a reduction of the digestibility of dry matter, crude protein and metabolization of crude protein, which decreased weight gain and impaired feed conversion. Results suggest that an increase in dietary fiber to reduce energy level leads towards an increase in feces production without increasing nitrogen and phosphorous production. This means more labor and cost on manure handling.

Acknowledgements: CNPq, UEM

Key Words: Environment, Feed Restriction, Pollution

M233 Avilamycin in the diet affects intestinal mucosal architecture and mucosa-associated bacteria in weaned pigs. B. Kleessen[3,2], R. Brunner[1], J. Kluess[1], W. Souffrant[1], U. Hennig[1], and C. Metges*[1], [1]*Research Institute for the Biology of Farm Animals*, *Dummerstorf, Germany*, [2]*German Institute of Human Nutrition (DIFE) Potsdam*, *Nuthetal, Germany*, [3]*Institute of Bacteriology and Mycology, University of Leipzig*, *Leipzig, Germany*.

Feed antibiotics have been included in the weaning diet of piglets to reduce postweaning stress reflected by reduced feed intake and weight gain, impaired digestive and absorptive function. We evaluated the effects of either a standard starter diet (StD; wheat, barley, whey) or StD + avilamycin (40 mg/kg) on mucosal morphometry of the intestine, and mucosa-associated bacteria of a total of 32 piglets (n = 8/group) at 1 and 15 d post-weaning. Addition of avilamycin to the diet resulted in higher villi and deeper crypts in the jejunum of piglets at 15 d postweaning compared with controls ($P < 0.05$). Avilamycin also increased thickness of tunica muscularis and numbers of goblet cells in the crypts of the duodenum of piglets ($P < 0.05$). In the ileum, caecum and colon, however, mucosal morphology was only affected by postweaning time ($P < 0.01$). Using fluorescent in situ hybridization with 16S/23S rRNA-targeted probes avilamycin resulted in a pronounced reduction of lactobacilli/enterococci counts in stomach, jejunum and colon ($P < 0.05$), whereas the gamma subdivision of Proteobacteria numbers were not changed. In contrast, lactobacilli/enterococci counts in duodenum, ileum and caecum were not affected by treatment. Digital image analysis by confocal laser scanning microscopy allowed the detection of mucosal invaded bacteria in the caecum and of spiral-shaped organisms in the stomach of avilamycin treated piglets at the age of 15 d postweaning. In conclusion, avilamycin added to a starter diet appeared to be beneficial for gut morphological characteristics, but may be detrimental to piglets health, because it is associated with the disruption of the mucosa-associated protective flora (i. e. lactobacilli), possibly facilitating mucosal bacterial penetration.

Acknowledgements: Funded by the EC grant HEALTHYPIGUT (QLK5-CT2000-00522)

Key Words: Intestinal Microbiota, Feed Antibiotic, Pig Health

M234 A high-resolution radiation hybrid map for swine. W.-S Liu*[1], K. Eyer[1], H. Yasue[2], B. Roelofs[1], H. Hiraiwa[2], T Shimogiri[3], E. Landrito[1], J. Ekstrand[1], M. Treat[1], and C. W. Beattie[1], [1]*University of Nevada*, *Reno*, [2]*National Institute of Agrobiological Sciences*, *Ikenodai, Tsukuba, Ibaraki, Japan*, [3]*Kagoshima University*, *Korimoto, Kagoshima, Japan.*

The swine physical map lacks the resolution required for fine mapping the 791 production QTLs (PigQTLdb; http://www.animalgenome.org/QTLdb/) currently reported and for providing a high-resolution scaffold for sequencing the swine genome. The radiation hybrid (RH) panels currently available for swine [the 3000-rad (T43RH), 5000-rad (SSRH), and 7000-rad (IMpRH)] provide sufficient resolution to order BAC contigs, but chromosome gaps and undefined synteny borders remain. We are characterizing a new, high-resolution, 12,000-rad panel (IMNpRH2) to fill gaps and identify all remaining synteny breaks and chromosomal rearrangements with the human genome (HGS). To date, we have typed and ordered ~4800 markers on the $IMNpRH2_{12,000\text{-}rad}$ panel, including ~1500 MS and 3300 genes/ESTs using the CarthaGene software. Retention frequencies ranged from 7.8% to 51.1%, avg. 33.1%. An initial $RH_{12,000\text{-}rad}$ map for pig chromosome 12 (SSC12), syntenic with HSA17, was constructed with 327 markers covering ~4866 $cR_{12,000}$. Sixteen linkage groups were ordered at LOD 6, based on framework markers previously mapped on the $IMpRH_{7000\text{-}rad}$ SSC12 and porcine genetic maps. The resolution of the current SSC12 $RH_{12,000\text{-}rad}$ map is approximately one marker ~ 250 kb, significantly improving the physical map of the pig. We expect to finalize a high-resolution, integrated $RH_{12,000\text{-}rad}$ map for swine with a total of ~12,000 markers including ~1500 MS, ~10,000 genes/ESTs and sufficient BESs to identify all breaks and close all gaps at an average resolution of ~15kb/cR by early 2006, to provide a high-resolution scaffold on which to help assemble the swine genome sequence.

Acknowledgements: This work was supported by USDA, CSREES (No. 2004-35205-14244).

Key Words: Swine, Genome, Radiation Hybrid Map

M235 Effects of operator and interpreter on real-time ultrasonic measures of backfat thickness and longissimus muscle area in pigs. L. L. Lo*, C. Y. Fang, H. C. Chung, Y. Y. Lin, and C. Y. Lien, *Chinese Culture University*, *Taipei, Taiwan*.

Several factors affect the accuracy of predicting the carcass composition using real-time ultrasound in pigs. Objectives of this study were to detect the effects of operator and interpreter for ultrasonic determination of backfat thickness (BF) and longissimus muscle area (LMA). A total of 102 Landrace, Yorkshire, and Duroc boars and gilts at six different growing stages (55, 65, 75, 85, 95, 105 kg of body weight), were scanned at the tenth and last rib by one experienced technician and three trained operators using an Aloka SSD 900 B mode ultrasound scanner for BF and LMA. All operators and the technician measured their own B-mode images after scanning. The images were then recorded and later read by an independent and trained interpreter using an image analysis system-ENCOMate®. Repeatabilities calculated as the intraclass correlation among animals for scanned tenth rib backfat (BFTN) was higher than those corresponding to the last rib (0.68 vs. 0.44). Ultrasound at the last rib longissimus muscle area (LMALR) measurement was more repeatable than those of the tenth rib (0.65 vs. 0.77). The coefficients of correlation between three operators and the technician ranged from 0.42 to 0.84, indicating the importance of operator effects, with ultrasonic measures of BF and LMA at the tenth rib had

higher values than those of at the last rib. Correlations between the measures of the BFTN and corresponding BF and LMA were similar between the technician and three operators. Coefficients of correlations were more varied in the last rib, with lower correlations between BFLR and LMALR. Correlations of LMA and BF at the tenth rib between the ultrasound technician and image interpreter were higher than those at the last rib (0.648, 0.560 vs. 0.518, 0.424). Results of this study indicated the importance of probing site, ultrasound and image interpretation in determining lean production associated with use of the Aloka SSD 900 B mode scanner. Method of evaluation and technical training standards, therefore, need to be established for operators of such equipment.

Key Words: Ultrasound, Repeatabilities, Body Composition

M236 Piglet performance and meat quality at slaughter in response to increased maternal feed allowance during mid gestation. A. Cerisuelo*[1], M. Baucells[1], J. Bonet[2], D. Carrión[3], S. Tibble[4], J. Gasa[1], and R. Sala[1], [1]*Universitat Aut&ogravee;noma de Barcelona*, *Spain*, [2]*Vall Companys Group*, *Spain*, [3]*PIC España, S.A.*, *Spain*, [4]*SCA Ibérica*, *Spain*.

The objective of this study was to verify the effect of increased maternal intake during mid-gestation on performance and carcass and meat quality traits at slaughter. Ninety-six sows were divided into two treatments and feed different amounts of feed from 45 to 80 days of gestation. Control sows (C=46) received 3.0 kg/day (2.9Mcal EM/kg and 6g lysine/kg) and experimental sows (E=50) received additionally +50% and +75% extra feed than control group for primiparous and multiparous sows, respectively. The offspring (castrated barrows) was reared conventionally during nursery (n=500) and growing-finishing (n=260) phases. They were divided in 5 weight groups and only group 3 (middle weight) and 4 (low weight) were used for carcass (carcass and main cuts yield, lean meat content and mid-line fat thickness at gluteus medium) and meat (pH24, Minolta colour and drip loss) quality measurements in *longissimus dorsi* and *semimembranosus* muscle. During nursery phase (from 7.3 kg to 16.5 kg), no differences were obtained ($p>0.1$) in average daily gain and average daily feed intake between treatments, but gain:feed ratio was higher in the E progeny (0.74 *vs* 0.72, $p<0.05$), specially in the smallest group of weight (Group 5). However, in the growing-finishing phase (up to 112 kg) no differences were observed between treatments. Higher feed allowance during mid-gestation did not affect carcass and meat quality traits at slaughter. Thus, this feeding practice during pregnancy did not show any benefitial effect on post-natal growth of the offspring. However, it seems to increase the growing efficiency of the lighter groups of pigs at nursery. Studies involving muscle fiber characteristics will be conducted to know if a higher feed intake from 45 to 80 days of gestation may induce differences in muscle fiber structure.

Key Words: Piglet Performance, Meat Quality, Maternal Nutrition

M237 Effect of additional feed allowance during mid gestation on body reserves changes and feed intake during lactation in lean sow genotype. A. Cerisuelo*[1], R. Sala[1], D. Carrión[2], J. Coma[3], S. Tibble[4], J. Gasa[1], and M. Baucells[1], [1]*Universitat Autònoma de Barcelona*, *Spain*, [2]*PIC España, S.A.*, *Spain*, [3]*Vall Companys Group*, *Spain*, [4]*SCA Ibérica*, *Spain*.

Restricted intakes during gestation may compromise maternal body reserve recovery in genetically lean sows; however, high backfat levels at farrowing have been related with a lower feed intake during lactation, affecting reproductive and lifetime performance. The present experiment was conducted to study the effects of supplemental feeding strategy during mid-gestation on body reserves changes and voluntary feed intake during lactation. Ninety-six LDxLW sows were allocated in two treatments at day 45 of gestation. Control sows (C=46) received an average of 3.0 kg/day (2.9 Mcal EM/kg and 6g lysine/kg) during all gestation period. Experimental sows (E=50) were provided from day 45 to 80 of gestation +50% and +75% higher amount of feed than control for primiparous (n=20) and multiparous (n=76) sows, respectively. Body weight (BW) and ultrasonically estimated backfat (BF) and loin depth (L2) were recorded at day 40 of gestation, at farrowing, at weaning (21 days) and at 40 days of the subsequent gestation. Average feed intake during lactation was registered. E sows gained more BW (34.5 kg *vs* 18.0 kg), BF (5.0 mm *vs* 3.0 mm) and L2 (5.1 mm *vs* 2.3 mm) than C sows during gestation ($p<0.05$). During lactation, E sows mobilized more BW ($p<0.05$) but BF and L2 losses were not different between treatments ($p>0.1$). Voluntary feed intake during lactation was significantly lower in the experimental group (4.1 kg/day *vs* 4.4 kg/day, $p<0.05$). In this case, gains of 2 mm of BF during gestation lead to a 300 g/day lower feed intake during lactation. In conclusion, leaner genotypes showed an interaction between mid gestation and lactation feed intake. However, this effect was not detrimental to body reserves as indicated the higher amount of BF and L2 found in the experimental group at weaning. Therefore, additional feed in gestation could avoid rebreeding and early culling problems in sows.

Key Words: Body Reserves, Feed Intake, Pregnant Sow

M238 Analysis of the association between farrowing and subsequent breeding performance with lactation feed intake. S. S. Anil*[1], L. Anil[1], J. Deen[1], S. K. Baidoo[2], and R. D. Walker[2], [1]*University of Minnesota*, *Saint Paul*, [2]*University of Minnesota*, *Waseca*.

A study was conducted at SROC, University of Minnesota, with 507 sows of parity 1-8 to analyze the association of lactation feed intake (LFI) with farrowing (litter birth and weaning weights, mummies and stillborn) and subsequent breeding (wean to service interval-WSI and conception) performances. Data on LFI, BW, backfat and farrowing and breeding performance were extracted from the sow records and PigCHAMP database. Logistic regression models were fitted to analyze the association of average LFI with farrowing performance and subsequent breeding performance. In the model with farrowing performance, change in body condition (weight and backfat changes) during lactation was also included. The LFI was categorized as lower or higher than the average (6.780 ± 0.07kg), mummies and stillborn were categorized as either present or absent, WSI was categorized as ≤5 or ≥6 days, conception as conceived or not conceived after breeding, parity was grouped into 3 as 1 and 2, 3-5 and ≥6 and the changes in BW and backfat were categorized as lower or higher than the average. Litter weights at birth and at weaning and lactation length were included as continuous variables. The likelihood for higher (≥mean) average LFI increased ($P \leq 0.05$) with an increase in litter weights at birth and weaning (Odds Ratio (OR): 1.076, Confidence interval (CI): 1.011-1.145 and OR: 1.049, CI: 1.025-1.075, respectively). The likelihood for higher average LFI was ($P \leq 0.05$) lower for sows of parities 1 and 2 compared to sows of parities≥ 6 (OR: 0.207, CI: 0.120-0.357). A higher average LFI was associated with an increase in BW at weaning compared to the BW at d 108 of gestation (OR for change in BW: 5.112, CI: 3.063-8.530). Lactation length, presence or absence of stillborn and mummies and backfat change had no association with LFI. Average LFI was found to have no association with WSI or subsequent conception. The results indicated that lactation feed intake was associated with parity, litter weights at birth and weaning and BW change whereas it showed no association with subsequent breeding performance.

Key Words: Lactation Feed Intake, Performance

M239 Effect of different levels of soybean hulls in growing and finishing pigs diets. I. Moreira*[1], A. R. B. Quadros[2,1], A. R. P. Parra[3,1], C. R. Ribeiro[1], N. Silvestrin[1], and C. Scherer[1], [1]*Universidade Estadual de Maringá*, *Maringá, Paraná, Brazil*, [2]*Universidade Federal de Santa Maria*, *Santa Maria, Rio Grande do Sul, Brazil*, [3]*Universidad del Tolima*, *Ibagué, Tolima, Colombia*.

A study was carried out over an 80-d period (34-d for growing and 46-d for finishing phases) to evaluate the effect of inclusion of different levels of soybean hulls (SH) in diets for growing/finishing pigs. SH contained (as-fed basis): 91.87% DM, 17.64% CP, 2,670 kcal DE/kg, 0.29 P, 0.52% Ca, 51.44% NDF. Forty crossbred pigs, average body weight 27.84 kg, were blocked by weight and randomly assigned to five experimental diets, with four replicates, with two pigs per pen (experimental unit). Treatments consisted of inclusion (0.0; 4.0; 8.0; 12.0 and 16.0%) of soybean hulls (ground at 2.5 mm) in an

isoenergetic (3,385 kcal DE/kg) diet (16.4 and 15.0% CP) for growing and finishing phases, respectively. When pigs reached an average body weight of 55.0 kg, diets were changed to finishing phase. Pigs were given free access to feed and water. Pigs were weighed and blood samples collected at start, 34-d and end of experimental period. Plasma urea nitrogen (PUN) and fat thickness (FT) was determined at the end of each experimental period. Results for growing phase (34-d) were: ADFI - 2.04; 1.95; 1.94; 1.94 and 2.05 kg; ADG - 0.80; 0.81; 0.76; 0.79 and 0.84 kg; G:F - 2.58; 2.42; 2.55; 2.45 and 2.44; PUN - 8.63; 7.64; 8.82; 8.91 and 8.16 mg/dL; FT (P2) - 9.2; 8.6; 9.1; 8.7 and 8.4 mm, respectively for 0.0; 4.0; 8.0; 12.0 and 16.0% of SH inclusion. Results for finishing phase (46-d) were: ADFI - 2.53; 2.45; 2.48; 2.63 and 2.69 kg; ADG - 0.84; 0.79; 0.79; 0.86 and 0.88 kg; G:F - 2.99; 3.09; 3.13; 3.05 and 3.05; PUN - 8,65; 8,74; 9,04; 7,79 and 8,18 mg/dL; FT (P2) - 13.0; 11.7; 11.4; 11.2 and 11.6 mm. respectively at SH inclusion levels. No variable has been affected by SH inclusion. Results suggest that inclusion up to 16.0% of soybean hulls in growing and finishing pig diets is feasible.

Acknowledgements: UEM; UFSM

Key Words: By-Product, Feeding, Feedstuffs

M240 Hematology and blood biochemistry of Enviropig™. R. G. Meidinger[1], A. Ajakaiye*[1], D. A. Murray[1], S. P. Golovan[1], M. Z. Fan[1], J. P. Phillips[1], J. Zhang[1], R. R. Hacker[1], J. M. Kelly[2], and C. W. Forsberg[1], [1]*University of Guelph*, *Guelph, Ontario, Canada.*, [2]*MaRS Landing*, *Guelph, Ontario, Canada.*

Hematology and biochemistry of animal blood are well documented standard methods for assessing animal health. We have analyzed a total of 17 hematology and 25 biochemistry parameters on fresh blood samples to assess the health of the recently developed Enviropig™ (EP) Cassie line of pigs that secretes phytase in the saliva. Forty eight pigs (24 EP and 24 Yorkshire [YK]) comprised of 12 boars and 12 gilts of each breed were used in the trial, with blood collected at 54.6 ± 0.7 and 55.7 ± 0.5, 90.6 ± 0.7 and 91.7 ± 0.5 and 125.6 ± 0.7 and 126.7 ± 0.5 days of age for weanling, growing and finishing phases, respectively. Growing and finishing pigs were individually housed in a temperature-controlled room maintained at 22°C. The experimental design was 2 x 2 factorial combinations of breed and gender. All growing and finishing pigs were fed at a percentage of their BW with weekly adjustments using the NRC (1998) model. The experimental diets for the growing and finishing pigs were formulated based on the available P with the Ca:P maintained at a ratio of 2:1. Blood samples were collected from the intraorbital sinus. There were either no significant differences in the assayed parameters across the treatments ($P<0.05$), but if there were differences, the values were within published normal ranges. These data indicate no appreciable biological differences between the EP and YK hematology and blood biochemistry.

Key Words: Enviropig™, Yorkshire, Blood

M241 Effects of feeding grains naturally-contaminated with *Fusarium* mycotoxins to first parturition sows on pre-parturition performance and metabolism. G. Diaz-Llano* and T. K. Smith, *University of Guelph*, *Guelph, Ontario, Canada*.

Fusarium mycotoxins such as deoxynivalenol (DON) and fusaric acid (FA) depress average daily feed intake (ADFI) and average daily gain (ADG) but do not affect gain:feed ratio (GF) of piglets. There is a lack of imformation concerning the effects of feeding sows grains naturally-contaminated with *Fusarium* mycotoxins. An experiment was conducted, therefore, to characterize the toxicity to first parturition sows and to determine the efficacy of a polymeric glucomannan mycotoxin adsorbent (GMA). Thirty first parturition sows were fed corn, wheat and soybean meal based gestation diets over three weeks prepartum. The diets included: (1) control (2) contaminated grains and (3) contaminated grains + 0.2% GMA. Diets had no effects on ADFI, however, the feeding of contaminated grain compared to controls reduced ADG ($P < 0.05$). There were no differences in ADG comparing controls and sows fed GMA. The G:F ratio was not affected by diet. There were no effects of diet on serum concentrations of B-OH butyrate, haptoglobin, total protein, albumin, globulin, albumin: globulin ratio, urea, creatinine, glucose, cholesterol, or on activities of alkaline phosphatase, gamma glutamyltransferase, aspartate aminotransferase, creatine kinase, glutamate dehydrogenase, total bilirubin, conjugate bilirubin and free bilirubin. There were no effects of diet on body weight of piglets at birth, nor on the number of piglets born alive, stillborns, mummies and total born. It was concluded that the feeding of diets containing grains naturally contaminated with *Fusarium* mycotoxins to first parturition sows during prepartum period affects ADG. Supplementing contaminated diets with GMA prevents this effect of mycotoxins.

Key Words: Sows, *Fusarium*, Mycotoxin

M242 Effects of feeding grains naturally-contaminated with *Fusarium* mycotoxins to first parturition sows on post-parturition performance and metabolism. G. Diaz-Llano* and T. K. Smith, *University of Guelph*, *Guelph, Ontario, Canada*.

Fusarium mycotoxins such as deoxynivalenol (DON) and fusaric acid (FA) depress average daily feed intake (ADFI) and average daily body weight change (ADBWC) but do not affect gain: feed ratio (GF) of piglets. There is a lack of information relating to the effects of feeding sows grains naturally-contaminated with *Fusarium* mycotoxins. An experiment was conducted, therefore, to characterize the toxicity to first parturition sows during the lactation period and to determine the efficacy of a polymeric glucomannan mycotoxin adsorbent (GMA). Twenty one first parturition sows were fed corn, wheat and soybean meal based lactation diets over three weeks prepartum and three weeks after farrow. The diets included: (1) control (2) contaminated grains and (3) contaminated grains + 0.2% GMA. The feeding of contaminated diets after farrowing reduced ADFI ($P < 0.01$) and ADBWC ($P < 0.05$) compared to controls. Feeding of the GMA diet reduced ADFI ($P < 0.01$) but not ADBWC compared to controls ($P = 0.074$). There were no effects of diet on serum concentrations of B-OH butyrate, haptoglobin, blood protein, albumin, globulin, albumin: globulin ratio, urea, creatinine, glucose, cholesterol, nor on activities of alkaline phosphatase, gamma glutamyltransferase, aspartate aminotransferase, creatine kinase, glutamate dehydrogenase, total bilirubin, conjugate bilirubin and free bilirubin the day of farrowing. Body weight gain of piglets to weaning was not affected by diet. Protein, fat and lactose concentration in milk was not affected by diet on the day of farrowing or during lactation. It was concluded that feeding first parturition sows diets containing grains naturally contaminated with *Fusarium* mycotoxins reduces ADFI during the lactation period.

Key Words: Sows, *Fusarium*, Mycotoxins

M243 Changes in dietary preferences in piglets due to different cereals. D Solà-Oriol[1], E Roura*[2], and D Torrallardona[1], [1]*IRTA-Centre de Mas Bové*, *Reus, Spain*, [2]*Lucta SA*, *Barcelona, Spain*.

Piglets at weaning undergo a severe reduction in dry matter intake due to low voluntary feed intake. The use of palatable diets during this phase should diminish this negative effect. Three trials were conducted to evaluate the palatability of different cereals compared to a basal diet with 60% of broken rice (reference). For each trial 36 four piglet pens had available simultaneous access to two different diets in two feeding hoppers; one with the reference diet and the other with the same diet but with partial (30%) or total (60%) substitution of the broken rice by a test cereal. In each trial three cereals were tested and a double control test (rice *vs.* rice) was included. The cereals were tested in mash form in two consecutive 4-day periods; the first period for the 30% inclusion level and the second period for the 60%. The preference for each cereal diet relative to the reference diet was calculated as the percentage contribution of the test diet to total feed intake. Preference values for all three trials were analyzed taking into account the effects of cereal, level of inclusion and their interaction. At 30% of inclusion, the preference values (% of total feed intake) were; broken rice (control): 51^{a}, barley: 47^{ab}, rye: 45^{abc}, wheat: 39^{abcd}, maize (Argen-

tina): 31^{bcde}, biscuit by-product: 31^{bcde}, cassava: 30^{bcde}, maize (Europe): 29^{bcdef}, sorghum: 27^{cdefg} and oats: 18^{efgh}. When included at 60%, the preferences were: broken rice (control): 47^{a}, rye: 29^{bcdef}, barley: 22^{defg}, cassava: 22^{defg}, wheat: 22^{defg}, biscuit by-product: 18^{efgh}, maize (Europe): 11^{fgh}, sorghum: 11^{fgh}, maize (Argentina): 8^{gh} and oats: 3^{h}. Values with different superscripts are significantly different ($P < 0.05$); pooled SEM=6.6. It is concluded that the palatability of the diet for piglets depends on the source of cereal used and its level of inclusion.

Key Words: Piglet Weaning, Diet Preference, Cereals

M244 Changes in dietary preferences in piglets due to different protein sources. D Solà-Oriol[1], E Roura*[2], and D Torrallardona[1], [1]*IRTA-Centre de Mas Bové*, *Reus, Spain*, [2]*Lucta, SA*, *Barcelona, Spain*.

Voluntary feed intake in piglets depends on the palatability of the diet. Two trials were conducted to study the effects of different protein sources on diet palatability in piglets. A double choice preference test was performed using a reference basal diet with 20% of a soy protein product (56% CP -SBM-56-) low in anti-nutritional factors. 36 four-piglet pens were offered free access to two different diets in two feeding hoppers; one of which contained the reference diet and the other contained the diet with the protein source to be tested. The tested protein sources were included in the diets at two levels (10 and 20%) replacing the corresponding amount of soy protein product from the basal diet. Each trial included a double control test (SBM-56 *vs.* SBM-56) and the diets were presented in mash form. The tests were performed in two consecutive periods of 4 days, first period to test the 10% and second period to test the 20% inclusion levels. The preference for each protein source relative to the reference diet was calculated as the percentage contribution of the test diet to total feed intake. The preference values of both trials were analyzed together taking into account the effects of ingredient, level of inclusion and their interaction. When included at a level of 10% the preference values (% of total feed intake) observed were: lupine (*L. angustifolius*): 70^{a}, soybean meal-44: 69^{ab}, extruded soybean: 68^{ab}, soybean meal-48: 62^{abc}, SBM-56 (control): 54^{abcd}, sunflower meal: 40de and rapeseed meal: 30^{ef}. On the other hand, when included at 20% they were: soybean meal-44: 55^{abcd}, soybean meal-48: 54^{abcd}, SBM-56 (control): 54^{abcd}, extruded soybean: 53^{bcd}, lupine (*L. angustifolius*): 47^{cde}, rapeseed meal: 10^{fg} and sunflower meal: 9^{g}. Values with different superscripts are significantly different ($P < 0.05$); pooled SEM=7.5. It is concluded that the source of protein and its level of inclusion affect the palatability of piglet diets. Sunflower and rapeseed meals showed the lowest preferences.

Key Words: Piglet, Diet Preference, Protein Sources

M245 Litter size of naturally bred and artificially inseminated sows from commercial swine production units in North-Central Mexico. L. A. Ruvalcaba, F. De la Puente-Ocampo, F. J. Escobar-Medina*, and C. F. Arechiga, *Universidad Autonoma de Zacatecas*, *Zacatecas, Zac. Mexico*.

Litter size from naturally bred (n=48), inseminated (n=64) and gonadotropin-treated and inseminated (n=37) sows from commercial swine units was evaluated. Sows parity was not alloted. Natural breeding and heat detection for insemination depended upon owner and/or manager's decission. Therefore, inseminations were performed by the same technician in a daily schedule for each farm (every 24 hours) based on heat information provided by the farm personnel. Total number of pigs born did not show differences within inseminated, gonadotropin-treated prior to insemination and naturally breeding. However, there was a tendency for higher number of piglets in multiparous than primiparous sows. Moreover, there were no significant difference in the number of piglets born alive and the number of pigs weaned, but there were differences between multiparous and primiparous sows using artificial insemination and natural breeding ($P < 0.05$). In conclusion, use of artificial insemination did not compromise litter size as compared to natural breeding in swine commercial units from North-Central Mexico.

Key Words: Sows, Artificial Insemination, Litter Size

M246 Reproductive function of sows inseminated using diluted semen in Androhep EnduraGuard and Androhep Plus. M. E. Vergara-Zambrano, F. J. Escobar-Medina*, J. Becerril-Ángeles, G. Rocha-Chavez, and F. De la Colina, *Universidad Autonoma de Zacatecas*, *Zacatecas, Zac. Mexico*.

A study concerning the reproductive behavior of sows served with dilluted semen in Androhep Plus stored during 1 to 3 days (group 1); Androhep EnduraGuard stored during 1 to 3 days (group 2) and 7 to 9 days (group 3) is described. The semen was stored at 17° C. Study was made in a commercial farm located a 22° 21′ N and 102° 02′W. Sows received only one artificial insemination. Percentage of conception was 82.56, 88.10 and 81.54%, and farrowing rates were 74.42, 79.76 and 76.92% in groups 1, 2 and 3, respectively. Litter size obtained was 9.7±3.8, 10.8±2.7 and 9.7±3.2 piglets of which 8.69±3.2, 10.0±2.5 and 8.82±2.9 were borne-alive in groups 1, 2 and 3, respectively. Treatment in group 2 (Androhep EnduraGuard 1-3 d), showed statistical significant difference in the number of piglets born alive compared to the other treatments. In conclusion, semen diluted in Androhep EnduraGuard stored during 7 to 9 days could be an alternative option to be used for artificial insemination of sows.

Key Words: Sows, Semen, Artificial Insemination

M247 Body-weight gain of piglets according to birth timing, mammary gland selection and litter size. M. G. Correa-Aguayo, F. J. Escobar-Medina*, and J. J. Hernandez-Berumen, *Universidad Autonoma de Zacatecas*, *Zacatecas, Zac. Mexico*.

Body weight of piglets was evaluated in response to birth sequence, litter size and mammary gland chosen (teat). Body weights were recorded weekly from birth to weaning at 4 wk of age. Recordings of mammary glands from which each piglet nursed were taken. There were not significant differences for daily weight-gain of piglets according to the locasion of the mammary gland. Sequence of birth and mammary gland chosen did not compromise body weight of piglets. However, there was a tendency for lower body weights in piglets born at the 11th, 12th and 13th place as well as for piglets nursing from inguinal teats. Piglets nursing from anterior mammary glands (from pair number 1 to pair number 6) tended to grow faster than piglets nursing from posterior mammary glands (from pair 7 and above). Litter size influenced daily weight-gain of piglets ($P < 0.05$). Litters with 3, 4, 5, and 7 piglets showed higher body weights. Litter weight-gain was related to number of piglets; a litter size of 11 pigs showed the highest body weight ($P < 0.05$). In conclusion, there is a tendency for lower body weights in piglets born by the end of parturition. Individual daily weight-gain for piglets nursuring from anterior mammary glands is greater than for piglets nursuring from posterior mammary glands, as well as for piglets born from a reduced litter size. As expected, litter weight-gain increased as litter size increased.

Key Words: Swine, Mammary Gland, Litter Size

M248 Fertility of artificially-inseminated sows presenting abnormal vaginal secretions. F. Medina-Jimenez[1], F. J. Escobar-Medina*[1], C. F. Arechiga[1], J. J. Hernandez-Berumen[1], G. Rocha-Chavez[2], and J. Becerril[2], [1]*Universidad Autonoma de Zacatecas*, *Zacatecas, Zac. Mexico.*, [2]*Minitube Mexico*.

Fertility of artificially-inseminated sows presenting abnormal vaginal discharges was evaluated. Study include F1 sows (Landrace x Yorkshire, n=235) with different age, parity, body weight and body condition. Sows were divided into two groups having or not having abnormal vaginal secretions, detected during routine revisions of estrus or by observing purulent material on the catheter after insemination. In addition, sows were grouped according to the extender used to preserve semen: Androhep Plus with service from one to three days after the collection and dilution of semen and EnduraGuard with service from one to

three days and from seven to nine days after the collection and dilution of semen. There were statistical significant difference among extenders. EnduraGuard with service from one to three days obtained higher litter size and number of piglets born alive ($P \leq 0.05$). On average, 86.8% and 78.9% of the females conceived and 78.6% and 73.7%, farrowed in the groups with normal and abnormal vaginal secretion, respectively. These numbers were not significantly different. There were no interaction within extender used and sows with or whitout abnormal vaginal secretion. The average litter size, in the same order, was 10.24 ± 3.0 and 9.88 ± 2.8 ($P \leq 0.01$), and the number of piglets born alive were 9.34 ± 2.8 and 8.92 ± 2.8 ($P \leq 0.01$). In conclusion, presence of abnormal vaginal secretions by the time of insemination might not severely compromise fertility and other reproductive parameters of the sows.

Key Words: Swine, Artificial Insemination, Vaginal Secretion

M249 Effect of gender, group size, and time of first removal for slaughter on pig performance in a wean-to-finish production system. J. M. DeDecker*, M. Ellis, C. R. Bertelsen, B. A. Peterson, and M. J. Ritter, *University of Illinois*, *Urbana*.

This study was carried out with 1326 crossbred pigs to investigate the effects of gender, group size, and timing of pig removal for slaughter on pig performance. A randomized complete block design was used with a 3×2×2 factorial arrangement of treatments:1) gender (barrow vs gilt vs mixed-gender pens), 2) group size (42 [floor space 0.54m2/pig] vs 36 [0.63m2/pig] pigs/pen), and 3) time of first removal for slaughter (18 vs 20 wk post-weaning). For the wk-18 treatment, 15% of the heaviest pigs were removed at wk 18, 25% at wks 20 and 22, and remaining pigs at wk 24; for the wk-20 treatment, 25% of the heaviest pigs were removed at wks 20 and 22, and the remaining pigs at wk 24. Growth was measured from 19.3 ± 0.01kg to 104.5 ± 0.59kg (Period 1, before removal) and from 104.5 ± 0.59kg to 131.4 ± 0.84kg (Period 2, wk 18 to 24 post-weaning). No treatment interactions were found. For Period 1, ADG was greater ($P < 0.01$; 897 and 876 g/d) and BW higher ($P < 0.05$; 105.3 and 103.7) for 36 and 42 pig groups, respectively; ADFI and G:F were not affected by group size. The CV for BW was higher ($P < 0.05$) at wk 18 for 42 pig groups compared to 36 pig groups (13.4 vs 12.0%, respectively). In Period 2, 36 pig groups had higher ($P < 0.01$) ADFI, lower ($P < 0.01$) G:F, but similar ADG than 42 pig groups. Removing pigs at wk 18 versus wk 20 resulted in higher ($P < 0.001$) ADG and ADFI for the remaining pigs, but had no affect on G:F. Barrow and mixed-gender groups had higher ($P < 0.05$) ADFI but lower ($P < 0.05$) G:F than gilts. The 42 pig groups compared to the 36 pig groups produced more total live weight ($P < 0.001$; 4359.6 and 4868.3 ± 65.36kg, respectively), consumed more feed/pen ($P < 0.01$; 8940.3 and 9949.1 ± 210.58kg, respectively), and had greater ($P < 0.01$) variation in BW for all pigs marketed. Variation in BW for all pigs marketed was higher ($P < 0.01$) for the wk 20 than the wk 18 treatment. In summary, the 42 pig groups grew slower but produced a greater total weight of pigs than 36 pig groups. Removing pigs at wk 18 compared to wk 20 improved the growth rate of the remaining pigs and resulted in lower variation in BW at market.

Key Words: Pigs, Group Size, Pig Removal

M250 Estimation of carcass compositional differences in live breeding swine using real-time ultrasound. T. Perkins*, *Southwest Missouri State University*, *Springfield*.

The use of ultrasound to estimate backfat thickness and loin muscle area has been documented as far back as the 1950's in swine research. However, the introduction of B-mode ultrasound has improved the accuracy of determining live animal composition. The objectives of this study were to determine carcass compositional differences and to estimate percent lean in seedstock swine using real-time ultrasound. Progeny seedstock boars (n = 543) from thirty different purebred Duroc sires were ultrasounded to determine backfat thickness and longissimus muscle area for estimation of percent lean in live seedstock boars. An Aloka 500V real-time ultrasound unit, equipped with a 17.2 cm transducer, was used to collect images for determination of the carcass attributes. Backfat thickness and loin muscle area was measured from a single cross-sectional image at the 10th rib. Individual liveweight was taken on each animal prior to scanning. Averages for scan age (DOA), scan weight (SWT), backfat thickness (BF10), loineye area (LEA) and percent lean (%Lean) were 166 d, 116.1 kg, 1.0 cm, 47.93 cm^2 and 59.3%, respectively. The correlation coefficients between SWT and BF10, SWT and LEA, and SWT and %Lean were 0.46, 0.62 and -0.40, respectively. Results from this study suggest that real-time ultrasound can be used to determine carcass attribute differences in Duroc seedstock boars. Accurate and reliable estimates of carcass composition in breeding stock are necessary for increased genetic improvement. Costly and time consuming harvest of progeny has been used for carcass data collection in the past. However, this study suggests that this may be an unnecessary production cost for seedstock swine producers.

Key Words: Carcass, Boars, Ultrasound

M251 Efficacy of two natuaral additives, SUPROL® and RepaXOL® as growth promotants for grow-finish pigs. R. Thaler[1], B. Rops[1], B. Christopherson*[2], and E. Cerchiari[3], [1]*South Dakota State University*, *Brookigns*, [2]*SODA Feed Ingredients LLC*, *Brookings, SD*, [3]*SODA Feed Ingredients Ltd.*, *Ireland*.

One hundred high lean-gain barrows weighing approximately 23 kg were utilized in a grow-finish trial to determine the efficacy of SUPROL® and RepaXol® as growth promotants. SUPROL® is a microencapsulated mixture of organic acids and essential oils that is used as a natural growth promotant, RepaXol® is a mixture of essential oils protected by a double coating process and both are natural growth promotants. Five dietary treatments were used (Control (Con); Con + SUPROL®; Con + RepaXol®; Con + Tylan; Con + Mecadox) in a 4-phase feeding program. There were 5 pigs/pen and 4 replicates/treatment. The trial was terminated at a final weight of 114 kg BW. From 23-36 kg (Grower 1), pigs fed either the RepaXol® or Mecadox diets gained faster ($P < 0.05$) and consumed more feed ($P < 0.05$) than pigs fed the rest of the diets, but there were no differences in G:F between any of the treatments. For the Grower 2 phase (36-59 kg), the only differences observed were that pigs on the Mecadox treatments consumed more feed ($P < 0.05$) than pigs fed the other dietary treatments, and gained faster than pigs fed the Suprol® diet ($P < 0.05$). For the Finisher 1 (59-86 kg) period, there were no differences in performance, but in the Finisher 2 (96-114 kg) period, pigs fed Tylan diets were more efficient than pigs receiving Mecadox diets ($P < 0.05$). In the overall period from 23-114 kg BW, daily gain, feed intake, and feed efficiency were unaffected by treatment.

Key Words: RepaXOL®, SUPROL®, Organic Acids

Monday, July 25, 2005

SYMPOSIA AND ORAL SESSIONS

ALPHARMA Beef Cattle Nutrition: Challenging the Limits of Caloric Intake in Feedlot Cattle

18 Sites, rates, and limits of starch digestion and glucose metabolism in growing cattle. G. Huntington*[1], C. Richards[2], and D. Harmon[3], [1]*North Carolina State University*, *Raleigh*, [2]*The University of Tennessee*, *Knoxville*, [3]*The University of Kentucky*, *Lexington*.

Growing cattle in the U.S. consume up to 6 kg of starch daily, mainly from corn or sorghum grain. Total tract apparent digestibility of starch usually ranges from 90 to 100% of starch intake. Ruminal starch digestion ranges from 75 to 80% of starch intake, and is not greatly affected by intake over a range of 1 to 5 kg starch /d. Starch apparently digested in the small intestine ranges from 36 to 49% of starch entering the small intestine, and digestibility decreases as starch entry increases. Starch apparently digested in the large intestine ranges from 44 to 46% of starch entering the large intestine. Approximately 70% of starch digested in the small intestine appears as glucose in the bloodstream. However, glucose use by visceral tissues regularly exceeds glucose supply from intestinal starch digestion. Within the range of starch intakes that do not cause rumen upsets, increasing starch (and energy) intake increases the amount of starch digested in the rumen, increases the supply of starch to the small intestine, increases starch digested in small intestine (albeit at reduced efficiency), and increases starch digested in the large intestine such that total tract digestibility remains relatively constant. Most of the starch is still digested in the rumen, but increasing amounts of starch escape ruminal and intestinal digestion, and disappear distal to the ileocecal junction. Again within the range of starch intakes that do not cause rumen upsets, as starch intake increases, hepatic gluconeogenesis increases, glucose entry increases, glucose irreversible loss increases, with a significant portion lost as CO_2. The ability to increase use of dietary starch to support higher weight gains or improved marbling could come from increasing starch digestion in a healthy rumen or the small intestine, but we conclude that the main limit to use of dietary starch to support liveweight gain is digestion and absorption from the small intestine. Increased oxidation of glucose at higher starch intakes may alter energetic efficiency by sparing other oxidizable substrates, like amino acids.

Key Words: Beef cattle, Grain, Starch

19 Ruminal dynamics during adaptation of beef cattle to high-concentrate diets. M. S. Brown*[1,2], [1]*West Texas A&M University*, *Canyon*, [2]*Texas Agricultural Experiment Station*, *Amarillo*.

Several economic factors have favored minimizing the proportion of forage in the diet for finishing cattle within biological constraints. Two such factors are lower ration costs per unit of net energy and greater ration density, which can result in a lower volume of feed to mix, deliver, and contain in the bunk. However, an abrupt transition in substrate supply to the ruminal environment from exclusively forage to cereal grain can have a persistent deleterious impact on subsequent performance by the ruminant host. Adaptation programs used in practice must balance optimizing performance by feeder cattle with the risk of digestive disturbance. Although the period of time during which finishing cattle are adapted to ad libitum consumption of a high-concentrate diet may only be 10 to 20% of the total length of the feeding period, the success of the adaptation process can exert an important influence on performance during the entire feeding period. The focus of this paper will be to review the influence of increasing dietary concentrate supply on ruminal microbial populations and ruminal fermentation dynamics.

Key Words: Diet adaptation, Fermentation, Starch

20 An upper limit for caloric density of finishing diets. C. Krehbiel*, J. Cranston, and M. McCurdy, *Oklahoma State University*, *Stillwater*.

High-concentrate finishing diets are fed to beef cattle to maximize growth and gain efficiency. High-concentrate diets generally contain from 2.0 to 2.4 Mcal/kg DM of NE_m, and 1.3 to 1.7 Mcal/kg DM of NE_g. Caloric density of finishing diets varies due to differences in grain source and degree of processing, roughage level and source, fat supplementation, among others. Because animals generally become more efficient as ME intake increases, it may be desirable to maximize energy density of the finishing diet. Grains, primarily corn, sorghum, barley and/or wheat, are the main constituents of high-concentrate diets, and are often processed to increase ruminal and total tract starch digestibility. Degree of processing results in varying dietary energy concentration and availability, which influences ME intake and animal performance. For example, a recent summary suggests that flaked corn has 14 and 19% greater NE_m and NE_g, respectively, than dry-rolled corn. Gain efficiency is generally greater in cattle fed steam-flaked grains. However, flaking to a density of 0.28 kg/L or less decreased DMI despite an increase in ME concentration. Although all-concentrate diets have been fed to ruminants, roughage is included to decrease the incidence of metabolic disorders. Because cost of ME increases as roughage level increases, a minimal percentage (4.5 to 13.5% DM basis) of roughage is generally included. Feedlot performance and carcass characteristics are influenced by roughage level and source, due to their affects on DM and NE intake. Fat is supplemented to finishing diets to increase dietary energy density. Although increasing ME intake by supplementing fat has generally increased G:F, supplementing fat above 6% of DM has resulted in decreased intake to a level where G:F is maintained or decreased. Effects of dietary energy density on ADG and G:F are well documented; however, effects on tissue accretion and metabolic control factors are not well defined. The purpose of this review will be to evaluate the literature and assess the relationship between dietary energy density and animal performance in an effort to define an upper limit for caloric density of finishing diets.

Key Words: Beef Cattle, Energy Density, Performance

Breeding and Genetics: Statistical Methods I

21 Joint modeling of age of dam and age of animal for growth in Gelbvieh by the random regression model. K. Robbins*, I. Misztal, and J. Bertrand, *University of Georgia*, *Athens*.

We examined the joint modeling of age of dam and age of animal in a random regression model analysis of growth in Gelbvieh cattle. The first method (M1) was analogous to multiple trait analysis and consisted of age of dam as a class variable and a cubic polynomial regression on age nested within birth, weaning and yearly weights. The second method (M2) utilized two-dimensional linear splines, with age of animal knots at birth, 160d, 205d, 250d, 320d, and 365d; and age of dam knots at 725d, 1464d, and 2189d. A data set containing Gelbvieh growth records was split along contemporary groups (cg) into two data sets. Data set 1 (D1) contained 643,937 records and was used for prediction by mixed model equations. Data set 2 (D2) contained 476,198 records and was used for cross validation. Models were evaluated based on average squared error (ASE) and plots of solutions. ASE for weights associated with birth weight, weaning weight and yearling weight for M1 were 82, 3042, and 6203. For M2 the ASE were 82, 3490, and 6722. Plots of the data showed that weight decreased after 350d. This was traced to a correlation between the age at which animals yearling weights were recorded and the animal's daily gain. This confounding had the greatest effect on the two-dimensional splines. After splitting the splines into two groups, the ASE for M2 at yearling weight declined to 5908. M1 modeling was better in regions with denser data while M2 performed best with sparser data. Two-dimensional modeling of fixed effects is complicated when records are concentrated in narrow age ranges and confounding exists between variables.

Key Words: Polynomial Regression, Two-Dimensional Spline, Cross Validation

22 Analysis of first insemination success subject to uncertainty in Australian Angus cattle. M. L. Spangler*, R. L. Sapp, R. Rekaya, and J. K. Bertrand, *The University of Georgia*, *Athens*.

Field data consisting of 33,099 records from Australian Angus herds were used to investigate two methods of analyzing uncertain binary responses for success or failure at first insemination. A linear mixed model, at the liability scale, that included herd, year, and month of mating as fixed effects; unrelated service sire, additive animal and residual as random effects; and linear and quadratic effects of age at mating as covariates was used to analyze the binary data. An average gestation length (GL) and standard deviation (SD), by sex, derived from artificial insemination (AI) records and observed days to calving (DC) interval were used to assign binary conception data from bull-sired females. Females deviating from average GL leads to uncertain binary responses. Two analyses were carried out: 1) a threshold model fitted to uncertain binary data ignoring uncertainty (M1), and 2) a threshold model fitted to uncertain binary data accounting for uncertainty via fuzzy logic classification (M2). There was practically no difference between point estimates obtained from M1 and M2 for service sire (0.135 and 0.127) and herd variances (0.128 and 0.123). However, the estimates of the additive variance from M1 and M2 were 0.055 and 0.031, and the corresponding heritability estimates were 0.042 and 0.024, respectively. Pearson correlations indicated no major re-ranking would be expected for service sire effects (0.99) and animal breeding values (0.98) using M1 and M2. Given the results of the current study, for noisy binary data, a threshold model contemplating uncertainty is suggested to avoid bias when estimating genetic parameters. The current study is being extended to situations were uncertain binary responses are jointly analyzed with other continuous/binary traits.

Key Words: Beef Cattle, Fuzzy Logic, Fertility

23 Properties of random regression models using linear splines. I. Misztal*, *University of Georgia*, *Athens*.

The purpose of this study was to determine rules to select knots in random regression models using linear splines (RRMS). Such models are much easier to implement than models with polynomials because of superior numerical properties and simplicity of obtaining parameters. Parameters in RRMS are similar to those in multiple trait models (MTM) with traits corresponding to knots, with the exception that the residual variance in MTM equals the sum of residual + permanent environmental variances in RRMS. The variance of an effect with linear splines, relative to a straight line, is concave between adjacent knots. The maximum depression is in the middle of knots and equals 0.5(1-r), where r is the correlation between the knots. For RRMS, the vector of covariables is [0.. 1-t t ..0], where t=<0,1>. The concavity in the middle can be eliminated if this vector is modified to [0.. $(1-t)^q$ t^q ..0], where q=log[2(1+ r)]/[2log(2)]. The influence of correlations between knots on accuracy and variance of predictions was analyzed by simulation. The model to simulate the data included 5 knots spaced equally, with correlations decreasing linearly with increasing knot distance; the correlation between the extreme knots was varied from 0.0 to 0.99. Observations were simulated for trajectory points corresponding to each knot for 1000 unrelated individuals with 50 observations per individual. Predictions were obtained for points corresponding to extremes and to the middle of the trajectory by models with 5 knots (K5), 2 knots (K2), and 2 knots with covariables modified (K2M). Compared to K5 and depending on r, the predictions by K2 (K2M) were inflated at the extremes by 0-16% (0-3%) and deflated in the middle by 0-39% (0-2%). Accuracies by K2M and K2 were similar and 0.0-0.04 below those by K5 but < 0.01 below for r ≥ 0.6. With modified formulas, the accuracy of RRMS increased only marginally when the correlations between the knots were ≥ 0.6. In practical analyses, knots in RRMS can be selected so that 1) they cover the entire trajectory and 2) the correlations between the adjacent knots are ≥ 0.6.

Key Words: Random Regression Model, Linear Splines

24 Calculating the distribution of the correlation between estimated breeding values from different analyses. D. Garrick*, *Colorado State University*, *Fort Collins*.

The validation of EPDs or EBVs from different genetic evaluations is a common occurrence. Two circumstances can be distinguished. 1) Different datasets are used for two analyses as in comparison of sire EPDs from two different progeny tests. 2) Datasets reflect a part-whole relationship as in estimates from a subset of data (eg region) that was also included in a larger (eg national) analysis. When either of the estimates are not perfectly accurate, the correlation between estimates are biased downwards. Accordingly, it is difficult to interpret the observed correlation. However, its expected distribution can be readily simulated. Consider the case with different datasets in the two analyses. Define a vector **u** of true and BLP/BLUP estimated effects on the same non-inbred animal in analyses 1 & 2 as containing g_1, g_2, $g\hat{}_1$, $g\hat{}_2$. Lower triangular elements of var(**u**) are (by row): var(g_1), cov(g_{12}), var(g_2), r_1^2 var(g_1), r_1^2cov(g_{12}), r_1^2 var(g_1), r_2^2cov(g_{12}), r_2^2 var(g_2), $r_1^2r_2^2$cov(g_{12}), r_2^2var(g_2) where r_i is the correlation between true and estimated merit in dataset i. This matrix forms the diagonal blocks of the var-cov matrix of all *n* animals represented in the two datasets. The Cholesky decomposition of such a matrix, in product with a vector of *4n* independent standard normal deviates will produce one possible realization of true and estimated values. The observed correlation (or regression) can be calculated for this one sample. This procedure can be repeated *k* times (say *k*=1000) to get a distribution of the expected correlation (or regression). A one-sided critical value at say α=0.05 can be obtained by sorting the sample correlations and using the 50th (from lowest) value. A similar procedure can be used for part-whole datasets. In that case, the expected covariance between estimates reduces from $r_1^2r_2^2$cov(g_{12}) to r_1^2cov(g_{12}) where dataset 1 is the subset of dataset

2. Inbreeding and relationships can be accounted for during simulation by including the Cholesky decomposition of the numerator relationship matrix in the calculation.

Key Words: Genetic Evaluation, Selection Index

25 A bivariate quantitative genetic model for a linear Gaussian trait and a survival trait. L. H. Damgaard* and I. R. Korsgaard, *Research Centre Foulum, Dept. Genetics and Biotechnology, Bioinformatics and Statistical Genetics*, *Tjele, Denmark*.

A bivariate quantitative genetic model for a linear Gaussian and a survival trait genetically and environmentally correlated was derived and implemented. For the survival trait, we considered the Weibull log-normal animal frailty model. A Bayesian approach using Gibbs sampling was adopted. Model parameters were inferred from their marginal posterior distributions. The required fully conditional posterior distributions were derived and issues on implementation discussed. The two Weibull baseline parameters were updated jointly using a Metropolis-Hasting step. The remaining model parameters with non-normalized fully conditional distributions were updated univariately using adaptive rejection sampling. Simulation results showed that the estimated marginal posterior distributions covered well and placed high density to the true parameter values used in the simulation of data. All the true parameter values were within the 95% central posterior density regions defined by the 2.5% and 97.5% percentiles. In conclusion, the proposed method allows inferring additive genetic and environmental correlations between a linear Gaussian trait and a survival trait.

Key Words: Survival, Gaussian, Genetic Correlation

26 Bivariate recursive and simultaneous models for milk yield and somatic cell scores. G. de los Campos*[1], D. Gianola[1], and B. Heringstad[2], [1]*University of Wisconsin-Madison*, *Madison*, [2]*Norwegian University of Life Sciences*, *Aas, Norway*.

Diseases may affect production and vice versa. Standard linear model theory does not accommodate recursiveness or simultaneity of effects. Structural Equation Models (SEM), however, allow modeling such features. Using LISREL®8, we compared four bivariate SEM for analysis of milk yield (MY) and somatic cell scores (SCS). Models were: MO (standard), M1 (SCS=>MY), M2 (SCS<=MY), and M3 (SCS<=>MY); arrows indicate direction of effects. The data set had test-day MY and SCS, and clinical mastitis (CM) records of 33,453 first-lactation daughters of the 245 Norwegian Red (NRF) sires with a first progeny test in 1991 or 1992. First lactation was divided into five 60-day periods and a test-day was assigned to each period. Within-herd SCS and MY deviates were responses, and presence of CM within 15-days prior to test day, age at calving, and sire were 'exogenous' variables. The Bayesian Information Criterion (BIC) favored M1. SCS had a negative effect on MY both in M1 and M3 (in M1: -1.1 kg/day/SCS, $p < .001$). The association between SCS and MY was mostly due to a negative effect of SCS on MY; 'dilution' effect (MY=>SCS) seems unlikely to exist. Using estimates from M1, an event of CM would be expected to increase SCC by 70,000 cells/ml in the following test day; through the recursive effect (SCS=>MY), MY would be reduced by 0.93 kg/day. Estimates may be biased downwards, because of false negative CM (cases outside of the 15-day period may affect SCS). For M1, phenotypic (additive genetic) variances of MY and SCS were 13.19 (1.74) and 1.19 (0.11) respectively. Phenotypic and genetic correlations between SCS and MY were -0.23 and 0.34 respectively. The phenotypic correlation was the most sensitive parameter to specification of recursive effects.

Key Words: Diseases and Production, Structural Equation Model, Simultaneity

27 Standard errors of solutions in large scale mixed models, application to linear and curvilinear effects of inbreeding on production traits. N. Gengler*[1,2] and C. Croquet[1,2], [1]*National Fund for Scientific Research*, *Brussels, Belgium*, [2]*Gembloux Agriculture University*, *Gembloux, Belgium*.

Many approaches for using linear mixed models do not produce standard errors of solutions. However, knowing the standard errors allows for statistical tests. Even if exact estimation of standard errors is not feasible in large mixed models, there are methods to approximate them. We based this on Mixed Model Conjugate Normal Equations associated with a Preconditioned Conjugate Gradient (PCG) solver. The advantage of associating both methods is that the right hand side vector normally accumulated by PCG can be easily changed to a function of solutions vector $\mathbf{k}$ allowing direct solution for $\mathbf{\Phi}=\mathbf{C}^{-1}\mathbf{k}$ using regular PCG solving programs. The square root of $\mathbf{k}'\mathbf{\Phi}=\mathbf{k}'\mathbf{C}^{-1}\mathbf{k}$ gives the standard error associated with the function of solutions described by $\mathbf{k}$. Often a block of $\mathbf{C}^{-1}$ is needed. Its elements were obtained by computing linear functions of element of this block and by backsolving to obtain the needed elements. In matrix notation let $\mathbf{K}$ be the coefficients of the linear functions and $\mathbf{D}$ a matrix containing the values obtained by computing $\mathbf{K}'\mathbf{C}^{-1}\mathbf{K}$. The elements of the block were then obtained as $(\mathbf{KK}')^{-1}\mathbf{KDK}'(\mathbf{KK}')^{-1}$. This method was applied to study linearity of inbreeding depression on milk, fat and protein test-day yields. Inbreeding effects were estimated using linear, quadratic and cubic regressions on inbreeding coefficients inside breeds in a test-day model similar to the one used in the Walloon Region of Belgium. The pedigree contained 956,516 animals. A total of 5,596,038 first lactations test-day records from 660,407 cows were used. Results had contrasting behaviors, however evaluation of plotted inbreeding effect and the associated confidence interval showed that between 0 an 10% inbreeding differences among evaluations of inbreeding depression were small.

Acknowledgements: Coraline Croquet who is Research Fellow, and Nicolas Gengler, who is Research Associate of the National Fund for Scientific Research, acknowledge their support.

Key Words: Standard Error, Inbreeding, Curvilinear

28 Predictions of test day yields for milk production traits in cattle by partial least squares multiple regression. N. P. P. Macciotta*[1], D. Vicario[2], C. Dimauro[1], N. Bacciu[1], and A. Cappio-Borlino[1], [1]*Università di Sassari*, *Sassari, Italia*, [2]*Italian Association of Simmental Cow breeders*, *Udine, Italia*.

The research of methods able to predict Test Day (TD) yields from a limited number of actual records available is an important challenge for the dairy cattle industry. Most of proposed methods deal with a univariate approach and can forecast only future TD in lactation in progress. On the other hand, multivariate approaches are theoretically and computationally heavy. The Partial Least Squares Regression (PLS) multivariate approach can represent a valid alternative, being able to handle plans characterised by the presence of missing data in different parts of the lactation. Moreover, the extraction of orthogonal latent factors enable the PLS to reduce problems of the collinearity among predictors and, at the same time, to exploit correlations between dependent and independent variables. The PLS prediction ability was tested on a data set of 31,356 lactations of Italian Simmental Cows of parity 1 to 3, with 8 test day records of milk production traits (milk, fat and protein yields) per lactation, arranged in a multivariate setting. Ten scenarios of missing TD records were simulated. Predictions were calculated separately for each parity class. Correlations among actual and predicted TD yields evaluated by cross validation methodology ranged from 0.60 to 0.90 for protein and from 0.55 to 0.80 for fat in the scenarios where also milk yield has to be predicted. Correlations increased up to 0.97 for protein and 0.88 for fat when all milk TD were available. Average correlations between actual and predicted TD for milk yield was 0.87. The analysis of Mean Square Error of Prediction confirm the higher accuracy of the PLS method and highlights a certain degree of imprecision mainly due to the random nature of individual variation. Results of the study indicate a good predictive ability of the PLS method that, in addition, is markedly flexible, does not require special computing capability and is easily transferable to the farm level.

Key Words: PLS, Prediction, Milk Test Day

29 Genetic parameters of latent variables related to main traits of lactation curve shape. N. P. P. Macciotta*[1], D. Vicario[2], and A. Cappio-Borlino[1], [1]*Università di Sassari*, *Sassari, Italia*, [2]*Italian Association of Simmental Cow Breeders*, *Udine, Italia*.

The genetic analysis of multivariate phenotypes has to cope with computational issues essentially due to the large number of parameters to be estimated. In recent years, dimension-reduction techniques have been proposed mainly based on principal component analysis. However, this multivariate technique does not always allow a simple and meaningful interpretation of the leading new variables. A different technique to extract latent variables able to reconstruct the (co)variance matrix of original data is the multivariate factor analysis, where extracted factors can be rotated to make their interpretation easier. In this work the factor analysis was used to extract two latent variables from Test Day milk yields, taken at different days in milk, related to peak yield and lactation persistency. A data set of 48374 lactations of 21721 Italian Simmental cows was used. Edits were on the number of Test Day records for cow (8), parity (<7), days in milk at first test (<30), lactation length (>200), n. cows per herd (>5). TD milk yields were arranged in a multivariate setting, latent factors were extracted. Factor scores were then used as new variables and analysed by a bivariate animal model that included the fixed effects of the herd, parity, year and calving season, and the random effects of the genetic additive value of the animal and of the permanent environment. Estimates of heritability are moderately low, (0.14 both for persistency and peak yield) confirming the results reported from other authors. Repeatabilities show values of 0.27 for peak and 0.29 for persistency. Particularly interesting is the moderate genetic correlation among these two variables (0.26) suggesting the possibility to select, at least to a certain extent, separately on different aspects of lactation curve shape.

Key Words: Lactation curve shape, Persistency of lactation, Latent factors

30 Simultaneous estimation of environmental values and genetic parameters in reaction norm model. G. Su*, P. Madsen, M. S. Lund, D. Sorensen, I. R. Korsgaard, and J Jensen, *Danish Institute of Agricultural Sciences, Department of Genetics and Biotechnology*, *Tjele, Denmark*.

The reaction norm model is becoming a popular approach for the analysis of G x E interactions. In a classical reaction norm model, the expression of a genotype in different environments is described as a linear function (a reaction norm) of an environmental gradient, such as overall effects of various environments (environmental values). An environmental value could be defined as the mean performance of all genotypes in a particular environment, which is typically unknown. One approximation is to estimate the mean performance based on data then treat this as a known covariate in the model (referred to as the approximate method below). However, a more satisfactory alternative is to infer the environmental values simultaneously with the other parameters of the model. The objectives of this study were (1) to describe a method and its Bayesian MCMC implementation that makes this possible and (2) to confirm the superiority of the present method relative to the approximate method by a simulation study. In the simulation study, data were generated using simulated herd-year effects as covariates of the reaction norm. The correlation between the estimates of herd-year effects from the present method and the true values was close to one. The genetic parameters inferred from the present method were similar to those estimated from a reaction norm model using true values of herd-year effects. On the other hand, using phenotypic mean of herd-year as a proxy for the environmental value resulted in biased estimates of genetic parameters.

Key Words: Reaction Norm, G x E Interaction, Genetic Parameters

Dairy Foods: Dairy Chemistry

31 Influence of lipolysis and proteolysis of calibration milks on infrared milk analyzer performance. K. E. Kaylegian* and D. M. Barbano, *Cornell University*, *Ithaca, NY*.

Lipolysis was measured weekly as the increase in free fatty acid (FFA, meq/kg milk) content and proteolysis was measured weekly as the decrease in casein as a percentage of true protein (CN%TP). Pasteurized, potassium dichromate preserved modified milk (MM) calibration sets had a shelf life of 4 wk and raw preserved producer milk (PM) calibration sets had a shelf life of 2 wk. Every day that the chemical analyses for lipolysis and proteolysis were performed, MM and PM calibration sets were used separately to calibrate a fixed-filter mid-infrared (MIR) analyzer. The experiment was replicated 3 times. The MM sets had a smaller ($P < 0.01$) mean and change in lipolysis over the first 2 wk of use than the PM sets. The mean FFA levels were 0.115 and 0.253 meq/kg milk for the MM and PM sets, respectively. The mean decrease in CN%TP was larger ($P < 0.01$) for the MM sets (1.96%) at the end of the first 2 wk than for the PM sets (1.54%). The mean level of proteolysis observed for the MM sets at the end of the 4 wk set life was a 4.06% decrease in CN%TP, and no effects on the calibration slope and intercept were observed . The highest FFA level observed was 0.589 meq/kg milk for an individual PM sample at the end of the 2 wk set life. Individual PM samples with high FFA levels did show a larger difference between IR predicted value and chemistry for those samples, as expected, but these did not affect the protein slope and intercept because they were in the middle of the protein concentration range of the calibration set. No significant differences were observed in the MIR calibration slope and intercept that were attributed to lipolysis or proteolysis for either type of calibration set.

Key Words: IR Milk analyzer Calibration, Lipolysis, Proteolysis

32 Comparing a gas chromatography/mass spectrometry technique with sensory evaluation in relation to the acceptability of fluid milk. A. A. Glueck-Chaloupka*[1], C. H. White[2], and W. E. Holmes[3], [1]*The Kroger Company*, *Cincinnati, OH*, [2]*Mississippi Agricultural & Forestry Experiment Station*, *Mississippi State, MS*, [3]*Mississippi State Chemical Lab*, *Mississippi State, MS*.

A gas chromatography/mass spectrometry (GC/MS) technique was evaluated for ability to detect changes in volatile compounds in reduced-fat milk over time. Pasteurized reduced-fat fluid milk samples were collected from 10 filler heads on a fluid milk packaging machine from one dairy plant (n=150). Expert sensory panelists evaluated samples for acceptability using the ADSA scorecard and a quality scale. Ten volatile compounds known to have an impact on the flavor and flavor intensities of reduced-fat fluid milk over the shelf life of the product were monitored with a GC/MS technique. The GC/MS technique was able to provide identification and quantification of compounds. It provides a qualitative and quantitative means of identifying metabolites present in both "good" and "bad" quality milk. Both sensory and GC/MS evaluations occurred on days 0, 1, 7, 11 and 15 at 7°C. Sensory data were subjected to analysis with Statistical Analysis Software (SAS) version 8.0. Response factors were determined by dividing the concentrations by the area counts and reported for the volatile compounds. By day 7 expert panelists were able to detect overall flavor intensity differences ($P<0.05$). Overall flavor scores and occurrence of "pleasant" flavor attributes decreased over shelf life. Concentrations on day 0 versus day 15 of ethanol (2.11ng, 2.50ng), ethyl butyrate (0.00ng, 0.01ng), ethyl hexanoate (0.01ng, 0.22ng), 3-methyl-1-butanol (0.00ng, 0.01ng), 2-nonanone (0.02ng, 0.12ng), and 2-heptanone (0.002ng, 0.014ng) increased as the milk aged. A similar trend over the 15 day evaluation period for both testing methods was shown, indicating that as the milk ages, concentration of volatile compounds increase, and overall flavor scores and occurrence of "pleasant" flavor attributes decrease. Therefore, GC/MS, when combined with sensory evaluation, shows promise in understanding flavor deterioration in reduced-fat milk.

Key Words: Reduced-fat milk, GC/MS, Flavor

33 Novel technique for the differentiation of caseins and whey proteins in confocal scanning laser microscopy. A. Dubert-Ferrandon*, A. Grandison, and K. Niranjan, *The University of Reading*, *Whiteknights, Reading, UK*.

This study aimed to understand the acid gelation process of milk following different heat treatments in Glucono-Delta-Lactone systems. A method was developed to allow separate observation of the incorporation of whey proteins and caseins into the gel structure. By combining a labelling technique with a purification step, the 2 proteins were tagged with different fluorescing dyes (Protein labelling kits Alexa Fluor 488 and 594, Invitrogen). Caseins (labelled in red) and whey proteins (in green) could thus be studied during gel formation on a real-time scale. Skim milk was subjected to 2 heat treatments: standard pasteurisation (72°C-15 seconds); and a heat treatment of 90°C-2 minutes. A series of images of exactly the same field was collected during gelation at 40°C using both fluorescent probes (allowing acquisition of gelation movies and snapshots). The confocal microscope used was an inverted motorised microscope (Leica DMIRE 2, Milton Keynes, UK) used with the Leica TCS SP2 AOBS computer system. A × 63 glycerol objective was used.

In the standard pasteurised milk, after addition of GDL, a green background colour was observed for up to 20 minutes, but no structure. From 20 to 40 minutes, the appearance of casein (red) aggregates was clearly observed and gaps (seen as a green background colour) were filled with whey proteins. As pH decreased, the gel network, which was coarse and made up of aggregates, became greener in appearance, implying that the whey proteins had coated the casein network subsequent to its formation.

At the higher heat treatment, after addition of GDL, formation of gel structure occurred much more rapidly (8 minutes). The appearance of the structure was quite different, being much less coarse, and the colour indicated that it consisted of both casein and whey protein. As pH decreased, the gel network became more and more finely structured, but the colour did not change, implying that the composition of casein and whey protein did not change.

It is apparent that the mechanism of gel formation is quite different for the 2 heat treatments. These structural observations will be linked to rheological studies in real time.

34 Effect of heat and homogenization pressure on activity of xanthine oxidase isolated from buttermilk. C. van den Berg and D. Everett*, *University of Otago*, *Dunedin, New Zealand*.

The effect of heat and homogenization pressure on activity of xanthine oxidase (XO), isolated by one of four methods, was examined: (1) precipitation from unpasteurized buttermilk with $(NH_4)_2SO_4$ (Ball, J. Biol. Chem. 128:51-67, 1939), (2) a two-step $(NH_4)_2SO_4$ precipitation (33% and 66% saturation) from unpasteurized buttermilk with batch-scale anion exchange chromatography (Spitsberg and Gorewit, Protein Expression and Purification 13:229-234, 1998), (3) a two-step adsorption from acid whey using charcoal and kaolin (Dixon and Kodama, Biochem J. 20:1104-1110, 1936), and (4) a modification of method 2 with with 35% and 50% saturated $(NH_4)_2SO_4$. XO preparations were dialyzed against deionized water using 10 kDa membranes, and freeze-dried. The protein-flavin (PF) absorbance ratio, A_{280}/A_{450}, was used to assess purity. XO from method 4 (22.7 mg/15 mL water) was heated to between 25°-75°C for 5 min, and at 70°C for 30 min. Activity was measured by monitoring conversion of xanthine to uric acid at 295 nm, and expressed as µmol uric acid per min per weight of dry matter (U/mg). XO (50.1 mg/50 mL pyrophosphate buffer, pH 8) was passed 40× through a Microfluidizer™ homogenizer at 38, 75, 100, 125 or 150 MPa and the activity measured. Turbidity of homogenized XO solutions was measured at 500 nm, and PAGE under reducing and non-reducing conditions. Methods 1 and 4 had PF-ratios of 7 and 8, close to maximum purity of 5, and activities of 5.5 and 4.5 U/mg respectively. Method 2 yielded low protein content and XO was not observed on the PAGE gel. Method 3 had a low purity of XO with a PF-ratio of 300 and activity of 0.06 U/mg. Molecular weight of XO was 148 kDa under reducing, and 290 kDa (dimer) under non-reducing conditions. Activity of XO in solution was 60% higher than in unpasteurized cream at 25°C. Activity dropped by 40% from 25°C to 70°C, and at 70°C dropped by 95% over 30 min. Turbidity of XO solutions decreased by 92% and activity decreased by 50% up to 150 MPa. Pressure had no discernable effect on the PAGE gel bands. Homogenization may reduce XO activity by a change in tertiary structure rather than reduction of the dimer.

Key Words: Xanthine Oxidase, Enzyme, Homogenization

35 Residues 69-74 of beta-lactoglobulin are responsible for a monoclonal antibody binding to thermal denatured lactoglobulin. C. Y. Song*, M. C. Yang, and S. J. T. Mao, *National Chiao Tung University*, *HsinChu, Taiwan*.

β-lactoglobulin (β-LG) is a bovine milk protein sensitive to thermal denaturation. Previously, we demonstrated that such structural change can be detected by a monoclonal antibody (mAb) specific to denatured β-LG. In the present study, we show a dramatic increase in β-LG immunoreactivity when heating raw milk between 70°C and 80°C. To map out the specific epitope of β-LG recognized by this mAb, we used a combined strategy including tryptic and CNBr fragments, chemical modifications (acetylation and carboxymethylation), peptide array containing in-situ synthesized peptides, and a synthetic soluble peptide for immunoassays. The antigenic determinant we defined was exactly located within the D strand (residues 66-76) of β-LG. The result suggests that a further disordered structure occurred in β-LG and thus rendered the mAb recognition. Mutations on each charged residue (three Lys and one Glu) revealed that Lys-69 and Glu-74 were extremely essential in maintaining the antigenic structure. Further deliniation on the antigenic site on the D strand shows the minimal residues of the epitope to the KKIIAE (residues 69-74) for the mAb recognition. In addition, we found an inverse relationship between the immunoreactivity in heated β-LG and its binding to vitamin D. Taken together, we concluded that strand D of β-LG participated in the thermal denaturation between the temperatures of 70°C and 80°C.

Acknowledgements: This work was supported by a grant 90-2313-B-009-001, 91-2313-B-009-001, 92-2313-B-009-002 and 93-2313-B-009-002 from the National Science Council (NSC) Taiwan, ROC.

Key Words: β-Lactoglobulin, Epitope Mapping, Thermal Denaturation

36 Properties of lactoperoxidase isolated from individual cow's milk by ion-exchange chromatography. A. Grandison*[1], F. Fonteh[2], and M. Lewis[1], [1]*The University of Reading*, *Reading, Berkshire, UK*, [2]*University of Dschang*, *Dschang, Cameroon*.

Lactoperoxidase (LP) was isolated from the milk of five individual cows and from a commercial powder, by ion exchange chromatography. The samples presented different elution patterns with varying peaks of LP activity, indicating that LP occurs in different forms. These could be isoenzymes, or the result of post-translational enzymic or chemical changes. The pH optima for the fractions varied between 5.0 and 6.5. SDS gel electrophoresis revealed three forms of the enzyme with molecular weights 92, 88 and 85 kDa respectively. The HPLC chromatographs of the eluents were also varied, presenting different peak shapes, heights, and double peaks in some samples.

These results show that LP exists as different chemical species with differing physicochemical properties. Such differences suggest that the different forms may also exert varying degrees of activity, depending on the prevailing environmental conditions. Therefore, the efficiency of the LP system will depend on the predominant enzymic form(s) in any batch of milk, and the prevailing environmental conditions.

Acknowledgements: Association of Commonwealth Universities

Key Words: Lactoperoxidase, Ion-Exchange, Isoenzymes

37 Evolution and regulation of the casein gene cluster region: A genomics approach. M. Rijnkels*[1], T. Le[1], and J. Thomas[2], [1]*Baylor College of Medicine*, *Houston, TX*, [2]*Emory University School of Medicine*, *Atlanta, GA*.

Multi-species sequence analysis and other genomics based approaches are being used in our studies of the evolution and regulation of milk protein genes.

Multi-species sequence analyses were performed on sequences from Bacterial Artificial Chromosome (BAC) clones isolated and sequenced for this purpose,

and from various genome-sequencing efforts. These sequences covered the casein gene cluster region or parts of it in 15 mammalian species: human, chimpanzee, macaque, marmoset, galago, mouse, rat, rabbit, shrew, bat, dog, cow, armadillo, elephant and opossum.

This and earlier studies indicated that the casein genes are located in a mammalian specific genomic domain. This domain contains besides the casein genes a number of non-casein genes that share evolutionary ancestry, spatial expression patterns (mammary and salivary gland), and functional properties (secreted (phospho)-proteins, involvement in mineral homeostasis, and immune modulation). The presence and structure of orthologous genes in the mammalian species studied was determined. Predicted transcripts were cloned from a number of species. Phylogenetic analyses showed that the divergence of the casein genes is not only due to a high rate of nucleotide substitutions but also to the differential use of exons. Genomic rearrangements were identified that result in deletions of genomic segments containing casein genes, e.g. lack of alpha-s2-like genes in shrew. Overall there is remarkable conservation in this region with regard to the genes present, gene structure, and gene order and orientation despite high divergence at the nucleotide level.

These studies also identified a number of non-coding conserved regions that might play a role in gene regulation. These included the upstream beta-casein enhancer, previously identified in human and cow and now shown to be present in most species studied albeit at different positions with respect to the beta-casein promoter. Computational analyses identified patterns of conservation in these regions and the proximal promoters that represent transcription-factor binding sites known to be involved in casein gene expression.

Acknowledgements: Funding USDA-CRIS 6250-51000-048

Key Words: Milk Protein, Casein, Genomics

38 Distinguish between native and thermally denatured β-lactoglobulin using a monoclonal antibody as a probe. S. J. T. Mao*, W. L. Chen, M. C. Yang, and W. T. Liu, *National Chiao Tung University*, *Hsinchu, Taiwan*.

Previously, we have established a monoclonal antibody (mAb) line to study the thermal denaturation of β-lactoglobulin (LG) and have identified an epitope responsible for its biological functions (Chen et al., J Dairy Sci. 2004 87:2720-2729 and Song et al., J Biol Chem. 2004 Nov 9; [Epub ahead of print]). In the present report, we prepared a mAb that specific only to native LG, the immunoreactivity was totally abolished when LG was cross-linked to casein, lactalbumin, or other milk proteins upon the heating. Characterization of this native mAb shows that residue Cys-121 of LG was possibly involved for the antibody binding using carboxymethylated LG. Since heating is a necessary procedure in bovine milk processing, the loss of native LG is almost unavoidable. We than used this native mAb to develop a quantitative immunoassay to determine the residual LG in the commercially available milks. The result shows that the loss of native LG was from minor to sever levels. Because LG plays provocative roles in fatty acid, retinol, and vitamin D binding as well as in cell proliferation, determination of native LG in milk products becomes a subject of essence.

Acknowledgements: This work was supported by a grant 90-2313-B-009-001, 91-2313-B-009-001, 92-2313-B-009-002 and 93-2313-B-009-002 from the National Science Council (NSC) Taiwan, ROC.

Key Words: β-Lactoglobulin, Monoclonal Antibody, Thermal Denatureation

Dairy Foods: Extended Shelf Life of Fluid Milk

39 Influence of raw milk quality on fluid milk shelf life. D. M. Barbano*[1], Y. Ma[1], and M. V. Santos[2], [1]*Cornell University*, *Ithaca, NY*, [2]*Universidade de São Paulo*, *Pirassununga, SP, Brazil*.

Pasteurized fluid milk shelf life is influenced raw milk quality. The microbial and somatic cell count (SCC) of milk will determine the load of heat resistant microbial enzymes in milk. Generally, high levels of psychrotrophic bacteria in raw milk will contribute significant quantities of heat stable proteases and lipases that will break down protein and fat after pasteurization. Sanitation, refrigeration, and the addition of CO2 to milk are used to control of both total and psychrotrophic bacteria count. It is not uncommon for total bacteria counts of raw milk to be < 10,000 cfu/mL. In the past, fluid milk processors have not focused much attention on milk SCC. Increased SCC is correlated with increased amounts of heat stable protease (plasmin) and lipase (lipoprotein lipase) in milk that originates from the cow. When starting with raw milk that has low bacteria count, and in the absence of microbial growth in pasteurized milk, enzymes associated with high SCC will cause protein and fat degradation during refrigerated storage and produce off-flavors. As the ability to kill, remove, or control microbial growth in pasteurized refrigerated milk continues to improve, the original milk SCC will be the factor limiting the time of refrigerated storage before development of an off-flavor in milk. Most healthy cows in a dairy herd have a milk SCC < 50,000. Bulk tank SCC > 200,000 are usually due to the contribution of high SCC milk from a small number of cows in the herd. Technology to identify these cows and keep their milk out of the bulk tank could substantially increase the value of the remaining milk for use in fluid milk processing. To achieve a 60 to 90 day shelf life of refrigerated fluid milk, fluid processors and dairy farmers need to work together to structure economic incentives that allow farmers to produce milk with the somatic cell count needed for extended refrigerated shelf-life.

Key Words: Shelf Life, Raw Milk, Somatic Cell Count

40 Current status of commercial fluid milk quality. K. Boor*, N. Carey, S. Murphy, and R. Zadoks, *Cornell University*, *Ithaca, NY*.

Packaged fluid milk samples were collected from 23 dairy processing plants across New York State at least twice per year over a period of 10 years and subjected to shelf life analyses that included Standard Plate Count (SPC), coliform count and sensory evaluation. Products were tested initially and after storage at 6.1°C for 7, 10 and 14 days post-packaging. On an annual basis, the percent of samples that met the Pasteurized Milk Ordinance (PMO) standard of SPC < 20,000 CFU/ml after 7, 10 and 14 days ranged from 46% to 66%, 25% to 50% and 12% to 32%, respectively. Over the ten year period, SPC values across test-days: decreased in eight plants, including the four plants that had the lowest SPC scores among all 23 plants; increased in two plants; and did not change significantly in the remaining 13 plants. The percent of samples positive for coliforms in a given year ranged from 5% to 15% on initial testing and up to 34% after subsequent storage. The percent of samples scored as unacceptable from a sensory perspective (score < 6.0) after 7, 10 and 14 days ranged from 0% to 8%, 16% to 35%, and 41% to 67%, respectively. For the majority of plants, product flavor scores improved during this 10 year period. While some plants involved in the study can produce fluid milk products that are consumer acceptable when stored at 6.1°C for > 14 days, others consistently fall short of this goal.

Acknowledgements: This work was supported by the New York State Dairy Promotion Order, dairy farmers dedicated to the production, manufacture and distribution of quality dairy products.

Key Words: Fluid Milk, Quality, Shelf Life

41 Extending refrigerated shelf life of fluid milk using a novel HTST system. M. A. Drake* and G. Cartwright, *North Carolina State University*, *Raleigh*.

Shelf life remains a crucial economic issue for pasteurized fluid milk. The Feldmeier system is a tubular heat exchanger that functions as a piggyback system on a conventional high temperature short time (HTST) plate pasteurizer allowing higher heat treatment of the milk. The system may provide an alternative economical way to increase refrigerated shelf life of fluid milk. Raw milk (1000 kg) was obtained on three occasions, standardized to 1.5 % fat (w/v) and pasteurized at one of five different temperatures (75°C for 20 seconds only (control) or with the additional heat treatments of 103, 114, 125 or 136C for 3 seconds). Milk was packaged in paperboard cartons or bag-in-boxes and stored at 4C. Pasteurized milks were tested following 0, 7, 14, 21, 28, 42, 49, 66, 80 and 101 days. Microbiological quality and enzymatic quality were determined. Descriptive sensory analysis was conducted with a trained panel at each timepoint. Consumer acceptance testing (n=75) was conducted within 24 h and after 7 and 60 days. Conventionally pasteurized milks reached shelf life failure (>10E6CFU/mL and sensory failure) within 38 days while all Feldmeier milks retained microbiological and sensory shelf life through 80 days. Trained panelists detected higher cooked flavors in the Feldmeier system milks compared to control milks, but these flavors and differences decreased with storage time. Consumer acceptability was comparable to conventional HTST milk after 1 week of refrigeration. The Feldmeier system may be an economically feasible method to increase shelf life of refrigerated pasteurized milk.

Key Words: Shelf Life, Fluid Milk, Refrigerated Storage

42 Application of microwave processing to extend shelf life of fluid milk. J. Simunovic*, P. Coronel, and D. Clare, *North Carolina State University*, *Raleigh*.

One of the significant emerging markets for white and flavored fluid milk and milk-based beverages are vending machines, especially in schools districts where availability of milk has been regulated as mandatory. Distribution by existing beverage vending machines requires processing treatments to impart commercial sterility (i.e. shelf stability) due to unfavorable temperature conditions during the distribution, storage, and vending stages. Flavor quality of such milk preserved using conventional thermal processing is inferior to pasteurized milk based beverages and is considered one of the main concerns for marketability of shelf stable fluid milks.

Non-contact volumetric sterilization using microwave energy is one of the available options for rapid, uniform heating of milk under continuous flow, which could potentially address the noted flavor quality issues of shelf stable milks. Analyses of dielectric properties, recirculated pressurized test runs as well as sterilization and aseptic packaging trials were performed for white and chocolate milk beverages using 915 MHz microwave energy with proprietary cylindrical applicators as energy focusing and delivery structures. Some of the technical issues also addressed were design of high temperature and pressure-rated microwave-transparent conduits and modeling and simulation of dielectric properties and heating behavior of milks in order to formulate appropriate pre-sterilization solutions. Obtained shelf stable beverages were analyzed for microbial stability, flavor profiles and color and compared to same products sterilized using conventional thermal treatment after extended storage under ambient conditions. Flavor quality of microwave-treated products was confirmed as superior to products sterilized using conventional plate heat exchangers.

Key Words: Extended Shelf Life, Fluid Milk, Microwave

43 Use of microfiltration (MF) to improve fluid milk quality. D. M. Barbano* and M. W. Elwell, *Cornell University*, *Ithaca, NY*.

Our objectives were to model bacterial growth in commercially pasteurized skim milk as a function of storage temperature, to determine the efficacy of a MF and pasteurization process in reducing the number of total bacteria, spores, and coliforms in skim milk, and to estimate the shelf life of pasteurized microfiltered skim milk as a function of storage temperature. For objective 1, pasteurized skim milk was stored at 0.1, 2.0, 4.2, and 6.1°C. The bacteria count in these samples was determined semi-weekly. A total bacteria count >20,000 cfu/mL was considered to be the end of shelf life. Shelf life ranged from 16 d at 6.1°C to 66 d at 0.1°C. Decreasing temperature increased lag time and reduced logarithmic growth rate. The effect of temperature on lag time was the biggest contributor to longer shelf life. For objective 2, raw skim milk was microfiltered at 50°C using a Tetra Alcross M7 Pilot Plant equipped with a ceramic Membralox membrane (pore diameter: 1.4 μ) and pasteurized at 72°C for 15 s. Bacteria counts of MF and pasteurized MF skim milk were determined using a most probable number (MPN) method. Across 3 trials, raw milk bacteria count was reduced from 2400, 3600, and 1475 cfu/mL to 0.240, 0.918, and 0.240 cfu/mL, respectively, by MF. Bacterial counts in the pasteurized microfiltered skim milk for the 3 trials were 0.005, 0.008, and 0.005 cfu/mL respectively, for a 5.6 log reduction due to the combination of MF and pasteurization. For objective 3, pasteurized microfiltered skim was stored at 0.1, 2.0, 4.2, and 6.1°C and the bacteria count was determined weekly for 92 d. At 6 time points, decrease in CN/TP (%) was measured as an index of proteolysis. After 92 d, 50% of samples stored at 6.1°C and only 12% of samples stored at 4.2°C had a bacteria count >20,000 cfu/mL. No samples stored at 0.1 or 2.0°C reached a detectable bacteria level. When bacteria count was <1,000 cfu/mL, shelf life was limited by proteolysis to 32 d at 6.1°C, 46 d at 4.2°C, 78 d at 2.0°C, and >92 d at 0.1°C.

Key Words: Microfiltration, Shelf Life, Bacterial Removal

44 Dairy applications for microfiltration. H. Iversen*, *Tetra Pak*, *Vernon Hills, IL*.

In the mid 90s, the microfiltration technology was introduced in the Dairy industry Canada. Creating a brand name PurFilter, the industry was able to convert approximately 15 to 20% of the consumers to microfiltered milk. The product brought an extended shelf life (ESL) milk to the consumer, with a better taste and improved profit for the industry. The log reduction achieved is approximately 4 to 5, allowing a shelf life of 35 days in a market traditionally used to 15 to 20 days with pasteurized milk.

Since then a number of improvements where brought to the technology. The membranes now offer cutting points of 0.8 to 1.4 Âμ, log reduction higher than 6 or 7, and although the commercial sterility has not been reached yet, the milk shelf life can now be extended significantly. The application of this technology in the US market could impact significantly the industry, improving milk sensory bringing better profitability to the industry.

Key Words: Microfiltration, ESL

Graduate Student Competition: National ADSA Dairy Production

45 Processing barley grain for midlactation dairy cows: Steam-rolling versus grinding. A. Nikkhah*[1], H. Sadri[2], M. Alikhani[2], and G. Ghorbani[2], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Isfahan University of technology*, *Isfahan, Iran*.

Economical constraints of replacing conventional grinding with complex steam-processing equipment have faced the dairy industries with a major challenge. The objective of this study was to evaluate the rumen conditions and productivity of dairy cows fed differently processed barley grains. Eight multiparous Holstein cows in their midlactation (85 ± 15 days in milk) were used in a double 4 × 4 Latin square design with four 21-d periods. Processing index (**PI**), or the ratio of the processed barley grain density to the whole barley grain density expressed as %, was used to measure the processing extent of the rolled grains.

Barley grain was included as 25.6% of dietary dry matter (DM). Treatments included 4 total mixed rations containing, 1) ground (GB), 2) steam-rolled (SRB, **PI** = 68%), 3) finely dry-rolled (DB72, **PI** = 72%), and 4) coarsely dry-rolled (DB81, **PI** = 81%) barley grains. Milk quantity and quality, dry matter intake, ruminal pH and concentrations of volatile fatty acids, fecal and urinary pH, and apparent total tract digestibility of DM and organic matter were not affected ($P > 0.05$) by the processing techniques. Milk protein yield tended to be greater ($P = 0.08$) for cows fed finely dry-rolled barley (DB72) than for cows fed coarsely dry-rolled barley grain (DB81) (0.86 vs. 0.79 kg/d). *In situ* measurements using three Naeini ewes fitted with rumen cannulas revealed that the coarse (2 mm) vs. finely (1 mm) grinding significantly ($P < 0.01$) reduced the ruminal degradation rate of the DM (63 vs. 27 %/h) and crude protein (36.2 vs. 15.2 %/h) of barley grain. Results declared that when the inclusion rate of barley grain is 25.6% of the dietary DM, cows fed SRB perform similar to cows on GB. It is imperative to assess the impact of processing techniques with higher dietary levels of barley grain before deciding on the economical efficiency of the expensive steam-rolling over the easy-to-access, conventional grinding.

Acknowledgements: This study was funded by Isfahan University of Technology.

Key Words: Barley Grain, Processing Technique, Lactating Cows

46 Evaluation of dried and wet distillers grains included at two concentrations in the diets of lactating dairy cows. J. M. Ladd*, D. J. Schingoethe, K. F. Kalscheur, and A. R Hippen, *South Dakota State University*, *Brookings*.

The purpose of this study was to determine the lactation performance of dairy cows fed dried or wet distillers grains (DG) with solubles (DDGS or WDGS) at two dietary concentrations. Using 15 cows, a lactation trial was designed as a replicated 5 x 5 Latin square. Periods were 4 wks, with samples and data collection during wk 3 and 4. Diets, on a DM basis, were: control (C), 10% DDGS, 20% DDGS, 10% WDGS, and 20% WDGS. All diets contained 25% corn silage, 25% hay, and 50% of the respective concentrate mixes. Diets were balanced, using corn and soybean meal, for 17% crude protein. DMI tended (P <0.1) to be greater for cows fed C than DG (23.4, 22.7, 22.5, 23.0, 21.9 kg/d for C, 10% DDGS, 20% DDGS, 10% WDGS, 20% WDGS). Milk yield (39.8, 40.9, 42.5, 42.5, 43.5 kg/d) was greater (P <0.05) for cows fed DG than C. Milk fat percentage (3.23, 3.16, 3.28, 3.55, 3.40) was similar for cows fed C and DG, but greater (P <0.05) for cows fed WDGS than DDGS. Milk fat yield (1.28, 1.32, 1.39, 1.44, 1.43 kg/d) was greater (P <0.05) for cows fed DG than C, and tended (P <0.1) to be greater for cows fed WDGS than DDGS. Milk protein percentage (3.05, 3.01, 3.02, 3.11, 3.06) was similar for cows fed C and DG, but greater (P <0.05) for cows fed WDGS than DDGS. Milk protein yield (1.20, 1.23, 1.29, 1.29, 1.33 kg/d) was greater (P <0.05) for cows fed DG than C, tended (P <0.1) to be greater for cows fed WDGS than DDGS, and tended (P <0.1) to be greater for cows fed 20% DG than 10% DG. Milk urea nitrogen (13.3, 12.6, 12.4, 12.9, 14.1 mg/dL) was similar for cows fed C and DG, but greater (P <0.05) for cows fed WDGS than DDGS, and tended (P <0.1) to be higher for cows fed 20% DG than 10% DG. Rumen NH3 concentration (4.81, 3.75, 3.10, 3.91, 5.04 mg/dL) was greater (P <0.05) for cows fed WDGS than DDGS. Overall, feeding DG improved performance by increasing DMI, and yields of milk, protein, and fat. Responses were similar for 10% or 20% DG; however, feeding WDGS instead of DDGS increased milk fat and protein percentages.

Key Words: Distillers Grains, Dairy Cows

47 Increasing time on a high energy diet increases expression of leptin in the mammary gland of prepubertal heifers. L. Davis*[1], M. Weber Nielsen[1], D. Keisler[2], L. Chapin[1], J. Liesman[1], and M. VandeHaar[1], [1]*Michigan State University*, *East Lansing*, [2]*University of Missouri*, *Columbia*.

We previously found that a high energy diet fed to prepubertal heifers for increasing lengths of time results in a linear decrease in mammary parenchymal tissue mass and increase in mammary fat when adjusted for carcass wt. We believe leptin may play a role in this phenomenon. Our objective was to determine the effects of feeding a high energy diet to prepubertal heifers for increasing lengths of time on expression of leptin and leptin receptor and concentrations of leptin in the mammary gland. Heifers (n = 64; age = 11 wk; BW = 107 kg) were randomly assigned to 1 of 4 treatments and fed 2 diets (low, L; high, H) for different lengths of time: H0, H3, H6, and H12 were on the L diet for 12, 9, 6, and 0 wk followed by the H diet for 0, 3, 6, and 12 wk, respectively. The L and H diet were formulated for 0.6 and 1.2 kg daily gain, respectively. Animals were slaughtered at 23 wk of age. Gene expression was measured by real time RT-PCR and presented as -ddCt with H0 as the reference. Statistical analysis tested linear, quadratic, and cubic contrasts of time on H diet. Results in the table are from samples collected at 23 wk of age. We conclude that high energy diets fed to prepubertal heifers for longer durations result in a linear increase in leptin concentrations in serum and mammary tissue and leptin expression in mammary tissue. This is consistent with the idea that leptin may mediate the negative effects of high energy diets on mammary development.

	H0	H3	H6	H12	Linear P
Mammary leptin (ng/g tissue)	2.5	3.2	3.6	3.8	< 0.01
Serum leptin (ng/ml)	1.8	2.1	2.4	2.5	< 0.03
Leptin expression (-ddCt)	0.0	0.9	0.9	1.2	< 0.02
Leptin receptor expression (-ddCt)	0.0	-0.2	0.0	0.1	> 0.4

Key Words: Leptin, Mammary Growth, Heifer

48 Effects of short-term glucagon administration on gluconeogenic enzymes in the liver of mid-lactation dairy cows. E. L. Williams*[1], S. Rodriguez[1], D. C. Beitz[2], and S. S. Donkin[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Iowa State University*, *Ames*.

During lactation, the dairy cow experiences an increased demand for glucose to support milk production. This demand can be met through increased capacity for gluconeogenesis or increased supply of glucose precursors. Glucagon, a key hormone in glucose homeostasis, promotes gluconeogenesis and glucose output from liver. The objective of this study was to determine the effect of short-term administration of glucagon on expression of gluconeogenic enzymes in lactating dairy cattle. Sixteen multiparous Holstein cows were selected from the Purdue University Animal Sciences Dairy Research Center herd. Cows were stratified based on milk production and days in milk and randomly assigned to either a saline or glucagon injection group (n=8 per group). Cows were injected subcutaneously at -21, -14, -7, and 0 h relative to final glucagon and saline injections with either 3.75 mg of lyophilized glucagon dissolved in 0.15 *M* NaCl (pH 10.25) or 60 ml 0.15 *M* NaCl. Liver biopsy samples were obtained 1 wk before injection to establish baseline values and at 3 h after cows received final injections. Biopsy samples were analyzed for mRNA and protein abundance, enzyme activity, and in vitro measures of gluconeogenesis. Glucagon did not alter pyruvate carboxylase (PC) mRNA, protein abundance, or enzyme activity. There was a tendency for greater cytosolic phosphoenolpyruvate carboxykinase (PEPCK-C) mRNA expression with the glucagon treatment. Gluconeogenesis from 2.5 m*M* [2-^{14}C]propionate and 2.0 m*M* [U-^{14}C]lactate was similar in liver biopsy samples from all cows. Glucagon did not effect DMI and milk production. Glucose, non-esterified fatty acids, β-hydroxybutyrate acid, and insulin were not altered by glucagon. Blood glucagon was elevated for cows receiving glucagon injections. The data indicate that short-term administration of glucagon may have residual effects on mRNA expression of PEPCK-C, but these changes are not reflected through immediate alterations in total PEPCK enzyme activity and gluconeogenic capacity.

Key Words: Gluconeogenesis, Gene Expression, Glucagon

49 Effect of biotin supplementation on biotin status of lactating dairy cows of different milk yields. G. Ferreira*, W. P. Weiss, and L. B. Willett, *The Ohio State University*, *Wooster*.

We hypothesized that biotin status is lower for high-producing cows than for low-producing cows. Twenty high-producing (HP) and 20 low-producing (LP) Holstein cows (43±5 and 23±4 kg/d, respectively) were used. Treatments consisted of a basal diet that contained 0 or 0.96 mg of supplemental biotin per kg of DM (C and B, respectively). Biotin status was determined by measuring avidin-binding substances (ABS) in plasma and milk. Plasma and milk samples were collected on d 15. Biotin status was also determined by measuring the urinary excretion of 3-hydroxy-isovaleric acid (3HIA) before and after an intraruminal challenge (d 16) with 1.36 mol of isovaleric acid (IVA). Urine samples were collected at 0, 8, 12, 24 and 48 h after challenge. Milk yields were 23.7, 24.4, 41.1 and 44.5 kg/d for LP-C, LP-B, HP-C and HP-B, respectively (SEM = 1.5). Concentrations of ABS in plasma and milk were not affected by production, but were increased by biotin supplementation. Concentrations in plasma were 1.09 and 1.92 ng/mL and 45 and 153 ng/mL in milk for C and B, respectively. No interaction was observed between production and biotin supplementation for ABS in either plasma or milk. The output of ABS in milk was increased by both production and biotin supplementation (0.8, 1.7, 3.4 and 7.0 mg/d for LP-C, LP-B, HP-C and HP-B, respectively). The 3HIA to creatinine ratio (3HIA/CREAT) in urine at 0 h was not affected by either production or biotin supplementation (67 mmol/mol). Intra-ruminal challenge with IVA increased the 3HIA/CREAT in urine, being greatest at 8 h, and greater for HP cows than for LP cows (150 and 119 mmol/mol, respectively). The 3HIA/CREAT in urine was not affected by biotin supplementation. Based on these results, production does not affect suggested measures of biotin status (i.e., plasma and milk ABS and urine 3HIA). Our data suggest that either our hypothesis is incorrect, or that the suggested measures are not appropriate measures of biotin status. Measuring actual biotin in fluids and/or measuring urine 3HIA after an extended challenge with IVA might be more appropriate measures of biotin status.

Key Words: Biotin Status, 3-Hydroxy-Isovaleric Acid, Isovaleric Acid

50 Effects of milk feeding period and anthelmintic treatment on fecal egg counts and growth in pastured dairy steers. B. M. Thompson*, S. P. Washburn, B. A. Hopkins, J.-M. Luginbuhl, H. M. Glennon, and C. Brownie, *North Carolina State University*, *Raleigh*.

A 2 x 2 factorial trial with 2 phases was conducted to evaluate the effects of weaning age (6 wk vs 12 wk) and anthelmintic treatment (none vs dewormed) on weight gain (ADG) in 36 Holstein and Jersey x Holstein crossbred steer calves born in Fall (Oct-Nov) and Winter (Dec-Feb) 2003-2004. Steers were blocked into 4 treatment groups by birth weight and breed. Calves of similar age were managed together in pastures regardless of treatment and group-fed 3.8 to 7.6 L of whole milk/d until weaning. Phase 1 (P1) extended from birth to July 15, 2004. Phase 2 (P2) started on July 15 and ended on Nov 18, 2004. Dewormed calves received 1mL ivermectin/10kg BW at 12 and 20 wk of age, and again on July 15 and Sept 23. Fecal samples and BW (birth to Nov 18, 2004) were taken from each calf at 4-wk intervals. Fecal egg counts (FEC), BW (see table), and ADG (during P1, P2 and P1& 2 combined) were compared among deworm, wean age, %Holstein, birth season, and their interactions. Parasite eggs were not detected until April and were lower (P<.001) in dewormed calves after July and Sept treatments. Fall-born calves usually had lower (P<.05) FEC than Winter-born calves. Gains during P1 were higher (P<.01) for Fall-born calves. In P2, dewormed calves actually had a higher ADG (P<.05) than non-dewormed calves. Gains across P1 and P2 were higher in Fall-born calves and tended to be higher (P=.06) in calves weaned at 6 wk. Gains and BW generally were higher with increasing %Holstein. Although steers that were not dewormed had higher FEC and differing ADG during parts of the trial, their overall performance was similar to those that received 4 doses of ivermectin.

LS Means +/- SE for Body Weights by Deworm, Wean Age, and Breed

	Deworm +	Deworm -	Wean Age 6wk	Wean Age 12wk	25% Holstein	50% Holstein	75% Holstein	100% Holstein
Birth	35.5+1.3	35.3+1.3	35.4+1.2	35.4+1.3	29.4+2.3^{a}	36.2+1.8^{b}	37.0+1.7^{b}	39.0+1.2^{b}
July 15	184.1+8.0	188.6+7.7	193.1+7.6	179.7+7.8	167.4+13.7^{a}	184.5+10.7^{ab}	190.6+11.5^{ab}	203.0+7.6^{b}
Nov 18	243.8+8.1	236.0+7.8	249.1+7.7^{c}	230.6+7.9^{d}	231.8+13.9	230.8+10.8	244.4+11.7	252.6+7.7

*All values reported in kg BW; Means with different symbols differ:a,b P<.05; c,d P=.07

Key Words: Anthelmintic, Weaning, Gain

Horse Species: Emerging Equestrian Varsity Competition

51 Integration of academic equine sciences and intercollegiate equestrian programs. G. Potter*, *Texas A&M University*, *College Station*.

Students in equine science programs need hands-on laboratory and extracurricular experiences with horses to enrich their academic training. The Intercollegiate Horse Show Association (IHSA) was formed in the late 1960's to provide college students extracurricular riding opportunities. Historically, IHSA programs have been conducted at the student club level at most institutions. Also, the overwhelming majority of students in equine sciences and IHSA activities are women. Thus, a women's equestrian team is an attractive option for athletic departments that have interest in adding women's sports. Recently NCAA division I universities have begun fielding varsity, women's equestrian teams. Such is the case at Texas A&M University (TAMU). An IHSA club-level program had been in place at TAMU for many years as a part of the Equine Sciences Program. In the late 1990's, the Associate Director of Athletics and the Equine Sciences Program Leader at TAMU began discussions regarding offering a varsity Women's Equestrian Team and merging that program with the existing Equine Sciences Program. Subsequently, the Director of Athletics and the Head of the Department of Animal Science approved a proposal outlining mutual use of the existing Equestrian Center and horses to support a varsity Equestrian Team and the riding component of the Equine Sciences Program. This program is jointly managed by both departments, and is a win-win program. The Equine Sciences Program benefits tremendously from the enhanced exposure and financial support of the Athletics Department, and serves as a recruiting tool for the Equestrian Team. The Athletics Department benefits from the use of facilities and horses to field the Equestrian Team and having another women's team with a large number of students. This has been and a very successful merger. It works primarily because of the mutual respect and support of the combined program by all the people involved, and it has generated tremendous visibility and support in both the horse industry and the alumni of Texas A&M University.

Key Words: Equestrian, Varsity, Equine Sciences

52 Albumin, a mammary gland secreting cell keeper. A. Shamay* and Y. Feuermann, *Agricultural Research Organization (ARO), the Volcani Center, Institute of Animal Science*, *Bet Dagan, Israel*.

The extensive lactation performance of the modern cow, due to advance genetic selection is accompanied with advanced apoptotic process. Resent studies in our lab established the ability of leptin to up regulate lactation performance in bovine. Our findings that albumin is synthesizes by the mammary gland and the effect of leptin on the bovine mammary gland, led us to investigate the relationship between leptin, lactation and albumin. Albumin is manufactured in the liver at a rate 9-12 g/d and there is no storage and no reserve. Albumin is catabolized at a rate of 9 - 12 g/d (the same rate as it was produced) by pinoctosis in cells adjacent to the vascular endothelium. Milk whey albumin has the same amino acid sequence as the blood serum molecule. Therefore, increase in milk albumin was taken as evidence for tight junction disruption. Albumin concentration in milk increases during functional transitions from lactation to involution and from involution to lactogenesis and during inflammation. During these periods albumin may augment the immune defenses of the gland. We found that albumin expression was approximately 4 times higher in mastitis mammary gland tissue compared to its expression in healthy tissue. The secretion of albumin was increased 3.5-fold in the mastitic mammary gland tissue explants, relative to the healthy mammary gland tissue explants. We have shown that leptin in the presence of prolactin (simulation of lactation) enhance the expression and accumulation of albumin in the bovine mammary gland. The results of our experiments suggest that the synthesis and secretion of albumin by the mammary gland is part of the innate nonspecific defense system. That albumin synthesis and secretion in the mammary gland is influence by the tissue health status and by hormones and that albumin is a mammary secreting cell keeper.

53 Increased mammary gland oxidative damage and apoptosis during prolonged lactation in the mouse is little affected by overexpression of des(1-3)hIGF-I. D. Hadsell*[1,2], D. Torres[1,2], and J. George[1,2], [1]*USDA/ARS Children's Nutrition Research Center*, *Houston TX*, [2]*Baylor College of Medicine*, *Houston TX*.

Prolonged lactation in the mouse is associated with decreased capacity to produce milk and loss of secretory tissue. This loss of function is delayed in transgenic mice that overexpress des(1-3)hIGF-I (WAP-DES). A primary goal of these studies was to determine the relationship between mammary cell apoptosis and oxidative damage during normal and prolonged lactation. A second goal was to determine if reduced mammary cell apoptosis occurs in WAP-DES mice during prolonged lactation. The percentage of TUNEL-positive mammary cells present in the mammary gland during early and prolonged lactation was analyzed in two separate studies. In study 1, TUNEL staining and mammary protein carbonyl content (CC) was compared in mammary tissue samples collected from lactating mice on days 1, 2, 3, 5, 10, 35, and 57 post partum (4 - 10 animals/day). In study 2 TUNEL analysis was done on mammary tissue samples collected during peak lactation (day 8) or prolonged lactation (day 37) from either nontransgenic or WAP-DES dams (4 -12 dams per time-genotype combination). A third study compared both mammary CC and the content of 8-hydroxy 2'-deoxyguanosine (8-OG) in mitochondrial DNA isolated from glands collected at day 2, 10 and 35 postpartum (3-5 animals/day). In both TUNEL studies, percent apoptosis was lowest at peak lactation (study 1, day 10, 0.2±0.04 %; study 2, day 8, 0.5±0.1%) and increased ($P<0.05$) 2- to 3-fold with prolonged lactation. Apoptosis in mammary tissue from the WAP-DES mice was similar ($P>0.05$) to that of nontransgenic mice. Both markers of oxidative damage change with day postpartum ($p<0.05$). Oxidative damage was high on day 2 decreased on day 10 and then increased on day 35 postpartum (CC, 3.1±0.2, 1.8±0.2, 2.4±0.2 nmole/mg protein respectively; 8-OG, 6.1±0.7, 4.4±0.8, 9.3±.7 nmole/L mitochondrial extract, respectively). These results support the conclusion that apoptosis in association with cellular oxidative damage is increased in the mammary gland during prolonged lactation.

Key Words: Persistence, Apoptosis, Oxidative Stress

54 Endocrine regulation of mammary function and persistency of lactation. T. B. McFadden*, *University of Vermont*, *Burlington*.

Mammary development and lactation are classical examples of physiological processes that are under hormonal regulation. At the level of the mammary gland, milk yield is fundamentally determined by the number of mammary epithelial cells and their secretory activity. In addition, milk production depends on adequate supply of precursor nutrients derived from systemic metabolism and delivered through the mammary blood supply. Each of these factors or processes is regulated by hormones and their overall coordination in support of lactation is likewise under endocrine control. The objective of this paper is to review the endocrine regulation of mammary function and persistency of lactation, with particular emphasis on the effects of pregnancy, nutrition, and environmental factors. For example, changes in the endocrine milieu during pregnancy appear to signal functional changes in the mammary gland that lead to reduction of milk production. Increasing or decreasing the frequency of milking not only alters the amount of milk retained in the udder, with potential effects on endocrine signaling, but also changes the profile of galactopoietic hormones released, especially prolactin and oxytocin. Finally, the imposition of long day photoperiod during lactation elicits increased milk yield through a mechanism that must involve hormonal regulation. In addition to the well known galactopoietic effects of bovine somatotropin, experimental application of other hormones such as oxytocin have been shown to enhance milk yield and persistency of lactation. Further study of these and other hormones, and of their roles in mediating mammary responses to extrinsic factors holds great promise for development of new approaches to enhancing mammary function and lactational persistency.

Key Words: Hormones, Lactation Persistency, Mammary Function

55 Effect of increased milking frequency (4X followed by 2X vs. 3X) in early lactation and its effects on future milk yield. R. Burgos*, L. Odens, L. Baumgard, and M. VanBaale, *University of Arizona*, *Tucson*.

Although frequently recommended and occasionally practiced on dairy farms, the effects of increased milking frequency (IMF) on production parameters are poorly understood. Two-hundred multiparous and 100 primiparous Holstein cows were randomly assigned to one of five milking frequency treatments at parturition to investigate IMF (4X followed by 2X vs. 3X) effects during early lactation and subsequent milk yield persistency. Treatments were 1) 3X milking for 120 DIM; 2) 4X milking from 0 to 10 DIM followed by 2X through 120 DIM; 3) 4X milking from 0 to 20 DIM followed by 2X through 120 DIM 4) 4X milking from 0 to 30 DIM followed by 2X through 120 DIM; and 5) 4X milking from 0 to 40 DIM followed by 2X through 120 DIM. Cows were housed in a dry lot facility under a thermal neutral environment throughout the study. Individual milk yields were collected daily and milk components were obtained monthly. All cows were body condition scored at parturition and every four wks thereafter. Blood was collected from the coccygeal vein at parturition and weekly for 5 wks thereafter using a subset of cows (n=27/trt from control and the cows milked 4X for 40 DIM). Data reported here in were analyzed through 42 DIM. Treatment effected milk yield ($P < 0.05$) between primiparous (31.4^{a}, 25.4^{b}, 27.4^{b}, 29.6^{a}, and 30.8^{a} kg/d) and multiparous (40.7^{a}, 37.1^{bc}, 34.8^{c}, 36.5^{bc}, and 37.9^{b} kg/d) cows milked 4X and 2X compared to 3X, respectively. Data suggest that IMF (4X followed by 2X vs. 3X) immediately post partum does not improve milk yield during the first 6 wks of lactation in primiparous or multiparous cows milked 4X for 10, 20, 30, or 40 DIM compared to 3X milking alone.

Acknowledgements: We thank United Dairymen of Arizona for funding and Tom Thompson and the employees of Stotz Dairy.

Key Words: Milking Frequency, Early Lactation

56 Peak and persistency: The mathematics of the lactation curve. I. Vetharaniam*[1], S. R. Davis[2], and E. S. Kolver[3], [1]*AgResearch Limited*, *Hamilton, New Zealand*, [2]*ViaLactia Biosciences (NZ) Limited*, *Newmarket, Auckland, NewZealand*, [3]*Dexcel Limited*, *Hamilton, New Zealand*.

Underlying the concept of lactational persistency is a complex of interactions which influence mammary secretory cell number and activity over the course of the lactation. The secretory cell population in the bovine mammary gland consists of alveoli in both active (secreting) and quiescent (engorged) states. We hypothesize that prolonged engorgement is a key regulator of changes in gene expression that lead to de-differentiation and secretory cell death. The number of active alveoli, modulated post partum primarily by nutrition and milking frequency, governs the capacity for milk production. Quiescent alveoli provide a latent secretory potential which can be unlocked through disgorgement of milk. Early in lactation, proliferation of progenitor cells provides new alveoli, resulting in growth of the mammary gland. After peak lactation, the size of the quiescent pool and the rate of cell death, driven from that pool, govern the rate of regression of the gland, and thus the persistency of the lactation. These biological dynamics have recently been incorporated into mathematical models which predict the active and quiescent secretory cell pools through time. This has allowed mechanistic description as to how milking frequency and nutrition might interact with persistency. In particular, chronic effects of nutrition are proposed to regulate the induction phase of apoptosis, while the influence of milking frequency is at the initiation of quiescence (and the size of the quiescent pool of secretory cells). This paper presents these models and discusses their results and their biological implications. Key experiments are identified which could be performed to either strengthen or refute key assumptions in the model. The sensitivity of the lactation curve to up- and down-regulation of pathways in the mammary gland are examined in considering strategies for improving production and its persistency. Differences between New Zealand and North American Holsteins in the way that nutrition modulates udder regression through apoptosis of mammary cells are considered in light of modelling predictions.

Key Words: Mathematical Modelling, Milking Frequency, Nutrition

Nonruminant Nutrition: Dietary Supplements and Additives

57 Growth performance and intestinal morphology responses to diet supplementation with spray-dried plasma protein and organic complex copper in weanling pigs housed under sanitary and sub-sanitary conditions. A. Harper*, J. Zhao, M. Estienne, K. Webb, Jr., and A. McElroy, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Weanling pigs (n = 192, 18 ± 2 d of age, 6.0 ± 0.2 kg BW) were used to investigate effects of dietary addition of spray-dried plasma protein (SDPP, 0 or 6% for 10 d) and copper from an organic copper complex (0 or 200 ppm for 35 d) on growth performance and intestinal morphology under sanitary or sub-sanitary conditions. The sub-sanitary condition was created by applying swine manure slurry to all surfaces of the sub-sanitary pens during the wk prior to weaning with the understanding that pen sanitation and nursery room would be confounded. There were four pigs per pen; feed and water were available ad libitum. On d 10, one pig per pen was killed and sections of duodenum, jejunum and ileum were fixed, stained and prepared for microscopic assessment of mucosal morphology. By d 10 post-weaning, SDPP and copper supplementation improved ADG and ADFI ($P < 0.001$), while pigs reared in the sub-sanitary pens had lower ADG ($P < 0.05$) than those from sanitary pens. Trends for interaction of diet and pen sanitation were observed for G:F with more pronounced response to SDPP ($P < 0.07$) or copper ($P < 0.11$) supplementation in the sub-sanitary pens. By d 35, there were no main or interactive effects of treatment on performance ($P = 0.19$). In each intestinal segment, shorter villus length and less crypt depth were observed in pigs housed in the sub-sanitary pens ($P < 0.05$). In the duodenum, reduced crypt depth with copper supplementation ($P < 0.01$) and a trend for greater villus length with SDPP supplementation ($P < 0.09$) were observed. Under these experimental conditions, SDPP and copper supplementation improved pig growth performance during the initial 10 d post-weaning and responses for G:F tended to be greater under sub-sanitary conditions. Poor sanitation conditions in the pig housing environment appear to have a negative impact on mucosal morphology.

Key Words: Pigs, Spray-Dried Plasma, Copper

58 Dietary spray-dried plasma and lactating sow feed intake. J. Crenshaw*[1], J. Mencke[2], R. Boyd[2], J. Campbell[1], B. Allen[1], and L. Russell[1], [1]*APC Incorporated*, *Ankeny, IA*, [2]*The Hanor Company*, *Franklin, KY*.

Segregated-parity PIC sows (n = 894) were fed lactation feed with 0% or 0.5% dietary spray-dried plasma (SDP) to determine the effects of SDP on sow feed intake, wean to estrus interval, and pig survival to weaning. There were 112 first parity sows, 112 second parity sows, and 223 older parity (> 2) sows per treatment in experiment 1. In a second experiment, 2,116 older PIC sows (parity, > 2) were fed lactation feed with 0% or 0.5% SDP to evaluate the effects of SDP on sow feed intake, pig survival to weaning and weaning weight of pigs. Litter weaning weight data were collected on 588 litters. At weaning (average 16 d of age), pigs were weighed and pig quality was recorded (high quality pigs weighed 3.6 or more kilograms at weaning). In both experiments, feed intake data were collected from individual sow feed records with feed additions to feeders recorded daily. Feed data were subjected to repeated measures analysis. In experiment 1, SDP increased feed intake of first parity sows (+0.82 kg/d; $P < 0.001$) and second parity sows (+0.23 kg/d; $P = 0.117$), but reduced feed intake of older parity sows (-0.20 kg/d; $P = 0.023$). First parity sows fed SDP had fewer days (-2.5) to postweaning estrus ($P = 0.001$). Older sows fed spray-dried plasma had improved ($P = 0.025$) pig survival (92.0% vs. 89.3%). In the second experiment, SDP reduced ($P < 0.001$) feed intake (-0.34 kg/d) of older parity sows and had no effect ($P > 0.25$) on pig survival to weaning, but the number of high quality pigs (> 3.6 kg) weaned was increased 0.35 pigs per litter from sows fed SDP ($P = 0.017$). Also pigs from sows fed SDP were 0.25 kg heavier ($P = 0.001$) at weaning than pigs from control sows. In conclusion, SDP increased feed intake in younger sows and reduced days to estrus in first parity sows. Although SDP reduced feed intake in older sows, both heavier pigs at weaning and increased number of high quality pigs at weaning from sows fed spray-dried plasma suggest that metabolic efficiency of the lactating sow was enhanced and milk production was improved.

Key Words: Swine, Lactation, Spray-Dried Plasma

59 Effects of Bio-Mos® and carbadox on gastrointestinal pH, organ weight and morphology of nursery pigs. J. Miguel* and J. Pettigrew, *University of Illinois*, *Urbana*.

A 3-wk experiment was conducted to evaluate the effect of a mannan oligosaccharide product (Bio-Mos®) and antibiotic (carbadox) on gastrointestinal characteristics of pigs. Thirty pigs were weaned at an average of 21.2 d and 5.95 kg BW. At weaning, six pigs were euthanized for gastrointestinal sample collection, while the remaining 24 pigs were randomly allocated to one of four dietary treatments. The experiment was conducted as a 2 x 2 factorial arrangement, with the factors being 0 or 0.2% Bio-Mos® and 0 or 55 ppm carbadox. Twelve pigs, representing three pigs per treatment, were euthanized on each of 2 days, 7 or 21 d post-wean. Gastrointestinal pH and wet empty organ weight measurements were taken as well as tissue samples from the duodenum, jejunum and ileum for morphological measurements. For the entire group of 30 pigs, the wet empty weight of the stomach, small intestine and large intestine (including cecum) as a percentage of body weight, was significantly smaller ($P < 0.001$) for pigs at weaning compared to older pigs. For intestinal morphology, pigs at 7

d post-wean had significantly lower ($P < 0.001$) villous height, villous height:crypt depth ratios, and villous cross-sectional area than pigs at weaning or 21 d post-wean, while crypt depth was significantly larger ($P < 0.001$) than in pigs at wean. Bio-Mos® tended ($P = 0.08$) to decrease the percentage of small intestine weight at 7 d post-wean, while at 21 d it tended ($P = 0.09$) to have an opposite effect on both the small and large intestine weight. Bio-Mos® significantly lowered ($P < 0.05$) the pH in various segments of the G.I. tract but the effect depended on the absence or presence of carbadox at 7 and 21 d post-wean. In the absence of carbadox, Bio-Mos® lowered the pH, while in its presence the pH was higher. Carbadox appeared to increase ($P = 0.06$) the size of the villi in the duodenum at 7 d post-wean, while Bio-Mos® appeared to have the same effect ($P = 0.02$) at 21 d post-wean. These observations suggest that both Bio-Mos® and carbadox have beneficial effects on the gastrointestinal tract.

Key Words: Pigs, Mannan Oligosaccharide, Carbadox

60 Effect of mannan-oligosaccharides and(or) organic zinc on the intestinal microbiota and immune response of early-weaned pigs. M. Castillo*[1], C. Rodríguez[1], S. M. Martín-Peláez[1], J. Roquet[2], J. A. Taylor-Pickard[3], J. F. Pérez[1], and S. M. Martín-Orúe[1], [1]*Departament de Ciència Animal i dels Aliments, Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*, [2]*Probasa*, *Barcelona, Spain*, [3]*Alltech Biotechnology Centre*, *Summerhill, Sarney, Ireland*.

To determine the possible effect of dietary mannan-oligosaccharides (MOS) and organic zinc (Zn) on intestinal microbial populations and immune response, 32 early-weaned (20 ± 2 days) pigs were divided into four dietary treatments: a control diet (CT) to which 0.2 % of a commercial source of MOS (Bio-Mos® Alltech Inc., USA; BM), 0.08% organic Zn (Bioplex-Zn™ Alltech Inc, USA; BP) or both additives (BMP) were added. After two weeks receiving experimental diets, animals were sacrificed and weights of the whole gastrointestinal tract, full and empty stomach and small intestine were recorded. Digesta samples from the stomach, ileum and caecum were taken, pH registered and short-chain fatty acid (SCFA) concentrations determined to evaluate possible changes of fermentation patterns. Microbiological counts for enterobacteria and lactobacilli were determined by quantitative-PCR and immunoglobulin concentration in plasma (IgG, IgM, IgA) and ileal digesta (IgA) were also analysed. Inclusion of organic Zn into the diets (BP and BMP) promoted increased empty ileal weight (containing the continuous Peyer patches) (8.9, 9.5, 11.9 and 10.3 g/kg BW for CT, BM, BP and BMP, respectively; $P = 0.03$). MOS addition promoted a decrease in enterobacteria counts in the jejunum (9.13, 8.05, 8.87, and 7.89 log 16 S rDNA copies/g FM for CT, BM, BP and BMP, respectively; $P = 0.01$) but no changes in lactobacilli populations. No significant differences were registered in pH or SCFA concentrations, or in plasmatic or ileal immunoglobulins. Results suggest that MOS could modulate intestinal microbiota through inhibition of certain microbial groups, whereas the observed increase in ileal weight with organic Zn would suggest a possible immunological effect (longer Peyer patches together with an increase in intestinal wall thickness). The use of both additives together result in complementary actions.

Key Words: Mannan-Oligosaccharides, Organic Zinc, Weaning Pig

61 Effect on nursery pig growth performance from phosphorylated mannan oligosaccharide supplementation to the sow and to pigs during the nursery phase. C. L. Bradley*[1], M. E. Davis[1], D. C. Brown[1], C. V. Maxwell[1], E. A. Halbrook[1], Z. B. Johnson[1], R. Dvorak[2], and B. Lawrence[3], [1]*University of Arkansas*, *Fayetteville*, [2]*Alltech, Inc.*, *Nicholasville, KY*, [3]*Hubbard Feeds, Inc.*, *Mankato, MN*.

An experiment was conducted to determine the effects of mannan oligosaccharide (MOS) supplementation to sow diets during gestation and lactation on subsequent performance of pigs supplemented with or without MOS in the nursery phases. Diets consisted of a control or the control with 0.3% MOS fed to 36 sows for 3 wk of gestation and throughout lactation. At weaning, 126 pigs from each gestation/lactation treatment were blocked by initial BW, stratified based on sex and litter, and assigned one of two treatments: a complex control diet or the control diet with 0.3% Mos. The nursery diets were fed during Phase 1 (d 0 to 13, 1.50% Lys), Phase 2 (d 14 to 27, 1.35% Lys), and Phase 3 (d 28 to 42, 1.20% Lys). Gestation/lactation data were analyzed as a completely randomized block design and nursery data were analyzed as a randomized complete block design with treatments arranged in a 2 x 2 factorial. The percentage of mummified pigs was reduced ($P < 0.05$) in sows fed MOS. Piglet performance during lactation was similar ($P > 0.10$) between the two treatments. Pigs had improved ($P < 0.05$) performance during Phase 1 (ADG, ADFI, and BW) and for Phase 1 and 2 combined (ADG and BW) from the addition of MOS in the nursery diets in pigs reared by unsupplemented sows, whereas pigs from sows fed MOS had similar performance (gestation/lactation treatment x nursery treatment interaction, $P < 0.05$). Pigs from sows fed Mos and not receiving MOS in the nursery phase had improved ($P < 0.05$) ADG, ADFI and BW compared to pigs from unsupplemented sows and fed diets devoid of MOS in Phase 1 and for Phase 1 and 2 combined. Addition of MOS in Phase 1 improved ($P < 0.01$) G:F, but G:F was similar among treatments in Phase 2. Performance among the treatments during Phase 3 was similar. These data suggest that the benefits to nursery pig performance from MOS supplementation can be realized when administered to the dam or to the pig during the nursery phase.

Key Words: Mannan Oligosaccharide, Growth Performance, Swine

62 Holo-analysis of the effects of genetic, managemental, chronological and dietary variables on the efficacy of a pronutrient mannanoligosaccharide in pigs. G. Rosen*, *Pronutrient Services Ltd.*, *London, England*.

All available pig test data sets from 31 publications on a yeast mannanoligosaccharide, Bio-Mos® (BM) Alltech Inc., have been holo-analysed by multiple regression of start-to-finish feed intake (FDIeff), liveweight gain (LWGeff) and feed conversion ratio (FCReff) effects on 14 independent variables, control performance, year, duration, dosage, factorial data, grower-finisher, male, slatted floor, pellet, soy, animal protein, added oil/fat, antibacterial and non-USA. Average responses from 69 tests are +7.5 g/day (0.99%) for FDIeff, +145 g/day (3.58%) for LWGeff and -0.0526 (-3.07%) for FCReff using BM at 0.12-4.0 g/kg feed (mean, 1.94) in 10-131 day tests (mean, 41.4) on 3,778 pigs in 10 countries in 1996-2002. Respective coefficients of variation of these responses average 511, 163 and 229%. Mean respective beneficial response frequencies for LWGeff and FCReff are 73 and 68% (54% jointly). Preliminary multiple regression analyses (P in, 0.05/P out, 0.10) afforded no LWGeff model; better FCReff in less efficient converters; no BM dosage term for FDIeff or FCReff; better piglet FCReff than grower/finisher; higher FDIeff in oil/fat-supplemented diets; and better FCReffs in animal protein and oil/fat diets. Less stringent (P in, 0.25/P out, 0.34) exploratory models for 64 FDI, 64 LWG and 67 FCR outlier-free tests indicate better FCReff in less efficient converters; maximum FDIeff at 3.5 g BM/kg; no significant LWGeff or FCReff dosage terms; lower LWGeffs in USA and pelleted feed; lower FCReffs with age, factorial data, supplemental oil/fat, step-down BM dosage and slatted floor; and better FCReffs in weaners and in animal protein and main vegetable protein not-soy feeds. Future research when data suffice could include weaner and slaughter pig dose-response functions; continuous and step-up BM dosages; disease, geographic and main diet ingredient and nutrient content effects; and BM interactions with antibiotics/antibacterials (including Cu and Zn compounds), enzymes, acids, other oligosaccharides and limiting nutrients.

Key Words: Holo-Analysis, Mannanoligosaccharide, Pig

63 Effect of an *E. coli* F4 (K88) probiotic, liquid acidifier, dry acidifier, or plant extract on early-weaned pigs challenged with enterotoxigenic *E. coli* F4 (K88). Y. Han*[1], M. Vignola[2], and J. Brennan[1], [1]*Maple Leaf Foods Agresearch*, *Guelph, Ontario, Canada*, [2]*Shur-Gain Quebec*, *St-Romuald, Quebec, Canada*.

To evaluate the efficacy of alternatives to antibiotic growth promotants (AGP), 130 piglets were weaned at 14 days of age and used in an *E. coli* F4 (K88) challenge trial. There were six dietary or water treatments, including a non-

medicated control (Non-Med), an AGP control (Tiamulin, 31.2 mg/kg), an avirulent *E. coli* K88 isolate as a probiotic (Probiotic), a liquid acidifier (phosphoric, lactic, and formic acid, 0.5 mL/liter of drinking water), a feed acidifier (phosphoric, lactic, citric, acetic, and formic acid; 1 g/kg), and a plant extract (genus papaveraceae). All treatments commenced on d 7 of the trial except for Probiotic that was orally administered to each piglet at weaning (one dose/pig). On d 15, all piglets were challenged orally with 10^9 (CFU/mL) of an *E. coli* K88 inoculum. The trial ended on d 42. Compared to Non-Med, the dry acidifier and plant extract failed to improve growth or health condition of pigs. By d 42, pigs fed liquid acidifier or AGP were heavier than those fed Non-Med (20.9, 21.3, 18.3 kg BW, respectively; $P < 0.01$). The liquid acidifier resulted in a non-significant reduction of *E. coli* K88 shedding and diarrhea score. The Probiotic tended to reduce diarrhea severity and *E. coli* K88 shedding but the effects were not significant. On d 42, pigs treated with Probiotic were heavier than those fed Non-Med (20.1, 18.3 kg BW; $P = 0.06$). In conclusion, both the liquid acidifier and *E. coli* K88 probiotic demonstrated potential as alternatives to AGP for prevention of *E. coli* K88 infection.

Key Words: Early Weaned Pigs, Alternatives, *E. coli* K88 Challenge

64 Effect of L-carnitine on growth performance in segregated early weaned pigs. D. C. Brown*[1], M. E. Davis[1], C. V. Maxwell[1], E. A. Halbrook[1], Z. B. Johnson[1], and J. Woodworth[2], [1]*University of Arkansas*, *Fayetteville*, [2]*Lonza*, *Fairlawn, NJ*.

Two identical experiments were conducted to determine the efficacy of L-carnitine in improving performance of early weaned pigs. A total of 216 barrows (19 ± 3 d of age) per experiment were moved to a wean-to-finish facility, sorted by BW into three weight groups, and allotted into twelve equal subgroups (six pigs/pen) with stratification based on sex and litter. Treatments were randomly assigned to pens within each of the six weight groups (18 pens/treatment). During the first 13 d post-weaning (Phase 1), pigs were fed either a simple diet containing 1.6% lysine with no L-carnitine or the control diet with 0.0050% (50 ppm) L-carnitine. Upon completion of Phase 1, pigs were fed a Phase 2 diet (1.45% lysine) from d 13 to 26, and a Phase 3 diet (1.35% lysine) from d 26 to 40 post-weaning. Treatments remained the same during the Phase 2 and Phase 3 periods. In trial 1, L-carnitine tended ($P < 0.10$) to increase ADG and ADFI during Phase 3 of the nursery period. In trial 2, L-carnitine supplementation tended to improve ($P < 0.10$) ADG during Phase 1 of the nursery period and in the combined Phase 1-2 period. In addition, pigs fed diets supplemented with L-carnitine tended to have greater ($P < 0.10$) BW at the end of Phase 1 compared to pigs fed the control diet, and the average BW of pigs fed L-carnitine was 0.81 kg greater ($P < 0.05$) than the average BW of pigs fed the control diet at the end of Phase 2. The improvement in ADG and pig BW was likely a result of the increased ($P < 0.05$) feed intake observed during Phase 1 of the nursery period and during the overall Phase 1-2 and Phase 1-3 periods. Pigs in trial 1 had a poor growth performance compared to pigs in trial 2, which may indicate that pigs were undergoing some type of heath challenge during trial 1. These data suggest that pig health status may influence the ability of L-carnitine to impact growth performance during the nursery period. Further research is needed to determine under which rearing conditions L-carnitine can enhance pig performance.

Key Words: L-Carnitine, Nursery Pigs, Performance

65 Effect of supplemental chromium level and source on fasting plasma nonesterified fatty acid concentrations in growing pigs. E. B. Kegley*[1] and T. M. Fakler[2], [1]*University of Arkansas*, *Fayetteville*, [2]*Zinpro Corp.*, *Eden Prairie, MN*.

Chromium is generally recognized as an essential nutrient; however, a dietary requirement for the pig has not been quantified. The objective of this experiment was to determine the effects of chromium level and source on fasting plasma NEFA concentrations in growing pigs. Two hundred ten pigs (105 barrows and 105 gilts, 23.3 kg, 54 to 62 d of age) were stratified by gender, litter and weight, and were then assigned randomly to one of 35 pens, with three barrows and three gilts in each pen. Pens were assigned randomly to treatment. Treatment diets were available to the pigs on an ad libitum basis for 33 or 34 d. Diets consisted of 72% corn, 23% soybean meal and 2% added fat, and were formulated to provide 1.05% lysine, and recommended levels of other nutrients. Seven dietary treatments were: control (no supplemental Cr); 200 ppb supplemental Cr as chromium picolinate (CrPic), chromium propionate (CrProp) or chromium-L-methionine (CrMet); and 400 ppb supplemental Cr as CrPic, CrProp or CrMet. After a 16 h fast, on d 34 or 35, pigs were bled via the anterior vena cava. Finding through boxplot analyses that the data were not normally distributed, NEFA concentrations were transformed logarithmically. Transformed data were analyzed by ANOVA using the MIXED procedure of SAS, with pen as the experimental unit. The model included dietary treatment. A random statement included block (the day of bleeding). Supplemental Cr as CrMet resulted in the greatest decrease in fasting plasma NEFA concentrations (control vs. CrMet, $P = 0.06$). Supplementation with CrProp or CrPic also tended to decrease fasting plasma NEFA concentrations (control vs. CrProp, $P = 0.09$; control vs. CrPic, $P = 0.11$). There was a linear effect of CrMet supplementation on decreasing NEFA concentrations ($P = 0.07$). This linear effect was not significant for the other two supplemental Cr sources (linear CrPic, $P = 0.12$; or linear CrProp $P = 0.22$). Chromium-L-methionine decreases fasting NEFA concentrations in growing pigs.

Key Words: Chromium, NEFA, Pigs

66 The effects of feeding inorganic zinc or zinc amino acid complex to sows during gestation and lactation, and the subsequent effects on the progeny during lactation and the nursery period. R. Payne[1], T. Bidner[1], L. Southern*[1], and T. Fakler[2], [1]*Louisiana State University Agricultural Center*, *Baton Rouge*, [2]*Zinpro Corp.*, *Eden Prairie, MN*.

An experiment was conducted to determine the effects of feeding inorganic Zn or a zinc AA complex (AvailaZn^®^) to sows during gestation and lactation and the subsequent effects on the progeny during the nursery period. Three diets were fed to sows (nine, seven, and nine for Diets 1, 2, and 3) starting from d 15 after breeding through lactation, and also to the offspring in the nursery. The diets were: 1) corn-soybean meal diet with 100 ppm Zn from $ZnSO_4$ (Control); 2) Control + 100 ppm Zn from $ZnSO_4$ (ZS); and 3) Control + 100 ppm Zn from AvailaZn (ZnAA). After weaning, pigs (63, 55, and 84 pigs; and nine, eight, and 12 pens/treatment for Diets 1, 2, and 3) were maintained on the same diet as the dam. At weaning and at the end of the nursery phase, one pig per replicate was killed for tissue analyses. Diet did not affect sow weight change during gestation ($P > 0.10$). During lactation, sows fed ZnAA had increased ($P < 0.10$) litter birth weight and pigs nursed and weaned compared with those fed the control or ZS diet. Jejunal villi height of the weaned pigs from sows fed ZS or ZnAA was increased ($P < 0.10$) compared with pigs from sows fed the control diet. During the nursery period, growth performance was not affected ($P > 0.10$) by diet. At weaning, pigs fed ZS had wider duodenal and ileal villi ($P < 0.10$) than those fed ZnAA. Pigs fed either ZS or ZnAA had increased ($P < 0.10$) bone Zn than pigs fed the control diet. Liver Zn was highest in pigs fed ZS, followed by those fed ZnAA, and then those fed the control diet ($P < 0.10$). Pancreas Zn was increased ($P < 0.10$) in pigs fed ZS compared with those fed the control diet. In this study, supplemental Zn from ZS or ZnAA, above typical trace mineral premix levels did not affect the sow during gestation or pigs during the nursery period. However, sows fed ZnAA had two more pigs per litter and nursed and weaned more pigs than sows fed ZS or the control diet.

Key Words: Lactation, Pig, Zinc

67 Effect of fat level in late finishing barrows fed ractopamine HCl (Paylean®). A. M. Gaines*[1], B. W. Ratliff[1], P. Srichana[1], G. L. Allee[1], and J. L. Usry[2], [1]*University of Missouri*, *Columbia*, [2]*Ajinimoto Heartland LLC*, *Chicago, IL*.

This experiment was conducted at a commercial research site in order to evaluate the effect of fat level in barrows fed ractopamine HCl (Paylean). A total of 588 pigs (TR-4 × C22; 106.2 ± 0.39 kg) were used in a completely randomized

block design with seven replicate pens/treatment and 21 pigs/pen. Pigs were allotted to one of four dietary treatments containing 0.0, 2.0, 4.0 and 6.0% supplemental fat (choice white grease), respectively. All diets contained the same inclusion of Paylean (7.2 ppm) and were formulated at a lysine:calorie ratio of 2.72 g true ileal digestible lysine/Mcal ME. The level of soybean meal (25.0%) was also held constant across the diet formulations and dietary lysine content was adjusted by adding L-lysine•HCl (0.10, 0.13, 0.17, and 0.20%, respectively) with additional synthetic amino acids supplied as necessary in order to meet the minimum amino acid profile. Growth performance was evaluated for 21 d. At d 21, pigs were transported to a commercial processing facility for carcass data collection. Fat supplementation increased (linear, $P = 0.01$) ADG (1,061, 1,093, 1,134, and 1,139 g/d, respectively) and improved (linear, $P < 0.001$) G/F (0.328, 0.341, 0.355, and 0.361, respectively). There was no effect on ADFI ($P > 0.20$). Based on linear regression analysis, for each one percentage unit increase in supplemental fat addition there were 1.30% and 1.72% improvements in ADG ($r^2 = 0.93$) and G/F ($r^2 = 0.98$), respectively. Fat supplementation slightly increased 10th rib backfat (20.0, 19.3, 20.8, 20.6 mm, respectively) and decreased carcass percent lean (54.1, 54.5, 53.5, and 53.7%, respectively). There was no effect on loin depth ($P > 0.74$) or carcass yield ($P > 0.45$). Based on the economic analysis, the optimum level of fat when feeding 7.2 ppm Paylean is 4.0%.

Key Words: Pigs, Ractopamine HCl, Growth

68 The effects of a carbohydrate- and protein-based feed supplement on sow and litter performance. W. Browning*, C. Fontenot, R. Guillory, M. Leger, and F. LeMieux, *McNeese State University*, *Lake Charles, LA*.

An experiment was conducted to determine the effects of a carbohydrate-and protein-based feed supplement on sow and litter performance. Fifty-two first parity and multiparous sows and their pigs were used to evaluate the effects of a novel carbohydrate-and protein-based feed ingredient (Nutri-Pal) on sow and litter performance during lactation. The dietary treatments were a corn-soybean meal control and a corn-soybean meal plus Nutri-Pal top-dress fed from farrowing to weaning. Top-dress was fed at a rate of 113 g per feeding, and sows were fed twice daily during lactation. Sows were allotted to treatment at random. There were 24 and 28 sows for the corn-soybean meal and corn-soybean meal plus Nutri-Pal treatments, respectively, over two farrowing groups. Farrowing months were March, April, July, August, and September, 2004. Within the first 3 d after birth, pigs were cross-fostered to equalize litter size. Pigs were cross-fostered only among litters of the same diet. Pigs were weighed within 1 d of farrowing and pigs were weaned at an average age of 20 d. Sow response variables (pigs born alive, and litter and average pig birth weight) were not affected ($P > 0.10$) by the diet. There were no effects ($P > 0.10$) of the diet on litter performance response variables (pigs weaned, litter and average pig weaning weight and gain, and percentage survival). The Nutri-Pal feed ingredient did not affect sow or litter productivity.

Key Words: Lactation, Litter Traits, Sows

Physiology and Endocrinology I

69 A comparison of progestin-based protocols to synchronize ovulation prior to fixed-time artificial insemination in postpartum beef cows. D. J. Schafer*[1], J. F. Bader[1], J. P. Meyer[1], J. K. Haden[2], M. R. Ellersieck[1], M. F. Smith[1], and D. J. Patterson[1], [1]*University of Missouri*, *Columbia*, [2]*MFA Inc.*, *Columbia, MO*.

The experimental objective was to compare pregnancy rates after fixed-time AI in postpartum beef cows following administration of two protocols to synchronize ovulation. Cows (n = 650) at four locations (n = 210, 158, 88, 194) were stratified by age, BCS and days postpartum (DPP) to one of two treatment protocols. The MGA Select treated cows (MGA Select; n = 327) were fed melengestrol acetate (MGA; 0.5mg•hd^{-1}•d^{-1}) for 14 d, GnRH was injected 12 d after MGA withdrawal (100 µg, i.m. Cystorelin; d 26), and PG was administered 7 d after GnRH (25 mg i.m. Lutalyse; d 33). Cows assigned to the CO-Synch + CIDR protocol (CO-Synch + CIDR; n = 323) were fed carrier for 14 d, were injected with GnRH (100 µg, i.m. Cystorelin) and equipped with a CIDR insert (1.38g progesterone) 12 d after carrier removal (d 26), and CIDRs were removed 7 d later at the time PG (25 mg i.m. Lutalyse) was administered (d 33). Artificial insemination was performed at fixed-times (72 or 66 h after PG for MGA Select and CO-Synch + CIDR groups, respectively), and all cows were injected with GnRH (100 µg, i.m. Cystorelin) at AI. Blood samples were collected 8 d and 1 d prior to MGA or carrier to determine pre-treatment estrous cyclicity [progesterone ≥ 0.5 ng/ml; (MGA Select, 185/327, 57%; CO-Synch + CIDR, 177/323, 55%); $P = 0.65$]. There was no treatment by location interaction ($P > 0.10$) for age, DPP, or BCS, and the results were therefore pooled for the respective treatments. Pregnancy rates resulting from fixed-time AI did not differ between treatments [$P = 0.20$; (MGA Select, 201/327, 61%; CO-Synch + CIDR, 214/323, 66%)], among sires ($P = 0.11$) or technicians ($P = 0.20$). There was no difference ($P = 0.36$) between treatments in pregnancy rate resulting from fixed-time AI based on pretreatment estrous cyclicity status, and no difference ($P = 0.25$) between treatments in final pregnancy rate. Both protocols provide opportunities for beef producers to use AI and eliminate the need to detect estrus.

Key Words: Estrus Synchronization, Beef Cow, Progestin

70 Resynchronizing estrus with a progesterone (P4) insert and estradiol cypionate (ECP) in cows of unknown pregnancy status. K. N. Galvao*[1], R. L. A. Cerri[1], H. M. Rutigliano[1], R. G. S. Bruno[1], R. C. Chebel[1,2], and J. E. P. Santos[1], [1]*University of California*, *Tulare*, [2]*University of Idaho*, *Caldwell*.

Holstein cows, 488, were randomly assigned to one of three treatments: Control, enrollment on the Heatsynch protocol (d0 GnRH, d7 PGF2a, d 8 ECP, and d10 timed AI) upon diagnosis of nonpregnancy on d 32 after AI; CG, intravaginal P4 (CIDR) inserted from d 14 (12 to 15) to d 21 (19 to 22) after AI, with cows observed for estrus from d 21 to 25 after AI and initiation of the timed AI on d 25 in those not in estrus, followed by pregnancy diagnosis on d 32 and completion of the timed AI in nonpregnant cows; CEG, same treatment as CG but with the an injection of 1.0 mg of ECP at the time of CIDR removal. Cows were continuously re-enrolled in the same treatment until diagnosed pregnant, which resulted in a total of 1001 AI. Blood was sampled on d 14, 21, and 25 after AI for P4 determination. Ovaries were scanned on d 21, 25 and 32 to monitor responses to treatments. Pregnancy was presumed based on P4 > 1.0 ng/mL on d 14, 21, and 25 and diagnosed by ultrasonography on d 32 and 60 after AI. The pregnancy rate (PR) was similar for Control, CG, and CEG on d 32 (34.6 vs 32.8 vs 34.2%; P = 0.93) and 60 (30.2 vs 30.7 vs 30.3%; P=0.96). The pregnancy loss (PL) based on a drop in P4 below 1 ng/mL was not affected by treatment between d 14 and 21 or between d 25 to 32, but was greater for CEG compared to Control or CG between d 21 and 25 (32.4 vs 25.4 vs 23.9%; P=0.02). Nevertheless, PL from d 32 to 60 was not affected by treatment (Control = 10.3%, CG = 5.5% and CEG = 9.9%; P=0.43). Survival analysis of the cows remaining pregnant from 14 to 60 d after AI showed no effect of treatment on embryonic and fetal survival. Re-insemination interval for nonpregnant cows was similar for the Control compared to CG and CEG groups (29.3 vs 29.6 vs 28.1 d; P=0.13), but for cows receiving CIDR, ECP tended to reduce the interval (P = 0.06) because of increased estrous detection after insert removal (56.4 vs 47.1%; P=0.01). Treatment did not affect interval from study enrollment to pregnancy. Resynchronization of non-pregnant cows with CIDR or CIDR and ECP did not affect reproductive performance of dairy cows.

Acknowledgements: NRICGP USDA

Key Words: Resynchronization, CIDR, Dairy Cows

71 Synchronization of ovulation for timed AI (TAI) in Bos indicus-influenced cattle using CIDR-based, GnRH-prostaglandin combinations I: ovarian follicular, luteal and hormonal events associated with suboptimal reproductive outcomes. J. Saldarriaga*[1], D. Cooper[1], J. Cartmill[1], R. Stanko[1,2], and G. Williams[1], [1]*Texas A&M University*, *Beeville*, [2]*Texas A&M University*, *Kingsville*.

Initial objectives (Exp. 1) were to evaluate TAI conception and overall reproductive performance of Bos indicus-influenced females managed with the CO-Synch + CIDR (COS-C) synchronization regimen compared with traditional management (TM). Secondary objectives (Exp. 2) sought to evaluate follicular, luteal and hormonal events associated with COS-C and COS (CO-Synch without CIDR). All females had a minimum BCS of 4.8 (1-9 scale) and if suckled, were at least 50 d postpartum. For Exp. 1, 266 predominantly Braford and Brangus females were utilized. COS-C included insertion of an Eazy-Breed CIDR and i.m. injection of 100 µg GnRH (GnRH-1; Cystorelin) on d 0, removal of CIDR and i.m. injection of 25 mg PGF (Lutalyse) on d 7, and GnRH (GnRH-2) plus TAI 48 h later (d 9). Bulls of proven fertility were utilized for 60 d beginning 7 d after TAI. Conception rates to TAI averaged 39 ± 0.03 % and were not affected by location, replicate, BCS, d postpartum, parity, sire or AI technician. Cumulative pregnancy rates in 170 of the COS-C females available for comparison were greater ($P < 0.05$) than in TM females (n = 165) after 30 (74.1 vs 61.8%) and 60 d (95.9 vs 89.7%). In Exp. 2, cycling (78%) and non-cycling (22%) Braford cows (n = 100) were divided into four replicates (n = 25/replicate), with half receiving COS-C and half COS. Ultrasonography and blood sampling were utilized to intensively evaluate ovarian and hormonal events and revealed no differences between treatments. Percentages of cows ovulating to GnRH-1, developing a synchronized follicular wave, exhibiting luteal regression, and ovulating in response to GnRH-2 were 40, 60, 93, and 72%, respectively. TAI conception rates averaged 33%. Ovulation rate and TAI conception after GnRH-2 were greater ($P < 0.01$) in cows that developed a synchronized follicular wave (43%) than not (17%) after GnRH-1. TAI produced low conception rates in part because up to 28% of cows did not have an ovulatory follicle on d 9.

Acknowledgements: Supported by TAES and Pfizer Animal Health

Key Words: Bos Indicus, Synchronization, Timed AI

72 Synchronization of ovulation for timed AI (TAI) in Bos indicus-influenced cattle using CIDR-based, GnRH-prostaglandin combinations II: Assessment of estrual and ovulatory distributions with Select Synch + CIDR to optimize TAI with Co-Synch + CIDR. J. Saldarriaga*, J. Zuluaga, J. Cartmill, D. Cooper, and G. Williams, *Texas A&M*, *Beeville*.

Objectives of this experiment were to characterize estrual and ovulatory distributions after treatment of Bos indicus-influenced females with the Select Synch + CIDR in order to develop optimal timing for TAI using CO-Synch + CIDR (COS-C). The Select Synch + CIDR regimen includes insertion of an Eazy-Breed CIDR and i.m. injection of 100 µg GnRH (Cystorelin) on d 0, removal of the CIDR and i.m. injection of 25 mg PGF (Lutalyse) on d 7. Extension of this protocol to include a second GnRH injection (GnRH-2) and TAI at a predetermined time (48-66h) defines the COS-C regimen. Fifty postpartum, primiparous (n =32) and pluriparous (n =18) Braford (F1) females were used. All cows had a minimum body condition score (BCS) of 4.8 (1-9 scale) and were at least 50 d postpartum. Cow-calf pairs (5 pairs/pen) were maintained in pens (25.6 x 9.6 m) after CIDR removal and observed for estrus based on homosexual behavior at 3-h intervals for 120 h. AI was performed approximately 12 h after detected estrus. Transrectal ultrasonography was performed every 12 h until ovulation, and blood samples were collected on d -21, -11, 0, 7, 8 and 9 to estimate ovarian cyclicity and incidence of corpus luteum (CL) regression after PGF. Mean BCS and d postpartum averaged 5.6 ± 0.1 and 61 ± 1.1, respectively. Neither cycling status nor parity affected the number of cows exhibiting estrus (54%) or ovulating (56%). Percentage of cows exhibiting CL regression was 97%. The majority (75%) of estrual events was observed between 60 and 72 h after CIDR removal and none by 48 h. Mean intervals from CIDR removal to estrus and ovulation were 70 ± 2.9 and 99 ± 2.8 h, respectively. Conception rates to AI in cows that displayed standing estrus and ovulated were 59.3 and 60.7 %, respectively. Results of this and an accompanying study demonstrate that GnRH-2 and TAI at 48 h after CIDR removal/PGF in the COS-C protocol is inappropriate for optimal fertility.

Acknowledgements: Supported by TAES and Pfizer Animal Health

Key Words: Bos Indicus, Synchronization, Timed AI

73 Effect of artificial insemination (AI) protocol on fertilization and embryo quality in high-producing dairy cows. R. L. A. Cerri*[1], H. M. Rutigliano[1], R. G. S. Bruno[1], R. C. Chebel[1,2], and J. E. P. Santos[1], [1]*University of California*, *Tulare*, [2]*University of Idaho*, *Caldwell*.

Objectives were to determine the effect of AI protocol on fertilization and embryo quality in dairy cows. Lactating cows, 396, were subjected to AI after one of four protocols: Detected estrus (DE), GnRH on d 6 of the estrous cycle (EC), followed by PGF2a 7 d later, and AI upon estrus; Ovsynch (GnRH, 7d PGF2a, 2d GnRH, 12h timed AI) as OV3, OV6 and OVE, which corresponded to injection of the first GnRH on d 3, 6, and 6 of the EC, respectively, but OVE also received an injection of 0.5 mg of estradiol cypionate 36 h before the timed AI. The same technician inseminated all cows with semen from a single sire. Ovarian responses were evaluated by ultrasonography, blood was analyzed for progesterone and estradiol, and uteri were flushed on d 6 after AI. Data were analyzed by the LOGISTIC and GLM procedures of SAS (2001). Ovulation to the GnRH was less ($P<0.001$) for cows receiving it on d 3 (OV3=7.1%) than on d 6 of the EC (DE=79.2%, OV6=87.3%, OVE=85.2%) because of smaller dominant follicle (9.5 vs 14.2 vs 15.4 vs 15.0 mm; $P<0.001$). A new follicular wave was observed after the GnRH in 7.1% of OV3, which differed ($P<0.001$) from DE (81.2%), OV6 (88.6%) and OVE (88.9%). Diameter of the ovulatory follicle at AI differed ($P<0.001$) and it was 20.7, 19.7, 18.1 and 19.7mm for OV3, DE, OV6 and OVE, respectively. Synchronization at AI (luteolysis and ovulation) was greater for DE (96.9%) than the timed AI treatments (84.1%). Fertilization rate was similar ($P=0.96$) and averaged 86.3% across groups. OV3 reduced embryos of excellent and good quality as proportion of fertilized ($P<0.01$) and total structures ($P<0.02$) compared with DE, OV6, and OVE. Embryos from OV3 had fewer ($P<0.01$) blastomeres than DE, OV6 and OVE (32 vs 49 vs 42 vs 45), and both OV3 and DE resulted in embryos with a lower ($P=0.09$) proportion of live blastomeres than OV6 and OVE. Insemination upon DE did not improve fertilization or embryo quality, but timed AI compromised embryo quality when the protocol was designed to reduce ovulation to the first GnRH (OV3) resulting in prolonged dominance of the ovulatory follicle at AI.

Acknowledgements: NRICGP USDA, USDA Formula Funds, Select Sires

Key Words: Embryo Quality, Dairy Cows, AI

74 Effect of pre-synchronization and resynchronization with CIDR on reproductive performance of lactating dairy cows. R. C. Chebel*[1,2], H. M. Rutigliano[2], R. L. A. Cerri[2], R. G. S. Bruno[2], and J. E. P. Santos[2], [1]*University of Idaho*, *Caldwel*, [2]*University of California*, *Tulare*.

Objectives were to evaluate the effects of pre-synchronization protocols on cyclicity, estrous detection (ED), pregnancy rate (PR), and pregnancy loss (PL), and the effects of re-synchronization on re-insemination rate (RIR) of non-pregnant cows prior to pregnancy diagnosis (PD). Holstein cows, 1019, were blocked by parity and body condition at calving (study d 0) and assigned to one of 3 pre-synchronization protocols: CON (PGF2a d35±7 and 49±7, AI upon ED from d49±7 to 62±7), CED (PGF2a d35±7 and 49±7 + CIDR from d42±7 to 49±7, AI upon ED from d49±7 to 62±7), or CTAI (same as CED, but 100% of cows subjected to timed AI on d72±7 after Ovsynch). Cows in CON and CED groups not inseminated by d62±7 were initiated on the Ovsynch and were timed AI on d72±7. Blood collected on days 35±7, 49±7, and 62±7 was analyzed for progesterone (P4) and cows were classified as anovulatory if P4 < 1.0 ng/mL in the first 2 samples. On d62±7, anovulatory cows with P4 > 1.0 ng/mL were classified as responsive to pre-synchronization. On d 14±1 after AI cows were assigned to resynchronization with CIDR for 7d (RES) or no treatment (RCON).

Pregnancy was diagnosed at 31±3 and 60±3 d post-AI. Data were analyzed using the LOGISTIC procedures of SAS (2001). Greater proportion of anovular cows receiving CIDR became cyclic on d62±7 (CTAI = 48.4; CED = 44.9; CON = 31.6%; P=0.01). Pre-synchronization affected PR at 31d post-AI (CTAI = 38.3, CED = 31.6, CON = 27.9%; P<0.02), but PR at 60d post-AI (P=0.15) and PL from 31 to 60d post-AI (P=0.44) were not affected. Re-synchronization did not affect RIR prior to PD (P=0.43), but fewer RES cows experienced PL (14.8 vs. 24.7%; P<0.05), and RES increased PR at 31 and 60d after first AI (P<0.05). Second AI PR was affected by pre-synchronization (P=0.02) and resynchronization methods (P=0.03). Pre-synchronization with CIDR increased cyclicity by d62 postpartum, improved PR on d31, but not on d60 post-AI. Resynchronization with CIDR on d14 post-AI did not improve RIR, but increased PR at first and second AI.

Acknowledgements: NRICGP USDA, NAAB, and Pfizer Animal Health

Key Words: Pre-Synchronization, Resynchronization, Dairy cows

75 Effect of GnRH or CIDR inserts administered early after first timed insemination on fertility of lactating dairy cows. R. A. Sterry*[1], M. L. Welle[2], and P. M. Fricke[1], [1]*University of Wisconsin*, *Madison*, [2]*Miltrim Farms, Inc.*, *Athens, WI.*

In two experiments, lactating Holstein cows received their first postpartum (PP) timed AI (TAI) after a Presynch/Ovsynch protocol using 25 mg $PGF_{2\alpha}$ (PG) and 100 µg GnRH (G) as follows: PG (d 32±3 and 46±3 PP); G (d 60±3 PP); PG (d 67±3 PP); G+TAI (d 69±3 PP). Cows lacking a CL >10 mm at the first injection of G were classified as anovular. Cows (n=674) in Experiment 1 were randomized to each of three treatments to receive: 1) no treatment (C; n=226), 2) 100 µg G 5 d after TAI (G5; n=228), or 3) CIDR from 5 to 12 d after TAI (CIDR; n=220). For pregnant cows, number of CL 33 d after TAI was greater (P<0.01) for G5 (1.8±0.1) than for C (1.3±0.1) or CIDR (1.3±0.1) cows. Treatment did not affect conception rate (CR) 33 d after TAI (50, 55, and 47%, respectively) or pregnancy loss (PL) from 33 to 61 d (8%, overall). Overall, 23% of cows were anovular, and CR at 33 d was greater (P<0.01) for cycling (54%) vs. anovular (40%) cows, whereas PL from 33 to 61 d was greater (P<0.01) for anovular (16%) vs. cycling (8%) cows. Cows in Experiment 2 (n=485) were randomized to each of three treatments to receive 1) C (n=163), 2) G5 (n=158), or 3) 100 µg G 7 d after TAI (G7; n=164). For pregnant cows, number of CL 33 d post TAI was greater (P<0.01) for G5 (1.6±0.1) and G7 (1.7±0.1) than for C (1.2±0.1) cows. Treatment did not affect CR 33 d after TAI (51, 49, and 53%, respectively). Overall, 26% of cows were anovular, and CR at 33 d was greater (P<0.05) for cycling (55%) vs. anovular (43%) cows, whereas pregnancy loss from 33 to 61 d was greater (P<0.01) for anovular (13%) vs. cycling (8%) cows. When C (n=389) and G5 (n=386) cows from Experiments 1 and 2 were combined and analyzed, treatment did not affect CR 33 d after TAI (50 vs. 53%, respectively) or PL from 33 to 61 d. Although administration of GnRH or CIDR inserts early after first PP TAI did not affect CR or PL in lactating Holstein cows, cyclicity status before TAI affected fertility with cycling cows yielding higher CR and lower PL than anovular cows.

Key Words: CIDR, GnRH, Pregnancy Loss

76 The effect of a progesterone releasing intravaginal device (PRID) on estrus activity and pregnancy rate in non-cycling postpartum dairy cattle. R. B. Walsh*[1], S. J. Leblanc[1], T. F. Duffield[1], D. F. Kelton[1], P Gadbois[2], and K. E. Leslie[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Vetoquinol N.A Inc*, *Lavaltrie, Quebec, Canada*.

A randomized, double-blind clinical trial was conducted in four Ontario dairy herds to examine the effect of supplemental progesterone on cows with no detected estrus at the start of the breeding period. Estrus was monitored continuously by pedometry and was defined as a 90% increase in activity above a rolling 10-day average. Animals not bred at 63 ± 3.5 DIM received a PRID (silastic coil; 1.55g progesterone; n=214) or a placebo device (n=190) for 7 days and all animals received 500mg of cloprostenol IM at device removal. Animals inseminated during the treatment period were excluded. Device retention and vaginitis score were recorded. The outcomes were first service pregnancy risk (analyzed with logistic regression), and the intervals from insertion to insemination and from calving to pregnancy (survival analysis). The retention rate was 93% for both treatment and control devices. Estrus during treatment was 5.4 times more likely in control than in PRID animals (P = 0.001). PRID treatment did not influence first service pregnancy risk (27.8 vs. 28%), but tended to improve pregnancy risk at second service (36.4 vs. 28.9%; P = 0.18). Median time to first insemination was 13 days shorter in PRID-treated cows than controls (12 vs 25 days after device removal, respectively).

Cox's proportional hazard model was used to investigate the effect of treatment on pregnancy rate. PRID significantly increased the speed at which cows became pregnant (Hazard Ratio = 1.36; P = 0.0001). Accounting for parity, season, and herd clustering, median time to pregnancy was decreased by 19 days in PRID treated animals vs. control (135 vs. 154 days, respectively). In conclusion, among animals that had not displayed estrus before enrolment, PRID treatment shortened time to pregnancy beyond the improvement in time to first insemination.

Key Words: Progesterone, Intravaginal, Non-cycling

77 Effect of addition of a CIDR insert prior to a timed AI protocol on pregnancy rates and pregnancy losses in dairy cows. R. G. S. Bruno*, H. M. Rutigliano, R. L. A. Cerri, and J. E. P. Santos, *University of California*, *Tulare*.

Holsteins cows, 898 (575 multiparous and 323 primiparous), not observed in estrus after 2 injections of PGF2a for a pre-synchronization protocol at 37±3 and 51±3 d in milk (DIM) were blocked by parity and DIM and randomly assigned to one of the two treatments. A Control group in which no progesterone insert was used; and a CIDR group, in which a CIDR (1.38 g of progesterone) was inserted at 58±3 DIM and removed on day 65±3 DIM, when the Heatsynch (GnRH, 7 d PGF2a, 1 d estradiol cypionate, 2 d timed AI) protocol was initiated. Cows were inseminated if observed in estrus during the Heatsynch or timed inseminated at 75 DIM. Ovaries of 560 cows were examined by ultrasonography at 37±3 and 51±3 DIM for multiparous and at 51±3 and 58±3 DIM for primiparous cows to determine cyclicity. Presence of a corpus luteum in one of the two examinations indicated cyclicity. Pregnancy was diagnosed at 31, 38, and 66 d after AI. Data were analyzed by the LOGISTIC procedure of SAS (2001). Of the 560 cows evaluated by ultrasonography that were not observed in estrus after the PGF2a at 51±3 DIM, only 10.2% were anovular and the proportion was similar for Control and CIDR cows (P=0.87). Of the 443 CIDR cows, 15 (3.4%) lost their inserts. An interaction between treatment and parity was observed (P<0.05) and CIDR improved pregnancy rates in primiparous at 31 (52.7 vs 41.6%), 38 (49.3 vs 38.7), and 66 (46.0 vs 38.0%) d after AI, but not in multiparous cows, and pregnancy rates at d 66 after AI were 34.2 and 37.9% for multiparous CIDR and control cows, respectively. Cyclic had greater pregnancy rates (P<0.02) than anovular cows at 31 (43.5 vs 27.1%), 38 (39.5 vs 18.8%) and 66 (38.2 vs 18.8%) d after AI. Furthermore, anovulation increased (P=0.05) pregnancy loss from 31 to 66 d of gestation (25.0 vs 9.7%), but treatment with CIDR prior to the timed AI protocol did not affect embryonic and fetal survival. Treatment with a CIDR insert in cows that did not display estrus or were anovular after a pre-synchronization with PGF2a improved pregnancy rates of primiparous, but not multiparous cows.

Acknowledgements: NRICGP USDA and Pfizer Animal Health

Key Words: CIDR, Synchronization, Dairy Cows

78 Prevalence and risk factors for postpartum anestrus in dairy cattle. R. Walsh, J. Walton, K. Leslie, and S. LeBlanc*, *University of Guelph*, *Guelph, Ontario, Canada*.

We present preliminary results from an ongoing field study on the prevalence and explanatory variables for prolonged postpartum anestrus. Milk samples were

collected at 46 and 60 (± 7) DIM for progesterone (P4) analysis. Anestrus was defined as P4 < 1ng/ml in both de-fatted milk samples. Data were available from 550 cattle in 18 herds from February through October 2004, and were analyzed with contingency tables and logistic regression. Overall, the prevalence of anestrus was 24.4% (95% confidence interval = 20.8 to 27.9%). The estimated herd specific prevalence varied from 9% to 56%. The prevalence of anestrus was not different among parities (27%, 28%, and 23% in parity 1 (34.2% of animals), 2 (32.3%), and ≥ 3 (33.4%), respectively). Anestrus was 1.7 times more likely in animals calving in March through May than in animals calving in June through August. In a representative subset of 321 animals, milk β-hydroxybutyrate (BHBA) was measured once in each of the first two weeks after calving. Among these, 33% had subclinical ketosis (≥ 100 mmol/ml BHBA) in the first week (range among herds, 6 to 80%) and 28% (range, 8 to 52%) in week 2 of lactation. Cattle with ketosis in week one were 1.4 times more likely (P=0.06) than non-ketotic animals to be classified as anestrus, but ketosis in the second week of lactation was not associated with anestrus. Accounting for season, parity and ketosis in week 1, anestrus tended to be less likely in animals with first DHI test projected 305ME > 10,000 kg than in animals projected to produce < 10,000 kg (odds ratio =0.65, 95% CI 0.4 - 1.1, P = 0.13). Time to first insemination was not significantly different between cycling and non-cycling animals (mean ± SD, 73 ± 20 vs. 78 ± 23 DIM); approximately half the cows in the study received timed AI for first insemination. The probability of pregnancy at first service was 30% and 20% (P = .04) in cyclic and anestrus cattle, respectively. The prevalence of anestrus varies considerably among dairy herds and has a negative effect on the probability of pregnancy at first insemination.

Key Words: Reproduction, Estrus Cycle, Anestrus

79 Endometrial thickness affects ovulation rate and conception rate in lactating Holstein cows. A. H. Souza*, A. Gümen, E. P. B. Silva, A. P. Cunha, J. N. Guenther, D. Z. Caraviello, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

The objective of this study was to test the association of endometrial thickness (ET) with ovulation rate (OR) and conception rate (CR) in dairy cows. Holstein cows (n=726) underwent a modified Ovsynch protocol: GnRH on d 0, PGF2α on d 7, GnRH 58 h later, and timed AI (TAI) 16 h after the 2nd GnRH. Half of the cows received 1 mg of estradiol-17β (E2) at 8 h before the second GnRH injection. Endometrial thickness was measured with ultrasound at about one inch after the uterine bifurcation 48h after the PGF2α injection. Ovulation was confirmed by ultrasonography 7 d after TAI. Data were analyzed with the Generalized Linear Mixed Effects Models with dependent variables assumed to follow binomial distribution and cow treated as a random effect. Primiparous had smaller mean ET (9.5mm±1.9 vs. 10.1mm±2.0; P<0.05). Although parity did not alter OR (95%, primiparous n=267 vs. 94%, multiparous n=459; P>0.10), primiparous cows had greater CR (44% vs. 38%; P<0.01). Regardless of parity, cows with ET ≤ 7mm had lower (P<0.01) OR (74%, n=82) than cows with ET>7mm (98%, n=644). Similarly, CR were lower (15%, n=80 vs. 43%, n=644; P<0.01) for cows with ET ≤ 7mm compared to cows with greater ET, respectively. The logistic regression model indicated that CR increased as ET increased up to 10 mm and this effect was independent of E2 treatment. Uterine tone grade (scale 1-min to 5-max) was highly associated with mean ET within each class of uterine tone (r=0.94; P<0.01) and CR increased as uterine tone increased from 1 to 3, remaining constant when uterine tone was > 3. No interaction between BCS and ET was found (P>0.10). A single uterine ultrasound evaluation of ET in Holstein cows 48 h after PGF administration in a TAI program was a surprisingly good predictor of ovulation failures (ET ≤7 mm) and pregnancy success (ET >10 mm).

Key Words: Endometrial Thickness, Ovulation Rate, Conception Rate

Ruminant Nutrition: Dairy—Protein and Amino Acids

80 A review of the 2001 dairy cattle NRC protein and amino acid model - A European perspective. P. Huhtanen*, *MTT Agrifood Research*, *Finland*.

NRC 2001 protein and amino acid model was tested using data from eight production experiments with dairy cows conducted using change-over designs. The experiments included a total of 72 selected to represent a wide range in feed intake, milk production and strategies to manipulate metabolizable protein (MP) intake (e.g. forage to concentrate ratio, level and type of CP supplementation). Grass silage, rolled barley and rapeseed feeds were the most typical forage, energy and protein supplements; i.e. the test data consisted of diets not typically used in the USA. The other protein systems evaluated were INRA, AFRC (1992), German and two versions [Danish (DK) and Finnish (FIN)] of the Scandinavian AAT/PBV system. The supply of MP was estimated according to different systems. For the NRC 2001 system EAA supply was also computed. A mixed model regression analysis with a random study effect was used to investigate the relationship between estimated MP or AA supply and milk protein yield (MPY). Scandinavian systems predicted MPY more accurately compared with NRC 2001 (RSME for adjusted for random study effect 16.9, 18.6 and 28.0 g/d for the FIN, DK and NRC 2001). Prediction accuracy of the NRC 2001 model was markedly increased, when a bivariate model with MP from microbial CP and RUP were used as independent variables (RSME 21.8 g/d). The slope was much higher for microbial MP compared to MP derived from RUP suggesting that NRC 2001 overestimates the range in RUP supply. Digestible Lys and Met in MP were not significantly associated to MPY supporting the conclusions from infusion studies that these AA are not limiting in dairy cows fed grass silage-based diets. However, MPY increased significantly (P<0.001) with increased digestible His in MP confirming the findings from infusion studies that His is the first limiting AA with these diets. It is concluded that the NRC 2001 amino acid model is a significant step forward in achieving a more precise feeding for N. Methodological aspects in determination parameters used to estimate MP supply will be discussed.

Key Words: Protein Evaluation, Metabolizable Protein, Dairy Cow

81 Use of NRC (2001) to examine the relationships between predicted supplies of metabolizable protein (MP), MP-methionine (MP-Met), and MP-lysine (MP-Lys) and actual yields of milk and milk protein. R. Ordway*, N. Whitehouse, and C. Schwab, *University of New Hampshire*, *Durham*.

The NRC (2001) predicts passage of MP-amino acid (AA) flows to the small intestine, but does not predict responses to changes in supplies of individual AA. To determine if milk and milk protein yields can be predicted more accurately from predicted supplies of MP-Met and MP-Lys than MP, results from over 300 diets published in the Journal of Dairy Science were entered into the NRC (2001) model. Results from the Summary and Duodenal Amino Acid Supply Reports were used to generate plots of measured milk and milk protein yields vs. predicted supplies of MP, MP-Met, and MP-Lys. Plots derived from predicted supplies of MP were restricted to include diets in which NE-allowable milk was greater than MP-allowable milk and NE-allowable milk was within ±6 kg of measured milk yield to ensure that MP was more limiting than NE and that factors other than MP or NE were not limiting performance, respectively. To generate plots of measured yields of milk and milk protein vs. predicted supplies of MP-Met and MP-Lys, diets were restricted to those in which MP balance was within -250 and +100 g/d of zero. To generate plots from predicted MP-Met supplies, diets were restricted to those having a Lys/Met ratio in MP greater than 3.0/1. To generate plots from predicted MP-Lys flows, diets were restricted to those having a Lys/Met ratio in MP less than 3.25/1. The following regression equations describe the relationship between measured milk yields and MP, MP-Met and MP-Lys supplies, respectively: MP (n=146): $y=-0.000004x^2+0.034x-20.56$, $R^2=0.65$; MP-Met (n=98): $y=-0.0226x^2+2.7383x-40.796$, $R^2=0.76$; and MP-Lys (n=28): $y=-0.0013x^2+0.6174x-26.37$, $R^2=0.90$ and between milk protein yields and MP, MP-Met and MP-Lys, respectively: MP (n=146): $y=0.4524x-62.063$, $R^2=0.74$; MP-Met (n=98): $y=-0.3497x^2+55.631x-732.68$, $R^2=0.81$; MP-Lys (n=98): $y=-0.0195x^2+13.098x-457.31$, $R^2=0.92$. Results indicate that yields of milk and milk protein are more accurately predicted by supplies of the first limiting AA rather than by supplies of MP.

Key Words: Methionine, Lysine, Metabolizable Protein

82 Effect of lysine (Lys) supply on its utilization by the mammary gland (MG). H. Lapierre*[1], L. Doepel[2], E. Milne[3], and G. E. Lobley[3], [1]*Agriculture and Agri-Food Canada*, *Lennoxville, Quebec, Canada*, [2]*University of Alberta*, *Edmonton, Alberta, Canada*, [3]*Rowett Research Institute*, *Aberdeen, UK*.

The uptake to output ratio of Lys across the MG is usually greater than 1, allowing for synthesis of non-essential (NE) amino acids (AA) from Lys-N in the MG (Lapierre et al., 2003- EAAP No.109). Six lactating dairy cows were used to determine if the contribution of Lys-N to NEAA synthesis was affected by Lys supply. Cows received a basal diet (12.0%CP) in twelve equal meals per day plus an abomasal infusion of AA (560 g/d, casein profile) with or without Lys (50.3 g/d), in a cross-over design with 7-d periods. On d 7, all cows received a 7.5-h jugular infusion of [2-^{15}N]Lys (0.8 mmol/h), preceded by a priming dose (0.8 mmol). The cows were milked at 6 and 7 h using oxytocin injection, and arterial blood was sampled at 7h. The isotopic enrichment (IE: atom percent excess (ape)) of AA in the arterial free pool and in 7-h milk casein (after 18h hydrolysis in 6M HCl) was determined by GC-combustion isotope ratio MS. Protein yield (P = 0.02; 1.01 vs 1.13 ± 0.039 kg/d) but not milk yield (P = 0.33; 34.8 vs 36.6 ± 1.12 kg/d) increased with Lys infusion. More Lys-N was used across the MG for the synthesis of NEAA (Ala, Glu, and Ser) when Lys was not limiting (trt*site interaction). Transfer of Lys-N to the branched-chain AA across the MG also increased with Lys supply. Uptake of Lys by the MG in excess of needs for milk protein output is not obligate and mammary metabolism responds to changes in Lys supply.

IE (ape x 1000) of AA

Trt Site	Control Artery	Control Casein	Lysine Artery	Lysine Casein	SEM	Effect Trt	P Site	value Trt*site
His	6.3	3.6	7.8	3.0	0.70	0.55	0.001	0.18
Leu	1.8	2.4	4.8	8.4	0.40	0.001	0.001	0.005
Lys	948	574	611	431	38.7	0.001	0.001	0.04
Phe	3.2	6.8	5.3	6.7	1.53	0.52	0.10	0.44
Thr	3.0	4.7	3.0	4.8	0.87	0.91	0.07	0.93
Val	1.3	1.8	3.2	5.7	0.34	0.001	0.001	0.02
Ala	2.5	4.7	9.5	16.8	0.68	0.001	0.001	0.003
Glu	3.9	7.3	5.0	28.2	1.18	0.001	0.001	0.001
Gly	1.1	2.2	2.8	3.3	0.46	0.02	0.12	0.50
Pro	0.4	1.0	3.1	3.8	1.52	0.04	0.67	0.96
Ser	3.4	6.7	8.4	20.4	0.92	0.001	0.001	0.001
Tyr	2.9	3.7	6.6	3.4	1.34	0.35	0.37	0.12

Acknowledgements: Thanks to Ajinomoto for supplying the AA.

Key Words: Dairy Cow, Lysine, Mammary Gland

83 Ruminal outflow of soluble amino acid fractions in lactating dairy cows. S. M. Reynal*[1], I. R. Ipharraguerre[2], M. Lineiro[2], A. F. Brito[1], G. A. Broderick[3], and J. H. Clark[2], [1]*University of Wisconsin*, *Madison*, [2]*University of Illinois*, *Urbana*, [3]*US Dairy Forage Research Center*, *Madison, WI*.

Three multiparous Holstein cows cannulated in the rumen and duodenum and averaging 154 DIM were used in an unbalanced 4x4 Latin square with 14-d periods to study the effects of CP source on ruminal outflow of amino acids (AA) as solutes. On DM basis, diets contained 35% corn silage, 25% alfalfa silage, 34.8 to 28.6% corn grain, and either 2.3% urea (NPN), 5.2% solvent extracted soybean meal (SSBM), 4.6% lignosulfonate-treated soybean meal (LSBM), or 8.5% corn gluten meal (CGM). DM intake averaged 19.7 kg/d overall and was 4.5 kg/d higher for cows fed LSBM than for cows fed CGM. Soluble AA (SAA) in omasal digesta were fractionated based on molecular weight by ultrafiltration into proteins (> 10 kDa), oligopeptides (3 to 10 kDa), peptides (< 3 kDa), and free AA. In each fraction, proportions of SAA of microbial and dietary origin were estimated using ^{15}N. Ruminal outflow of total SAA was not altered by treatments (P > 0.05) and ranged from 254 (NPN) to 377 g/d (CGM) and accounted for 9.2 (LSBM) to 15.9% (CGM) of total AA outflow. Averaged across diets, omasal flow of SAA in proteins, oligopeptides, peptides, and free AA were, respectively, 29.2, 216.7, 50.4, and 4.9 g/d and accounted for 10.3, 70.6, 17.5, and 1.6% of total SAA outflow. On average, SAA of feed origin contributed 27, 75, 93, and 93% of total SAA that passed to the omasum in proteins, oligopeptides, peptides, and free AA, respectively. Ruminal outflow of Met, Val, and total AA in soluble peptides was higher for SSBM than for LSBM (1.2 vs. 0.2; 4.9 vs. 3.4; and 59.6 vs. 45.5 g/d, respectively), whereas that of AA in soluble peptides was higher for CGM than for LSBM (49.1 vs. 45.5 g/d). Results indicate that 1) a substantial proportion of AA of feed origin escapes ruminal degradation as solutes, mainly in oligopeptides, and 2) ruminal concentrations and outflows of small peptides might be overestimated when measured in acid-deproteinized digesta.

Key Words: Omasal Flow, Soluble AA Fractions, Dairy Cows

84 Supplementing rumen-protected methionine to reduce dietary crude protein in dairy cows. G. A. Broderick*[1], M. J. Stevenson[2], R. A. Patton[3], N. E. Lobos[4], and J. J. Olmos Colmenero[4], [1]*U.S. Dairy Forage Research Center*, *Madison, WI*, [2]*Degussa Corp.*, *Kennesaw, GA*, [3]*Nittany Dairy Nutrition, Inc.*, *Mifflinburg, PA*, [4]*University of Wisconsin*, *Madison*.

Over-feeding of crude protein (CP) adds expense and can cause environmental pollution from excess N excretion. Met has been reported to be the amino acid limiting milk and protein yield in dairy cows. Supplementing rumen-protected Met (RPM) may allow feeding less CP without loss of production but with reduced urinary N excretion. A lactation trial was conducted in which dietary CP was reduced in steps of 1.3 percentage units by replacing soybean meal with high moisture shelled corn; RPM (as Mepron®) was increased with each reduction in CP. Twenty-four multiparous Holstein cows averaging 598 kg BW were blocked by DIM into 6 groups and randomly assigned to 4x4 Latin square sequences and fed TMR containing (DM basis): 18.6% CP, 0% Mepron; 17.3% CP, 0.035% Mepron; 16.1% CP, 0.07% Mepron; 14.8% CP, 0.105% Mepron. All diets contained (DM basis) 21% alfalfa silage, 28% corn silage, 4.5% roasted soybeans, 5.8% soyhulls, 0.6% sodium bicarbonate, 0.5% vitamins and minerals, and 27% NDF. Periods were 4-wk long; production data were summarized from the last 2-wk. The statistical model included square, period, cow(square), diet, and diet*period. Probability was set at 0.10; least square means are reported. There were no effects of diet on intake and gain and on yield of protein, lactose and SNF. However, there were significant effects (P ≤ 0.08) on milk/DM intake and on yield of milk, 3.5% FCM and fat. Production was greater at 17.3% CP plus 8.2 g/d of RPM and 16.1% CP plus 16.6 g/d of RPM, than on the other 2 diets. Apparent N efficiency (milk N/N-intake) was greatest (P < 0.01) on the lowest CP diet containing the most RPM. Typical large reductions (P < 0.01) in MUN were observed with reduced dietary CP. Under the conditions of this trial, feeding lower CP diets supplemented with RPM as Mepron resulted in improved N-efficiency.

Item	CP, % RPM, g/d	18.6 0	17.3 8.2	16.1 16.6	14.8 25.0	SE	P > F
DMI, kg/d		23.4	23.4	23.8	23.7	0.5	0.88
Milk, kg/d		39.7^{ab}	41.6^{a}	41.7^{a}	39.7^{b}	0.7	0.06
Milk/DMI		1.72^{ab}	1.80^{a}	1.77^{ab}	1.69^{b}	0.03	0.06
3.5% FCM, kg/d		38.9^{b}	42.0^{a}	41.2^{ab}	38.6^{b}	1.0	0.04
Fat, kg/d		1.37^{ab}	1.49^{a}	1.43^{ab}	1.32^{b}	0.05	0.08
Protein, kg/d		1.15	1.23	1.23	1.20	0.03	0.19
MUN, mg/dl		14.5^{a}	11.8^{b}	9.4^{c}	7.9^{d}	0.3	< 0.01
Milk N/N-intake		0.26^{c}	0.30^{b}	0.32^{b}	0.34^{a}	0.01	< 0.01

^{a,b,c,d}Means in rows with different superscripts differ (P < 0.05)

Key Words: Mepron, Rumen-Protected Methionine, Milk Yield

85 Determination of ruminal escape and metabolizable methionine values of 2-hydroxy-4 (methylthio) butanoic acid (HMB) as a function of dose and mode of supply. J. C. Robert*, C. Richard, and B. Graulet, *Adisseo France SAS, Antony, France*.

The aim of this trial was to explain discrepancies between experimental results about the value of metabolizable Met (or bioavailable Met) of HMB for cows. Three non-lactating rumen-cannulated Holstein cows were randomly assigned in a factorial design based on 3 doses of HMB (25, 50 and 100 g Met equivalent as Rhodimet™ AT88, Adisseo) and 2 modes of rumen supply (spot-dose at T0 or 12-h infusion). Rumen HMB by-pass measurements were achieved using Cr-EDTA as a marker to estimate the rumen liquid out-flow. For this purpose, HMB and Cr were dosed in samples of rumen juice collected at T0 and 1, 3, 6, 10, 14 and 24h. At the same time, metabolizable Met supply to cows from HMB was determined using a blood kinetics test based on area under the curve (AUC) calculations from plasma Met concentrations, as previously described (Robert et al, 2001). HMB rumen by-pass and corresponding blood plasma Met bioavailability were significantly higher with spot doses vs staggered doses and also increased with HMB doses whatever the mode of supply. However, between 50 and 100 g Met equivalent, bioavailability remained constant suggesting a steady-state. In practical conditions (25 g of HMB supply per day per cow), the metabolizable Met supply as HMB would be insufficient to meet the requirements of a high producing dairy cow fed a Met-deficient ration.

Mode of rumen supply	Infusion			Spot			P value	
Dose(g Met eq.)	25	50	100	25	50	100	dose	mode
HMB outflow (g)	0.73±0.19c	3.43±0.61c	10.83±1.90b	2.84±0.39c	7.90±1.07b	18.52±2.15a	0.001	0.001
HMB by-pass (%)	2.56±0.65d	6.04±1.06cd	9.53±1.67bc	10.0±1.36bc	13.90±1.88ab	16.30±1.89a	0.001	0.001
AUC (plasma Met)	1.2±0.3b	5.1±4.3b	11.3±1.5b	2.4±0.6b	9.1±4.8b	31.4±11.0a	0.001	0.019
metab. Met (g)	1.6±0.4c	6.3±5.3bc	12.6±0.5b	3.3±0.8bc	10.6±4.0bc	23.5±4.9a	0.001	0.008
Met bio availability (%)	6.4 ±1.5c	12.7±10.6bc	12.6±0.5b	13.2±3.4bc	21.2±8.0bc	23.5±4.9a	0.048	0.005

Key Words: Ruminant, Methionine Analog, Metabolism

86 Effects of soy gum application to soybean meal on protein degradation by ruminal microbes and intestinal protein digestion. M. D. Stern*[1], T. K. Miller-Webster[2], W. H. Hoover[2], M. Ruiz Moreno[1], and C. A. Macgregor[3], [1]*University of Minnesota, St. Paul*, [2]*Rumen Fermentation Profiling Laboratory, West Virginia University, Morgantown, WV*, [3]*Grain States Soya, Inc., West Point, NE*.

In a preliminary in situ study, mechanical-extracted (ME) soybean meal (SBM) #1 with fresh soy gums (MEC1G) was incubated for 16 h in the rumen of a cow that was 50 days in milk (DIM) and producing 36 kg milk. Rumen undegraded protein (RUP) was 73.3%. In a second in situ study, ME SBM #1 (MEC1) and MEC1G were incubated for 16 h in the rumen of a cow that was 200 DIM and producing 27.2 kg of milk. RUP was 58.0% for MEC1 and 62.1% for MEC1G, indicating that application of fresh soy gums to ME SBM increased RUP. Two subsequent experiments were conducted. In Experiment 1, eight diets containing 17% CP were examined in continuous culture fermenters to determine RUP. In each diet, 28% of the CP was provided by one of the following products: solvent-extracted (SE) SBM (SOL), ME SBM #1 (MEC1), ME SBM #1 with fresh soy gums (MEC1G), ME SBM #2 (MEC2), ME SBM #3 (MEC3), ME SBM extruded (MECE), SE SBM heat treated (SOLH), SE SBM nonenzymatically browned (SOLNEB). RUP was 30.9, 33.0, 37.6, 32.1, 30.1, 34.3, 32.0 and 31.5% for SOL, MEC1, MEC1G, MEC2, MEC3, MECE, SOLH and SOLNEB diets, respectively. Diet MEC1G had the numerically highest RUP and was different ($P < 0.10$) compared with the SOL, MEC2, MEC3, SOLH and SOLNEB diets. Results indicate that application of fresh soy gums onto ME SBM can increase RUP. In Experiment 2, a 3-step in situ/in vitro procedure was used to estimate intestinal CP digestion (ID) for seven SBM products. ID was 67.5, 83.8, 78.9, 75.7, 76.5, 65.4 and 57.7% for SOL, MEC1G, MEC2, MEC3, MECE, SOLH and SOLNEB, respectively. Intestinally absorbable dietary protein (IADP), calculated as RUP x ID was 15.7, 41.3, 33.2, 25.2, 29.3, 34.2 and 39.4% for SOL, MEC1G, MEC2, MEC3, MECE, SOLH and SOLNEB, respectively. ID ranged from 57.7 (SOLNEB) to 83.8% (MEC1G) indicating that processing can overprotect protein from digestion in the intestine.

Key Words: Soybean Meal, Protein, Gums

87 Effect of abomasal pectin infusion on digestion and nitrogen balance in dairy cows. T. F. Gressley* and L. E. Armentano, *University of Wisconsin, Madison*.

Dietary manipulation to shift nitrogen (N) excretion from urine to feces may reduce N volatilization from manure and improve air quality. In a previous study, abomasal infusion of 1 kg/d pectin tended to decrease urinary N by 25 g/d. We suggested that postruminal pectin fermentation stimulated bacterial growth in the large intestine and shifted some N excretion from urine to feces. However, voluntary DMI was reduced with pectin infusion and there was an apparent failure in the markers used to precisely predict urinary and fecal outputs, making data interpretation difficult. The present experiment was conducted to correct these problems. Six mulitparous lactating cows were assigned to a double reversal design with 4 21-d periods. All cows were fed the same basal diet (30.2% NDF) at 90% of ad-libitum intake. Cows received 30 L/d saline infused into the abomasum via a rumen fistula. Treatments were: 0 Pectin=saline only; 1 Pectin=saline plus 1.0 kg/d pectin. For the final 3 days of each period, total collection of urine and feces was conducted. Apparent total tract digestibility of OM including infused pectin was unaffected by treatment, however starch digestibility was reduced with 1 Pectin. Urinary N output decreased 27 g/d and fecal N increased 22 g/d with 1 Pectin. Fecal purine output increased 3 g/d with 1 Pectin, suggesting that approximately 60% of the increase in fecal N output was due to increased fecal bacteria output. Abomasal pectin tended to decrease rumen ammonia concentration and urinary purine derivative excretion, demonstrating that postruminal fermentation may reduce rumen ammonia available for microbial growth.

	0 Pectin	1 Pectin	SED	P value
Milk, kg/d	29.4	28.9	0.8	0.56
Basal DM eaten, kg/d	22.2	22.2	0.1	0.45
Total DM input, kg/d	22.2	23.1	0.1	0.001
OM digestibility including pectin, %	66.3	66.0	0.5	0.49
Starch digestibility, %	86.3	84.1	0.5	0.001
MUN, mg/dl	11.9	11.2	0.56	0.29
Urine N, g/d	230	203	8	0.002
Fecal N, g/d	209	231	5	0.001
Fecal purines, g/d	15.4	18.5	0.4	0.001
Rumen ammonia, mM	6.9	6.0	0.4	0.06
Urine allantoin + uric acid, mmol/d	532	510	11	0.09

Key Words: Nitrogen, Pectin, Urine

88 Comparison among microbial markers for quantifying microbial protein flow from the rumen of lactating dairy cows. S. M. Reynal*[1], G. A. Broderick[2], and C. Bearzi[3], [1]*University of Wisconsin, Madison*, [2]*US Dairy Forage Research Center, Madison, WI*, [3]*Universidad de Buenos Aires, Buenos Aires, Argentina*.

Eight ruminally cannulated lactating cows were assigned to 4 x 4 Latin squares and fed diets with different levels of rumen-degraded protein (RDP) to compare ^{15}N, total purines (TP), and AA profiles as microbial markers for quantifying the flow of microbial protein at the omasal canal. Dietary RDP was gradually decreased from 13.2 to 10.6% of DM by replacing solvent soybean meal (SSBM) and urea with lignosulfonate-treated soybean meal (LSBM). Dietary RDP had significant effects on the chemical composition of isolated bacteria and protozoa. The guanine to adenine ratio of the fluid phase of omasal digesta was 4.6

times greater than that of fluid-associated bacteria, suggesting different degradation rates between purines. When estimated using TP, flows of microbial NAN did not change and flows of non-microbial NAN (NMNAN) decreased linearly (from 273 to 219 g/d; $P < 0.01$) when SSBM and urea were replaced in the diet with the less degradable LSBM. These results were in contradiction with published results and predicted responses to changes in the ruminal degradability of the protein source fed. However, as RDP decreased, microbial NAN flow decreased linearly ($P < 0.01$) when measured using ^{15}N (from 470 to 384 g/d), and AA profiles (from 392 to 311 g/d), while NMNAN flow (expressed as % of total NAN flow) increased linearly ($P < 0.01$) when estimated based on ^{15}N (from 30.4 to 37.8%) and AA profiles (from 44.5 to 52.0%). The regression ($P < 0.01$) of TP on ^{15}N for microbial NAN flow had a slope of 0.57 ($P < 0.01$) and an intercept of 195 ($P < 0.01$). Averaged across diets, microbial NAN flows estimated using ^{15}N, TP, and AA profiles were 429, 401, and 360 g/d, respectively, and were lowest for AA profiles and highest for ^{15}N and TP ($P < 0.01$). Microbial and dietary NAN flows from the rumen estimated using ^{15}N appeared to be more accurate and precise than flows estimated with the other markers.

Key Words: Microbial Markers, Omasum, Dairy Cows

89 Effects of daily variation in dietary protein concentration on milk production in mid-lactation cows. N. R. St-Pierre* and D. Gerstner, *The Ohio State University*, *Columbus*.

Thirty lactating Holstein cows (18 primiparous, 12 multiparous) with an average body weight of 633 kg and averaging initially 38.2 kg of milk per day at 186 days in milk, were used in an incomplete, balanced cross-over design to assess the effects of fluctuating daily dietary crude protein (CP) on milk production and composition. Three dietary treatments consisting of three levels of daily variation in dietary CP were studied. Each cow was randomly assigned to a series of two dietary treatments that were administered in two consecutive periods of 21 days each. Treatment diets were based on 52% roughage on a DM basis (42% corn silage, 10% alfalfa hay), 8% cottonseed and 40% concentrate. All treatments averaged 15.5% CP but differed in level of day to day variation. Treatment 1 (small variance) consisted of a diet constant in theoretical CP content (15.5%). Treatment 3 (large variance) alternated on a daily basis the feeding of a 19.5% and 11.5% CP diet. Treatment 2 (medium variance) alternated between a 17.5% and a 13.5% CP diet. Two concentrates were used to prepare all 5 diets. Changes in CP were achieved through the substitution of corn for soybean meal in the concentrates. Treatments had no effect on milk yield (34.9, 34.9, 34.4 ± 0.90 kg/d), milk true protein content (2.97, 3.00, 3.00 ± 0.038 %), fat content (3.39, 3.30, 3.25 ± 0.136 %), lactose content (4.87, 4.86, 4.86 ± 0.046%), protein yields (1040, 1050, 1033 ± 30.5 g/d), fat yield (1171, 1146, 1123 ± 54.4 g/d), lactose yield (1708, 1699, 1674 ± 49.1 g/d), and milk urea N concentration (9.33, 9.14, 9.42 ± 0.36 mg/dL), for the small, medium and large variance treatments, respectively. Variation in daily dietary CP content does not affect milk production in mid lactation if the cycle of variation is over a period of two days.

Key Words: Dietary Variation, Milk Response, Crude Protein

90 Relationship between milk urea nitrogen (MUN) and days open in early lactation dairy cows. M. Nowrozi*, M. Raisianzadeh, and M. Abazari, *Agriculture and Natural Resources Research Center of Khorasan, IRAN*, *Mashhad, Khorasan, IRAN*.

Our objective was to evaluate the relationship between MUN and days open in Holstein dairy cows. Ten dairy farms in the countryside of Mashad, Iran were randomly selected, milk samples of postpartum cows (from calf birth to 3 months after parturition) were collected at monthly intervals, and reproduction data were compiled for three years. MUN content of 12,000 samples were measured by enzymatic method. The cows were categorized into four quartiles based on the MUN levels in these data: less than 12, between 12 and 16, between 16 and 18, and greater than 18 mg/dl. Data were analyzed by survival analysis and Cox model. The results show that the effect of mean milk yields in peak, herd, fat percentage, and season on model was not significant, but MUN had a significant effect on days open ($P < 0.0001$). The least days open were observed in cows with 16-18 mg/dl MUN and out of this range, days open were increased, significantly (134 vs. 148.6 and 150.29 d).

Acknowledgements: The authors would like to thank the Agriculture and Natural Resources Research Center of Khorasan IRAN for the technical support.

Key Words: Dairy Cows, MUN, Days Open

Swine Species: Effects of Maternal Nutrition on Offspring Performance

91 Consequences of birth weight for postnatal growth performance. C. Rehfeldt*, *Research Institute for the Biology of Farm Animals*, *Dummerstorf, Germany*.

In multiparous species such as the pig there is an intra-litter variation in birth weight and skeletal muscle fibre number. It is commonly recognized that low birth weight in piglets correlates with decreased survival and lower postnatal growth rates. So-called runts are usually excluded from rearing. In the majority of low birth weight piglets low numbers of muscle fibres differentiate during prenatal myogenesis, for genetic or maternal reasons, and only those low birth weight piglets with normal fibre numbers are able to exhibit postnatal catch-up growth. Pigs of low birth weight show the lowest growth performance and the lowest lean percentage at slaughter. In addition, they tend to develop extremely large muscle fibres (giant fibres) and poor meat quality, which, in part, results from the inverse correlation between fibre number and fibre size. Prenatal growth/myogenesis is under the control of various genetic and environmental factors, which can be targeted for growth manipulation. Prenatal development is mainly dependent on a close interrelation between nutritional supply/utilization and regulation by hormones and growth factors. In particular, the maternal somatotropic axis plays a significant role in the control of myogenesis. Thus, treatment of sows with growth hormone (GH) until mid gestation was able to increase birth weight and the number of muscle fibres in the progeny, which was most pronounced in small littermates disadvantaged by insufficient nutrient supply. GH treatment was associated with increased nutrient availability to the embryos and changes in regulatory proteins of the GH- IGF axis. Interactions between maternal nutrition and the somatotropic axis in determining prenatal growth and myogenesis are worthy of further investigation.

Key Words: Pig, Growth hormone, Muscle fiber

92 Improving lowly heritable traits in dairy cattle by crossbreeding. T. Steine* and A. G. Larsgard, *Geno Breeding and A.I. Association*, *Hamar, N-2326, Norway*.

Crossbreeding is not the common breeding practice in dairy cattle. Most improvement programs are based on selection within pure breeds. There are some logical reasons for this. The dairy cow has a very low reproduction rate, and most of the female calves are needed for replacement. Therefore all dairy cows are potential dams of the next generation which makes it impossible to run crossbreeding systems in the same way as in swine and poultry.

There are three possible ways of utilizing crossbreeding in dairy cattle: Crossing through, rotational crossing or making a synthetic breed. Today most of the crossbreeding carried out in dairy cattle seem to focus only on the degree of heterosis for low heritable traits. In this presentation the effect on improving these traits by both heterosis and improved additive genetic merit is discussed, including a continous genetic improvement of the traits. If heterosis alone causes the superiority of the crosses, there will always be a drop if the F1s are crossed back to one of the start breeds. The results in this presentation are based on a program where the performance of the herd is estimated. This is without doubt the main interest of a farmer. We have simulated rotational crossing with two or three breeds to predict the composition of the herd or the population at any given time in a period of twenty years from the start. By using different levels of heterosis and additive genetic merit it is possible to follow the development of the herd for many traits during the whole period with different breeds involved. The results show that if additive genetic merit is playing a role and it is possible to find breeds with higher genetic merit for the low heritable traits than the breed to improve, heterosis is no longer of so vital importance alone. In most cases it seems that rotational crossing with two breeds is better than or at least equally good as using three breeds. This will be even more pronounced if it is possible to select sires for the desirable traits in the breed being used.

Key Words: Dairy Cattle, Crossbreeding, Heterosis

93 Comparison of the production, liveweight, feed intake, health and reproductive performance of Holstein and Jersey Holstein crossbred cows in Australian pasture-based herds. M. Pyman*[1], M. Auldist[2], C. Grainger[2], and K. Macmillan[1], [1]*University of Melbourne*, *Werribee, Victoria, Australia*, [2]*University of Melbourne*, *Ellinbank, Victoria, Australia*.

Introduction of Holstein genetics into Australia has resulted in significant milk yield gains and a higher proportion of Holstein cattle (83%) at the expense of the Jersey (12%) and the Jersey x Holstein (JxH) crossbred (5%) based on 2003 figures. This is in direct contrast to New Zealand, where the national herd in 2002 comprised 48% Holsteins, 16% Jerseys and 35% JxH crossbreds.

There is little information on how crossbreds perform under Australian conditions although the New Zealand literature shows substantial and highly profitable benefits attributable to crossbreeding.

In this study an extensive assessment of crossbreeding was undertaken to provide direction on the profitability of crossbreeding under Australian seasonal calving conditions.

Assessment of the Australian Herd Improvement database showed the geometric mean somatic cell count for Holstein cows to be consistently higher compared to crossbreds throughout the lactation. In addition, the backcross Holstein x (Jersey x Holstein) cow outsurvives other breed types by at least 8%, nearly a full lactation beyond the fifth lactation, indirectly indicating superior reproductive performance, health and sustainability.

Data was also collected from 1300 straight and crossbred cows during a single lactation in 2003/2004. Reproductive parameters, milk yield and the liveweight of 400 cows were measured to compare breed differences under pasture-based seasonal calving conditions. Preliminary results indicate that the 39kg heavier Holsteins produced 2.1kg/cow/day more milk despite yields of fat and protein generally being not significantly different between the breeds. Furthermore, the reproductive performance of the crossbreds was superior, as measured by 6-week in-calf rate, the percentage of cows pregnant 6 weeks after mating start date (absolute difference of 15%, $p < 0.05$).

Acknowledgements: The study gratefully acknowledges the support of the Gardiner Foundation, the National Herd Improvement Association, GippsDairy and the University of Melbourne.

Key Words: Crossbreeding, Fertility, Sustainability

94 Birth weights, mortality, and dystocia in Holsteins, Jerseys, and their reciprocal crosses in the Virginia Tech and Kentucky crossbreeding project. B. Cassell*[1], A. McAllister[2], R. Nebel[1], S. Franklin[2], K. Getzewich[1], J. Ware[2], J. Cornwell[1], and R. Pearson[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*University of Kentucky*, *Lexington*.

Calves from crosses of Holstein and Jersey breeds were first born beginning June, 2003 at Virginia Tech and the University of Kentucky. Four Holstein and four Jersey bulls have been used as foundation sires at both facilities with matings to purebred dams to control inbreeding in offspring. Heterospermic inseminates of one Holstein and one Jersey bull initiated the project and provided data for a fertility trial. Data through early 2005 include 197 births at Virginia Tech and 99 births at the University of Kentucky. Dystocia scores (1-5) and birth weights were recorded at birth, and mortality was recorded (alive 0 or dead 1) at 48 hours. Dystocia scores of 1-5 were assigned to 79, 5, 11, 5, and 0.3% of births and death by 48 hours occurred in 10.5% of births. Birth weights averaged 36.0 kg (SD 15.4 kg). A fixed model analysis of the three traits considered effects of station, breed group (HH, HJ, JH, and JJ with breed of sire listed first), parity number 1-8 of the dam (67% lactation 1 and 2), sex, and twin status (7.4% twins) of the birth. For birth weights, all effects except station were significant ($P<0.05$), with least squares means of 38.5, 29.4, 31.3, and 22.5 kg for HH, JH, JH, and JJ breed groups. Birth weights were larger for single births to male calves from multi-lactation dams. Dystocia results from the linear model showed significant ($P<0.05$) effects for all terms including station with higher dystocia scores for male HH calves, born in twin births to first lactation dams at Kentucky. Mortality differences from the linear model were significant (higher) only for twin births. Logistic regression analysis of dystocia with scores 3-5 recoded as problem births revealed higher odds ratios for problem births in HH, HJ, and JH (in descending order) versus JJ calves. Heifers and single births faced significantly lower odds of difficult birth. Only twin status significantly affected mortality in logistics regression, with single births only 4.7% as likely to die in 48 hours as twins.

Key Words: Crossbreeding, Dystocia, Mortality

95 Crossbreds of Normande-Holstein, Montbeliarde-Holstein, and Scandinavian Red-Holstein compared to pure Holsteins for production during the first 150 days of first lactation. B. J. Heins, L. B. Hansen*, and A. J. Seykora, *University of Minnesota*, *St. Paul*.

Normande-Holstein crossbreds (n = 231), Montbeliarde-Holstein crossbreds (n = 468), and Scandinavian Red-Holstein crossbreds (n = 305) were compared to pure Holsteins (n = 419) for milk, fat, and protein production during the first 150 days of first lactation. Cows were housed in seven commercial dairies in California and calved from June 2002 to December 2004. Dependent variables for analysis were test-day observations from DHI. All Holstein sires and all Holstein maternal grandsires were required to have an NAAB sire code to assure they were A.I. sires. Normande, Montbeliarde, and Scandinavian Red crossbreds were all daughters of A.I. sires via imported semen. Independent variables were breed (H, NxH, MxH, SxH), random effect of sire within breed, random effect of cow within sire and breed, stage of lactation (4-30 d, 31-60 d,

61-90 d, 91-120 d, 121-150 d), herd-year-season (3-mo seasons within the seven herds), age at calving (linear, months), and PTA of Holstein maternal grandsire (linear). Cows that had test day observations that were 3x-milking were pre-adjusted to 2x-milking using USDA-AIPL adjustment factors. Least squares means for fat plus protein were 1.97 kg (H), 1.83 kg (NxH), 1.94 kg (MxH), and 2.01 kg (SxH). Normande-Holstein crossbreds had significantly (P<.01) lower production (-7%) than pure Holsteins. Montbeliarde-Holstein (-1%) and Scandinavian Red-Holstein (+2%) crossbreds were not significantly different than pure Holsteins for production.

Key Words: Crossbreeding, Production, Hybrid Vigor

96 Crossbreds of Normande-Holstein, Montbeliarde-Holstein, and Scandinavian Red-Holstein compared to pure Holsteins for dystocia and stillbirths. B. J. Heins*, L. B. Hansen, and A. J. Seykora, *University of Minnesota*, *St. Paul*.

Holstein, Normande-Holstein, Montbeliarde-Holstein and Scandinavian Red-Holstein crossbred cows calving from June 2001 to August 2004 were compared for dystocia and stillbirths from seven California dairies. Dystocia scores were 1, 2, 3 (no calving difficulty) and 4, 5 (calving difficulty), and stillbirths scores were 1 (alive) and 0 (dead). Effects of calf sex, age at calving and herd-year-season were included in the general linear model. For the effect of breed of sire, 1769 first-parity Holsteins were bred to Holstein (n=31), Montbeliarde (n=22), Brown Swiss (n=13), and Scandinavian Red (n=17) sires. Calf sex and herd-year-season were included in the model and had significant effect (P<.01). Dystocia rates were 16% (H), 12% (M), 11.9% (BS) and 5.5% (SR). Stillbirth rates were 15.7% (H), 13.2% (M), 12.0% (BS), and 7.9% (SR). Scandinavian Red sires had significantly (P<.01) less dystocia and fewer stillbirths than Holstein sires. For 2nd to 5th parity Holstein dams, cows were bred to Normande sires in addition to the other breeds. Dystocia rates were 7.7% (H), 9.1% (N), 5.7% (M), 5.4% (BS) and 2.6% (SR). Stillbirth rates were 11.8% (H), 6.5% (N), 4.4% (M), 4.9% (BS), and 4.2% (SR). Scandinavian Red sires had significantly (P<.01) less dystocia than Holstein, Montbeliarde, and Normande sires. All breeds of sire other than Holstein had significantly (P<.01) fewer stillbirths than Holstein sires. For the effect of breed of dam, 1398 first-parity Holsteins, 269 Normande-Holstein, 370 Montbeliarde-Holstein, and 264 Scandinavian-Holstein cows were bred to Brown Swiss (n=15), Montbeliarde (n=26), and Scandinavian Red (n=17) sires. Mean dystocia rates for breed of dam were 9.3% (H), 9.2% (MxH), 8.1% (MxH) and 4.7% (SxH). For stillbirth rate, least squares means were 11.8% (H), 7.8% (NxH), 7.1% (MxH) and 4.9% (SxH). Scandinavian Red-Holstein crossbred cows had significantly (P<.10) less calving difficulty and significantly (P<.05) fewer stillbirths than pure Holsteins at first calving.

Key Words: Crossbreeding, Dystocia, Stillbirths

97 Crossbreds of Normande-Holstein, Montbeliarde-Holstein, and Scandinavian Red-Holstein compared to pure Holsteins for days to first breeding, first service conception rate, days open, and survival. B. J. Heins*, L. B. Hansen, and A. J. Seykora, *University of Minnesota*, *St. Paul*.

First-lactation Normande-Holstein, Montbeliarde-Holstein, and Scandinavian Red-Holstein crossbred cows were compared to pure Holsteins for days to first breeding, first service conception rate, days open, and survival. Cows were in seven commercial dairies in California and calved from June 2002 to October 2004. Holstein cows were required to have sires with a NAAB code to assure they were sired by A.I. sires. Normande, Montbeliarde and Scandinavian Red crossbreds were all daughters of A.I. sires via imported semen. For days open, cows having greater than 250 days open were truncated to 250 days and cows were required to be at least 250 days in milk. Adjustment was made for herd-year-season. PROC GLM of SAS was used to analyze phenotypic differences. Least squares means for days to first breeding were 69(H), 62(NxH), 65(MxH), and 66(SxH). First service conceptions rates were 22%(H), 35%(NxH), 31%(MxH), and 30%(SxH). Least squares means for days open were 150(H), 123(NxH), 131(MxH), and 129(SxH). Normande-Holstein, Montbeliarde-Holstein and Scandinavian Red-Holstein crossbreds cows had fewer days to first breeding (P<.01), higher first service conception rates (P<.01), and fewer days open (P<.01) than pure Holsteins. Three measures of survival were used; survival to 30 days, 150 days, and 305 days postpartum. For survival to 30-d postpartum, 692 Holsteins were compared to 465 Normande-Holstein, 655 Montbeliarde-Holstein, and 434 Scandinvaian-Holstein crossbred cows. Least squares means for survival to 30 days were 95%(H), 98%(NxH), 98%(MxH), and 98%(SxH); for survival to 150 days were 91%(H), 96%(NxH), 96%(MxH), and 96%(SxH); and for survival to 305 days were 86%(H), 93%(NxH), 92%(MxH), and 93%(SxH). All crossbred breed groups survived significantly longer (P<.05) than pure Holsteins during first lactation.

Key Words: Crossbreeding, Survival, Days Open

Ruminant Nutrition: Dairy—Grazing

98 Genotype and feed effects on BW and BCS profiles for grazing dairy cows. J. R. Roche*[1], D. P. Berry[2], and E. S. Kolver[1], [1]*Dexcel*, *Hamilton, New Zealand*, [2]*Teagasc Moorepark*, *Ireland*.

To determine the effect of genotype and concentrate supplementation on BW and BCS (scale 1-10) lactation profiles, fortnightly data across 113 lactations from 2002 to 2004 were analyzed. New Zealand (NZ) and North American (NA) cows of equal estimated genetic merit for milk production were randomly allocated to three levels of concentrate supplementation (0, 3 or 6 kg DM/cow/d) on a basal pasture diet. The Wilmink exponential model ($Y_{DIM}= a+b*e^{(-0.05*DIM)}+c*DIM$) was fitted within lactation. Days to nadir were calculated by setting the first derivative of the function to zero, defining nadir as the corresponding value for that day. The function explained 73 and 62% of the variation in BW and BCS, respectively. There was a tendency (P<0.1) for NZ cows to reach BW (9d) and BCS (12d) nadir earlier. Concentrate supplementation tended (P<0.1) to shorten postpartum interval to nadir BW. New Zealand cows had a lower BW(P<0.001) but were in greater (P<0.001) BCS at nadir. Nadir BCS increased (P<0.01) with each increment of supplementation. New Zealand cows lost less BW (P<0.001) and BCS (P<0.1) between calving and nadir. Supplementation with concentrates reduced (P<0.1) the amount of BCS lost postpartum, but did not affect BW change. The *a* parameter (height of the curve) for BW and BCS was lower and higher, respectively, for NZ cows compared with NA cows (P<0.05). Feeding system did not affect the height of either BW or BCS curves. The *b* parameter (pre-nadir phase) for BW was affected (P<0.001) by genotype; the rate of postpartum decline being less in NZ cows. The *c* parameter (post-nadir phase) for BW was not affected by genotype, but rate of BW gain in cows offered 6 kg DM concentrates/d (0.39 kg/d) was greater (P<0.001) than cows offered 0kg DM/d (0.24kg/d) or 3kg DM/d (0.27kg/d). The NZ cows gained more (P<0.001) BCS post-nadir ($4.7x10^{-3}$ units/d) than NA cows ($2.2x10\}^{-3}$ units/d). Rate of BCS replenishment increased (P<0.001) with concentrate supplementation from $1.9x10^{-3}$ at 0 kg DM/d to $3.1x10^{-3}$ and $5.3x10^{-3}$ units/d at 3 and 6 kg DM/d concentrates, respectively. No significant genotype by environment interactions were found.

Key Words: Pasture-based, Genotype × Environment, Body Condition Score

99 Genotype and feed effects on annual milk production and reproduction of grazing dairy cows. E. S. Kolver*, C. R. Burke, and J. R. Roche, *Dexcel Ltd.*, *Hamilton, New Zealand*.

Decision rules for supplementing North American (NA) and New Zealand (NZ) Holstein Friesians (HF) were investigated over two years using 57 cows fed well on pasture throughout lactation and receiving 0, 3 or 6 kg concentrate DM/cow/d. Cows calved in spring as a single herd and were individually fed a grain supplement. Treatments were balanced at the start of each season for estimated genetic merit, and for sire and live weight within genotype. The 2 x 3 factorial design was analysed by the REML procedure of Genstat. No significant genotype x diet interaction was detected for any production response. However, genotype responses were more divergent at the highest level of supplementation. Over the 291-d lactation, milk yield and yield of fat and protein (milksolids: MS) responded linearly (P<0.001), and production efficiency quadratically (P<0.05) to supplementation. Genotype differences were observed for milk yield (P<0.01), and MS as a % BW (P<0.05), but not for MS. NA cows gave a greater (P<0.05) linear production response than NZ cows (37 vs. 74 g MS/kg concentrate DM; 0.67 vs. 1.22 kg milk/kg concentrate DM, respectively). NA cows maintained a lower (P<0.001) BCS (scale 1-10) throughout lactation. BCS responded linearly (P<0.001) to supplementation. NA cows had a lower (P<0.01) 42-d pregnancy rate (31 v. 55%) and 11-wk in-calf rate (58 v. 86%). Supplement level did not affect reproductive performance. While NA HF gave twice the milksolids response to supplements compared to NZ HF, NZ HF were more efficient (MS as a % BW), maintained higher BCS throughout lactation, and had a higher pregnancy rate. These results suggest that when fed high quality pasture ad libitum, NZ HF can largely meet their requirements from an all-pasture diet, whereas NA HF have a requirement for additional high-energy supplementary feed.

	NZ0	NZ3	NZ6	NA0	NA3	NA6
Milk kg/cow	5568	6365	6632	6112	7114	7827
Milksolids kg/cow	462	512	519	462	520	567
Milksolids % of BW	94	104	101	83	95	99
BCS	4.3	4.5	4.9	3.9	3.8	4.3
42-day pregnancy rate %	58	45	63	20	44	26
11-wk in-calf rate %	84	78	95	54	67	53

Key Words: Genotype, Supplement

100 Genotype and feed effects on milk production profiles for grazing dairy cows. J. R. Roche*[1], D. P. Berry[2], and E. S. Kolver[1], [1]*Dexcel*, *Hamilton, New Zealand*, [2]*Teagasc Moorepark*, *Ireland*.

The objective was to determine the effect of genotype and concentrate supplementation on milk production lactation profiles. Data from 76 cows across 113 lactations from 2002 to 2004 were used. New Zealand (NZ) and North American (NA) cows of equal estimated genetic merit for milk production were randomly allocated to three levels of concentrate supplementation (0, 3 or 6 kg DM/cow/d) on a basal pasture diet. The Wilmink exponential model $(Y_{DIM} = a+b*e^{(-0.05*DIM)}+c*DIM)$ was fitted within lactation. Days to peak yield were calculated by setting the first derivative of the function to zero, defining peak yield as the corresponding yield for that day. The function explained 81, 57 and 62% of the variation in milk, fat and protein yield, respectively. Days to peak milk and protein yield were not affected by genotype, while NZ cows exhibited a later (P<0.05) peak fat yield. In contrast, supplementation delayed (P<0.05) the interval to peak milk and protein yield. Peak production was lower (P<0.05) for NZ cows across all variables investigated. Peak milk and protein production increased (P<0.01) with concentrate supplementation. The *a* parameter (height of the curve) for milk and protein yield was augmented in NA cows (P<0.1) and cows receiving concentrates (P<0.01). The *a* parameter for fat yield was not significantly affected by genotype. Genotype did not affect the *b* parameter (pre-peak phase) for milk or protein yield, but NZ cows expressed a lower *b* value for fat yield. Level of supplementation accelerated the rate at which peak protein (P<0.01) and milk (P<0.1) yield were reached. Only the *c* parameter (post-peak phase) for fat yield was affected by genotype (P<0.05); the rate of post-peak decline being greater for NZ cows. Concentrate supplementation did not affect the *c* parameter for any of the production variables investigated. Milk and protein 270d-yield was greater (P<0.001) in NA cows (a difference of 933 and 25 kg, respectively). All measured 270d yields increased (P<0.05) with concentrate supplementation. No significant genotype by environment interaction was found for parameters reported.

Key Words: Pasture-based, Genotype × Environment, Nutrition

101 Extending lactation in pastoral systems using divergent Holstein-Friesian genotypes and levels of nutrition. E. S. Kolver* and J. Roche, *Dexcel Ltd.*, *Hamilton, New Zealand*.

Milking cows for two successive years, with calving and mating occurring every second year, may overcome the reduced pregnancy rates and exploit the superior lactation persistency of North American (NA) Holstein-Friesians in pastoral dairy systems. Production results are reported for the first 535 d of lactation from a study that tested the feasibility of extended lactations in pastoral systems using divergent dairy cow genotypes (New Zealand; NZ or NA Holstein-Friesian) and levels of nutrition (0, 3, or 6 kg concentrate DM/cow/d). Cows calved on 28 July 2003 (±3.5 d SEM) and were managed as a single herd. A grain supplement was fed to individual cows twice daily at milking. Treatments in the 2 x 3 factorial design were balanced for estimated genetic merit, and for sire and live weight within genotype and analysed using the REML procedure of Genstat. Of the 56 cows enrolled, 6 cows were dried off when production was less than 4 kg milk/cow/d for two weeks (NZ0 2 cows; NZ6 3 cows; NA3 1 cow). DIM did not differ between treatments. Genotype x diet interactions (P<0.05) were detected for the total yield of milk, 4% FCM, and fat and protein (milksolids). These interactions only became apparent during the extended phase of lactation (>290 DIM). Differences between genotypes were greatest at the highest level of supplementation (NZ0 9320; NZ3 11092; NZ6 9629; NA0 10226; NA3 12696; NA6 13760 kg 4% FCM/cow; NZ0 716; NZ3 853; NZ6 741; NA0 780; NA3 972; NA6 1053 kg milksolids/cow). Compared to NZ cows, NA cows produced 22% more (P<0.001) 4% FCM, 18% more (P<0.001) milk fat, 25% more (P<0.001) milk protein, and at 535 DIM had 1.7 units less (P<0.01) body condition (1-10 scale). Milk protein content was high at 4.17% (±0.12 SEM) across all treatments at 535 DIM. These results indicate that productive extended lactations of 535 d or more may be biologically possible on pasture diets, and that NA-type cows with superior lactation persistency may be more suited to pasture-based systems that are not constrained by a 12-month calving interval.

Key Words: Extended Lactation, Genotype, Pasture

102 Performance of lactating dairy cows fed varying levels of total mixed rations and pasture. R. Vibart*, V. Fellner, J. Burns, and M. Gumpertz, *North Carolina State University*, *Raleigh*.

An 8-week study beginning October 2004 was conducted to examine animal performance under different combinations of partially-restricted total mixed ration (TMR) feeding and high-quality pasture grazing. Thirty Holstein cows in early to mid lactation averaging 33.3 kg/d of milk at the initiation of the study were used. Cows were assigned to either an all-TMR diet (100T, no access to pasture, positive control) or one of the following three TMR-restricted dietary treatments: 1) 85% TMR-restricted diet (85T), 2) 70% TMR-restricted diet (70T), and 3) 55% TMR-restricted diet (55T). Cows on TMR-restricted diets were confined to pasture (annual ryegrass, average paddock size 0.17 ha/d) as a single group for 7 h/d between the a.m. and p.m. milking. Individual pasture intake was measured weekly on one cow selected randomly from each grazing group for 6 weeks. Body weight and body condition scores were recorded at the beginning and during weeks 5 to 8 and averaged 570 kg/cow and 3.0, respectively. Data from individual pasture intakes (n=18), total mixed ration intakes (n=30), and milk weights (n=30) were analyzed separately according to a randomized complete block design using PROC GLM with initial days in milk as a covariate. Individual pasture intakes averaged 6.9 kg/d and did not differ between grazing groups due primarily to a large variation among cows. Intakes

of total mixed ration were different ($P < 0.05$) among all treatments and were 26.7, 17.9, 14.8, and 12.0 kg/d for 100T, 85T, 70T, and 55T, respectively. Milk yields were 36.1, 33.6, 30.5, and 30.8 kg/d for 100T, 85T, 70T, and 55T, respectively, and only tended ($P = 0.06$) to be different between treatments 100T and 70T. Total intakes (pasture + TMR) and milk yields were similar between cows fed 85T and 100T. As the proportion of pasture in the ration increased cows ate less TMR and maintained pasture intake. Cows fed 70T and 55T had similar milk yields to cows fed 85T and 100T but lower TMR intakes suggesting a higher feed to milk efficiency.

Acknowledgements: The authors wish to acknowledge Weston McCorkle and Wayne McLamb for their hard work and collaboration.

Key Words: Total Mixed Ration, Grazing, Milk Yield

103 Acidosis in pasture-fed dairy cows: Risk factors and outcomes. E. Bramley[1], I. J. Lean*[2], N. D. Costa[3], and W. J. Fulkerson[1], [1]*University of Sydney*, *Camden, NSW, Australia*, [2]*Bovine Research Australaisa*, *Camden, NSW, Australia*, [3]*Murdoch University*, *Murdoch, WA, Australia*.

Differences in rumen function characterized three groups of 797 cows examined in a randomized cross-sectional survey in 100 dairy herds from five areas of Australia. Rumen fluid was obtained by both rumenocentesis (RC) and stomach tube (ST) from eight fresh cows < 100 DIM; three primipars and five multipars; randomly selected from each herd. Acidotic cows had higher valerate, propionate, D-lactate and lower pH and ammonia concentrations than groups 2 and 3. Category 2 cows had high ammonia concentrations and a ′ suboptimal ′ rumen function, while group 3 cows had lower VFA concentrations. Table 1 shows mean production data (± SE) for cows in categories where a herd test was recorded (corrected for DIM, parity and effect of herd). Herds were categorized as acidotic (group 1), suboptimal (group 2) or non-acidotic (group 3) if the herd had ≥ 3/8 cows in a category. Acidotic herds were significantly more likely to be fed diets higher in NFC% and lower in NDF% and higher in the B1 CHO fractions than non-acidotic herds. Acidotic herds were best described by the NDF%: NFC% ratio on multivariate modelling. Observed differences in ruminal biochemistry between cows in non-acidotic and suboptimal herds were supported because suboptimal herds tended ($P < 0.1$) to have a higher prevalence of poor forages and fibrous byproducts fed and less prevalence of ryegrass pastures. Acidotic herds had 150% more risk of being herds with a high prevalence of lameness than the other group herds. Groups characterized by differences in rumen function had differences in diet and outcomes that provide insight to subclinical acidosis in pasture fed dairy cows.

Table 1

Mean production	Category 1	Category 2	Category 3
	(n=39)	(n=132)	(n=276)
milk volume (L)	33.0±0.94[a]	27.0±0.54[ab]	29.1±0.4[b]
%milk fat	3.3±0.11[a]	3.9±0.07[ab]	3.7±0.04[b]
%milk protein	3.2±0.05	3.2±0.03[c]	3.1±0.02[d]
%fat:protein	1.1±0.04[a]	1.2±0.02[b]	1.2±0.01[b]
Milk fat yield (kg)	1.1±0.04	1.0±0.02	1.0±0.02
Milk protein yield (kg)	1.0±0.04[a]	0.9±0.02b[c]	0.9±0.01[d]

[a,b]means within a row with different superscripts differ ($P < 0.01$). [c,d]means within a row with different superscripts differ ($P<0.05$)

Key Words: Dairy Cows, Acidosis

104 Changes of β-carotene content in plasma of cows following different diets: Influence of pasture and farm location. S. Carpino*[1], P. Palozza[2], A. Valdannini[1], and G. Licitra[1,3], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*Institute of General Pathology, Cattolica University*, *Rome, Italy*, [3]*D.A.C.P.A, Catania University*, *Catania, Italy*.

Our objective was to determine the influence of different level of the same native pasture in the diet on β-carotene content in cows plasma. β-carotene content in bovine plasma was studied in three groups of cows in a farm of Hyblean region sited on mountain level (ML) in Spring 2004. In this farm we had three groups of cows (10 per group): group 1 fed TMR (ML0); group 2 fed TMR supplemented with 30% DM of native pasture (ML30), and group 3 fed TMR supplemented with 70% DM of native pasture (ML70). Blood samples from each cow were collected before evening milking. Blood sample was taken from jugular vein, immediately refrigerated, and centrifuged at 2000 rpm 4°C x 10 min. Plasma samples were stored at -80°C. β-carotene was then extracted from plasma with hexane and analyzed by HPLC (mobile phase: 60% acetonitrile/10% methanol/30% isopropanol; flow rate:1 ml/min; detection: 460 nm). The experiment was repeated three times. β-carotene content in plasma was: 0.123 ± 0.010 μM (ML0), 0.242 ± 0.022 μM (ML30), 0.637 ±0.056 μM (ML70), respectively, suggesting that pasture addition in the diet was responsible for a significant ($P<0.01$) carotenoids increase in plasma content. Another farm sited on sea level (SL) was also tested. In farm SL there was only one group of cows fed TMR supplemented with 30% DM of native pasture (SL30). Cattle breed (Fresian), TMR, lactation days and milk production level were similar to the ML farm. Plasma content of β-carotene in SL30 group was found to be 0.197 ± 0.020 μM. When plasma β-carotene level was compared between the two groups, fed the same pasture addition (ML30 and SL30), a significant ($P<0.05$) interaction was observed, suggesting that a different altitude of the farm may deeply increase carotenoids concentration in bovine plasma. Analysis are in progress to verify if plasma content of β-carotene in the different experimental groups may also affect milk and cheese composition.

Key Words: β-Carotene, Pasture, Diet

105 Omega-3 and conjugated linoleic acid contents in blood plasma of cows grazing on native pasture plants. S. La Terra*[1], S. Carpino[1], S. Banni[2], L. Curdeddu[2], M. Caccamo[1], and G. Licitra[1,3], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*Cagliari University*, *Cagliari, Italy*, [3]*D.A.C.P.A. Catania University*, *Catania, Italy*.

Fatty acid profiles of bovine plasma were studied in three groups of cows in a farm of Hyblean region sited on mountain level (ML) in Spring 2004. In farm ML we had three groups of cows (10 per group):group 1 fed TMR (ML0); group 2 fed TMR supplemented with 30% DM of pasture (ML30), and group 3 fed TMR supplemented with 70% DM of pasture (ML70). Blood samples from each cow of each farm were collected before evening milking every 15 days during the experimental period. Blood sample was taken from jugular vein immediately refrigerated, and centrifuged at 2000 rpm 4° C x 10 min. Plasma samples were stored at -80°C. The experiment was repeated three times. Our objective was to determine the influence of different level of pasture in the diet on omega-3 and CLA content in cows plasma. The concentrations of 20:5 (EPA) and 22:6 (DHA) were influenced by the diet ($P\leq0.01$). EPA and DHA level increased with the percentage of pasture content in the diet. EPA concentration increased, from ML0 to ML70, respectively from 7.47 to 18.46 (nmoles/mg fat), DHA increased from 4.40 to 9.84 (nmoles/mg fat). The effect of pasture in the diet was also significant ($P\leq0.01$) for CLA concentration. CLA level increased with the percentage of pasture in the diet: 1.17 (nmol/mg fat) in the ML0, 2.07 (nmol/mg fat) in the ML30, and 2.70 (nmol/mg fat) in the ML70 treatment. Another farm sited on sea level (SL) was also tested. Cattle breed (Fresian), TMR, lactation days and milk production level were similar to the ML farm. In this farm there was only one group of cows fed TMR supplemented with 30% DM of pasture (SL30). The impact of the location of the farms (ML-SL) was also significant on plasma bovine fatty acid profiles. EPA, DHA, vaccenic acid, 20:3, and the 20:2 acid had a higher concentration in the bovine plasma of the mountain area. The increase of EPA, DHA and CLA in plasma may have a beneficial impact not only for a possible increase of these fatty acids in milk and meat, which will be tested in the near future, but also for possible beneficial effects on animal health. As a matter of fact, an increase of CLA and omega-3 in tissues may result in an increased protection against inflammatory events.

Key Words: Plasma, Diet, CLA

106 Lipid content and fatty acid composition of grasses sampled on different dates through the first 139 d in 2004. P. Mir*[1], S. Bittman[2], D. Hunt[2], T. Entz[1], and B. Yip[1], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Agassiz, BC, Canada*.

Hydrogenatable fatty acids (HFA) content of the grasses was estimated after determining dry matter (DM) yield, lipid content and fatty acid concentration in samples of orchard grass (OG), perennial rye grass (PRG) and tall fescue (TF) from four plots per species, on d 89, 113, 119, 133 and 139 of 2004. Fatty acid and HFA content of the grasses was estimated as the product of fatty acids concentration and lipid content, and the sum of the content of C18:1, C18:2 and C18:3, respectively. The HFA content is the available substrate for production and deposition of fatty acid bioconversion compounds such as conjugated linoleic acid in ruminants that consume the grass. The DM yield of the three species of grasses increased ($P < 0.05$) between 89 and 113 d to average yields of 3694 ± 153 kg. By d 139 the DM yield estimates were 5246 ± 234, 6185 ± 514, 8642 ± 502 kg, for OG, PRG and TF, respectively, and different ($P < 0.05$) from each other. However, the lipid content decreased in all the grasses over the 139 d of sampling. Although concentration of the saturated fatty acids and C18:1, C18:2 and C20:4 increased over the sampling period, the content did not alter substantially. In OG samples, C18:2 concentration and content was higher ($P < 0.05$) than that in PRG or TF samples obtained on d 89, 119, 133 and 139. The concentration and content of C18:3 was highest (65 to 70% of fat) in all the forages, but declined progressively to 52-55% of fat. The C18:3 concentration remained the highest in PRG samples obtained up to 113 d. The availability of HFA up to 113d was greatest in PRG, (3.1 ± 0.2%) and lower ($P < 0.05$) in OG and TF (2.2 ± 0.1 and 2.0 ± 0.4%). However, by d 139 of the season TF produced more DM but with substantially reduced lipid (1.6 ± 0.2%) and HFA (1.1 ± 0.1%) content. The results indicate that PRG would provide greater levels of HFA until the first 113 d of the season in 2004.

Key Words: Grasses, Hydrogenatable Fatty Acids, Ruminants

ADSA-SAD: Original Research (Undergraduate)

107 On-farm Rota-Coronavirus prevention methods. A. Nelkie*, *North Carolina State University*, *Raleigh*.

Rota-Coronavirus is one of many scours-causing pathogens and costs calf growers time and money. It is prevalent 7 to 10 days after birth. There are 2 different vaccination approaches used to prevent this virus; 1) through passive immunity by vaccinating the dam pre-calving, then feeding the calves the immunoglobulin-rich colostrum; 2) administering an oral vaccine to the calf at birth. Currently, there is no recommended time at which the oral vaccine should be given in relationship to feeding colostrum. In this case study, a farm vaccinating all cows and heifers pre-calving still had a 100% scour rate among calves 7 to 10 days after birth and lost 3 calves. An initial fecal sample collected in March was sent to Michigan State University Diagnostic Laboratory where the Rota-Coronavirus was cultured. In August, a scouring calf sent to Michigan State University was diagnosed with Rota-Coronavirus. Due to the presence of Rota-Coronavirus on the farm, 5 different protocols were attempted to prevent scours in calves, including: 1) administering Calf Guard®, an oral Rota-Coronavirus vaccine given at birth with colostrum (n=30); 2) using Bio Moss®, a mannan oligosacharide that prevents the binding of pathogens to the lining of the small intestine (n=10); 3) cleaning the maternity pen with bleach (n=3); 4) administering Calf Guard® 10 minutes before colostrum (n=5); and 5) cleaning the maternity pen with bleach and administering Calf Guard® 10 minutes before colostrum (n=24). The fecal samples were taken: 1) at the beginning of the study; 2) during protocol 1; and 3) after protocol 2. Because scours stopped, fecal samples were not taken after protocols 3, 4, and 5. Since the implementation of protocol 4 scours have not been observed, therefore, protocols 4 and 5 appear to be successful in eliminating scours caused by Rota-Coronavirus, while protocols 1-3 were not successful as scours continued. Limiting calves' exposure at birth to the Rota-Coronavirus by cleaning maternity pen and administering preventative Calf Guard® 10 minutes before colostrum appears to be part of successful protocols to prevent scours caused by the Rota-Coronavirus.

Key Words: Scours, Rota-Coronavirus

108 Effect of sunflower oil delivery method on conjugated linoleic acid (CLA) content in milk. G. McGregor*, A. Meszaros, Y. Parrott, S. Tam, M. Oba, and L. Doepel, *University of Alberta*, *Edmonton, Alberta, Canada*.

The effect of supplementing sunflower oil directly into the rumen vs. incorporating it into a total mixed ration (TMR) on milk CLA concentration was examined. Four ruminally cannulated multiparous Holstein cows (127 ± 4.5 days in milk) were used. Sunflower oil (2.5% of dietary dry matter) was either dosed ruminally twice per day (RD) or fed once daily in a TMR (CTL) in a crossover design with 6-day periods. The same basal TMR was fed to both groups except the TMR for RD treatment was devoid of sunflower oil which was instead dosed ruminally in an amount based on each cow's dry matter intake the previous day. Dry matter intake was 22.8 vs. 21.9 ± 1.6 kg/d ($P = 0.39$), and milk yield was 31.4 vs. 31.0 ± 0.7 kg/d ($P = 0.50$), respectively, for RD and CTL. Milk fat, protein and lactose content, and somatic cell count were also unaffected by treatment. Milk from cows receiving RD had a higher concentration of *trans*-10, *cis*-12 CLA (0.04 vs. 0.02 ± 0.003 %; $P = 0.05$), and tended to have a lower concentration of short-chain fatty acids (C: <16) compared to the milk of CTL cows (52.6 vs. 57.1 ± 0.9 %; $P = 0.07$). *Trans*-11 vaccenic acid concentration was greater (5.39 vs. 3.33 ± 0.27 %; $P = 0.03$), and *cis*-9, *trans*-11 CLA concentration tended to be greater (1.72 vs. 1.12 ± 0.12 %; $P = 0.07$) for RD cows. It is speculated that, compared to gradual consumption of sunflower oil supplemented within a TMR, infrequent large doses of sunflower oil suddenly increase the availability of unsaturated fatty acids, thus exceeding the capacity of the rumen microbes to complete biohydrogenation. This might have allowed accumulation of *trans*-11 vaccenic acid in the rumen which is then desaturated to *cis*-9, *trans*-11 CLA in the mammary gland. These results indicate feeding management affecting the frequency of lipid intake alters milk CLA concentration and fatty acid composition.

Key Words: Conjugated Linoleic Acid, Sunflower Oil, Ruminal Dose

109 Prostaglandin-induced luteolysis: Effects of dosage and route of administration in lactating Holstein cows. J. Brinkerhoff* and R. Silcox, *Brigham Young University*, *Provo, UT*.

We previously reported that the luteolytic response of cyclic, lactating dairy cows did not differ between cows administered 15 mg prostaglandin F2 alpha (Prostamate™)(PGF) by way of the ischiorectal fossa (IRF) as compared to those given 25 mg PGF intramuscularly (IM). This study utilized a two by two factorial design to determine if luteolytic response to PGF was affected by dosage (15 vs 25 mg) and/or by route of administration (IRF vs IM). A total of 100 non-pregnant, lactating Holstein cows that were approximately 128±5 (range=73-245) days in milk during their 1-5 lactation were recruited into the study based on the presence of a functional corpus luteum (CL≥20 mm) as determined by transrectal ultrasonography. Number, location, and diameter of CL, location and diameter of the two largest follicles, and body condition score were recorded. A blood sample (~7ml) was collected, and cows were injected with PGF according to their randomly assigned treatment. Blood samples were collected 24 and 72 hr later and ovaries of cows were examined by ultrasound 72 hours post-injection. Cows were considered responders (luteolysis induced) if CL diameter decreased by at least 5 mm. Luteal regression, induced in 80 of the 100 cows, was not affected by lactation number (P≥.05). Injection of 3 ml PGF by way of the IRF (92% responders) was just as effective in inducing luteolysis as 5 ml injected IM (88% responders)(P≥.05). Injection of 3 ml IM or 5 ml IRF

tended to be less effective (68% and 72% responders, respectively)(P≤.1). It appears that dairy producers can realize a 40% savings in PGF cost by injecting 60% of the prescribed dose via the IRF in lactating cows without decreasing the rate of luteolysis.

Acknowledgements: We express appreciation to Vanessa Davis, Warren Bingham and Richard Miller for assistance with the cattle.

Key Words: Cattle, Luteolysis, Prostaglandin

110 Effect of ground canola seed on milk production and composition, and blood metabolites of lactating Holstein cows. F. M. Lewis*, D. R. Bae, M. S. Laubach, W. L. Keller, D. E. Schimek, and C. S. Park, *North Dakota State University*, *Fargo*.

The objective of this study was to examine the effect of ground canola seed on milk production and composition, and blood metabolites of early lactation cows. Twenty-four primiparous and multiparous Holstein cows (588 ± 48 kg body weight; 33 ± 21 d in milk) were assigned to one of two treatments: with or without canola seed. Ground canola seed were blended into the treatment diet as a total mixed ration with ca. 15% of total ration dry matter as ground canola seed which contained ca. 37% lipid. Diets were comprised of corn silage, alfalfa haylage, beet pulp, and concentrate mixture and fed ad libitum as a total mixed ration. Corn and barley in the control diet was replaced with ground canola seed in the treatment diet. Twelve cows were housed in tie stalls, and twelve cows were housed in a pen with calen gates where they were fed individually for 12 wk. Cows were milked twice daily. Milk yield and dry matter intake were recorded daily. Blood and milk samples were collected at 3-wk intervals. Body weight and body condition scores were also recorded at 3-wk intervals. Data were analyzed using the general linear models procedure of SAS. Dry matter intake, body weight, and body condition scores were not affected by treatment ($P > 0.05$). Milk production and composition were not different between treatments ($P > 0.05$). However, cows fed canola seed had higher serum concentrations of nonesterified fatty acids (109.2 vs. 159.1 μEq/L; $P < 0.01$) and triglycerides (11.6 vs. 14.1 mg/dL; $P < 0.01$) compared to that of control cows. Feeding ground canola seed at 15% of the diet dry matter (ca. 3.2 kg/d) increased serum nonesterified fatty acids and triglycerides without affecting milk production and composition.

Key Words: Canola Seed, Milk Production, Dairy Cow

111 Case study of prevention and therapy strategies in a high somatic cell count herd. L. Schultz* and L. Timms, *Iowa State University*, *Ames*.

This case study involves a 60 cow dairy whose DHIA average somatic cell count (SCC) was > 750,000 cells/ml (linear scores 4.3-5.2) for eight months prior to study initiation. Initial study DHI SCC showed 948,000 herd average SCC with 56% of the cows >300,000 (36% were >1,130,000). Milk from all quarters of all cows was individually evaluated at milking time (California Mastitis Test and aseptic samples taken for bacteriological analysis initially and 4 weeks later). Combined bacteriological analyses showed: Uninfected: 27 cows(C), 159 quarters(Q); Staphylococcus aureus: 18C, 35Q; Streptococcus dysgalactiae: 14C, 25Q; Strep. alpha hemolytic: 2C, 3Q; Strep. uberis: 1C, 1Q. Following initial culture results, a new milking order was immediately established to stop infection spread. Uninfected cows were milked first, followed by Strep-infected cows, with S. aureus cows milked last. Only one new infection (based on DHI-SCC) occurred before the therapy trial began 8 weeks later. Herd visit evaluations showed excellent cow cleanliness (score1.1), leg score (1.3), body condition score (~3), tie and free stall cleanliness and comfort, and very good milking equipment performance and teat health. Milking procedures evaluation revealed inadequate udder stimulation, no drying of teats, and improper prep lag timing. Based on these observations, corrective milking procedures were instituted. A targeted therapy trial was conducted based on antibiotic sensitivity tests. Nine Strep. cows (20 quarters) were treated using recommended pirlimycin therapy (one 10 ml plastet 50 mg pirlimycin HCl (Pirsue, Pfizer, Inc.) at 24-hour intervals for two days). Eleven S. aureus cows (19 quarters) were treated using an extended pirlimycin therapy (one plastet every 24 hours for eight days). 65% of treated cows had a SCC reduction with average change of -521,000 for all treated cows 20 days post treatment. DHI SCC was 484,000 (linear score 4.0), with 13% of the herd having a SCC > 1,130,000. Follow-up cultures to assess true bacteriological cure will be conducted ~ 45 days post therapy (mid Feb. 2005), with long term strategies based on results.

Key Words: Somatic Cell Count, Mastitis, Pirlimycin

Graduate Student Competition: ADSA Southern Branch

112 Use of formaldehyde-treated protein capsules as a means to protect conjugated linoleic acid from ruminal biohydrogenation. P. J. Myers*, S. E. Ellis, K. J. L. Burg, and T. C. Jenkins, *Clemson University*, *Clemson, SC*.

Improved technologies for protecting dietary lipids from ruminal biohydrogenation are needed to take advantage of the benefits of unsaturated fatty acids (FA), such as improved reproductive performance or altering milk composition to meet consumer preferences. This study investigates a novel method for protecting FA by their containment within porcine-based protein capsules treated with hydroalcoholic solutions of formaldehyde. The treatment consists of washing capsules in 5% formaldehyde solution, rinsing in ethanol and drying. Protection was assessed by placing capsules in nylon bags, incubating in cultures of mixed ruminal microorganisms for 24 hours, and then analyzing for FA content by gas chromatography. The capsules (n=10) were loaded with 59±1 mg of a conjugated linoleic acid (CLA) supplement containing 12.3 ± 0.01% oleic acid, and 74.2 ± 0.12% total CLA consisting of three isomers: (A) 36 ± 0.1% *cis*-9, *trans*-11, (B) 35.7 ± 0.1% *trans*-10, *cis*-12, and (C) 2.54 ± 0.03% *trans*-9, *trans*-11. Treated capsules (n=5) were intact after incubation (opposed to untreated) with an average weight loss of 4.0 ± 2.3%. After incubation, the capsules (n=25) contained similar oleic acid (12.4 ± 0.1%) and total CLA (69.7 ± 1.1%) concentrations as before incubation. However, a shift occurred in proportions of individual CLA isomers (18.4 ± 2.0% A, 18.1 ± 1.9% B, and 33.1 ± 3.1% C) indicating isomerization. Treated capsules (n=10) were then suspended in buffer alone and the final CLA composition (35.8 ± 0.7% A, 35.4 ± 0.7% B, and 3.5 ± 0.4% C) showed no isomerization. Similarly, no isomerization was detected when treated capsules were suspended in clarified ruminal fluid (microorganisms removed by centrifugation), or in ruminal fluid boiled for 10 minutes to denature enzymes. This study shows that formaldehyde-treated protein capsules substantially reduces FA loss due to biohydrogenation. Isomerization was observed in treated capsules, but only in the presence of viable microorganisms. Encapsulation in protected capsules therefore shows promise for the development and delivery of high-quality rumen-bypass supplements.

Key Words: CLA, Rumen, Biohydrogenation

113 Effect of combining GnRH and ECP with a CIDR-$PGF_{2\alpha}$ protocol on pregnancy rates in Holstein Heifers submitted to timed AI. J. L. Fain*, W. M. Graves, J. M. Haslett, S. C. Nickerson, and J. K. Bernard, *University of Georgia*, *Athens*.

Our objective was to determine if incorporation of GnRH and ECP into the EAZI-BREED CIDR-$PGF_{2\alpha}$ protocol would increase pregnancy rates of dairy heifers using timed artificial insemination (TAI). This study was conducted over

a 6-mo period at The University of Georgia Teaching Dairy in Athens. Forty Holstein heifers with average age of 16 mo were randomly allocated to one of two treatment groups. In Treatment 1, 20 heifers were synchronized by: 100 μg GnRH (-9 d), CIDR (1.38g progesterone) (-9 d), 25 mg $PGF_{2\alpha}$ (-3 d), 1 mg ECP (-2 d), CIDR removal (-2 d), 100 μ GnRH (0 d), and TAI (0 d), (OverSynch). A second group of 20 heifers (Treatment 2) were synchronized by: CIDR (1.38g progesterone) (-9 d), 25 mg $PGF_{2\alpha}$ (-3 d), CIDR removal (-2 d), and TAI (0 d). Treatment 2 is the recommended CIDR protocol with a TAI. Upon CIDR removal, retention rates and discharges were recorded. Estrus activity was determined using Estrus Alerts (Universal Cooperatives, Eagan, MN) applied on -3 d. Timed AI occurred 48h after CIDR removal. Pregnancy diagnosis was conducted by ultrasonography at 35d post AI. For both treatments, CIDR retention rate was 100% and discharge was minimal with no significant effect on pregnancy rate ($P > 0.05$). Pregnancy rates for heifers synchronized by OverSynch (Trt 1) was 9 of 20 (45%) and similar to those in the heifers synchronized with the standard CIDR protocol (Trt 2) with 11 of 20 (55%). Pregnancy rates were not significantly different between treatments ($P > 0.05$). In Treatment 1, 16 of 20 (80%) heifers had Estrus Alerts that were all or partially rubbed while only 11 of 20 (55%) were observed in Treatment 2. Additionally, 55% of the Estrus Alerts on heifers in Trt 1 were completely rubbed while only 15% were in Trt 2. Signs of estrus synchronization through visual appraisal of Estrus Alerts were significantly higher in the OverSynched (Trt 1) heifers ($P < 0.05$). Although the OverSynch treatment did not increase pregnancy rate with a TAI protocol, it did significantly increase estrus activity prior to TAI.

Key Words: Dairy Heifer, Estrus Synchronization, Timed Artificial Insemination

114 Evaluation of immunological differences among Jersey, Holstein, and crossbred calves. J. V. Ware*[1], S. T. Franklin[1], A. J. McAllister[1], J. A. Jackson[1], K. I. Meek[1], and B. G. Cassell[2], [1]*University of Kentucky*, *Lexington*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Previous studies reported greater survival of crossbred dairy calves compared to purebred dairy calves. The objective of this study was to investigate immunological differences among crossbred groups [Holstein x Jersey (HJ) and Jersey x Holstein (JH)] and purebred groups [Holstein x Holstein (HH) and Jersey x Jersey (JJ)] as a possible explanation for differences in survival. Holstein and Jersey cows were bred using mixed semen (Holstein and Jersey). Calves (n = 68) were removed from their dams prior to nursing and fed pooled colostrum based on birth weight. Blood samples were collected on d 0, 1, 7, 14, 21, 28, 35, and 42 and analyzed for serum protein concentrations and white blood cell counts. Percentages of CD2, CD4, CD8, and γδ T-cells, B-cells, and monocytes were determined by flow cytometry using blood samples from d 0, 1, 7, 14, 28, and 42. Leukocyte proportions and white blood cell counts were used to calculate numbers for each cell type. Numbers are reported as cells/mL x 10^{-6}. Daily fecal scores were obtained to indicate general health. Serum protein concentrations were higher ($P < 0.01$) for JH (5.73 ± 0.07 g/dL) compared with HH (5.43 ± 0.05 g/dL) and HJ (5.54 ± 0.06 g/dL). Numbers of B-cells, CD2, CD4, CD8 and γδ T-cells differed ($P < 0.01$) among purebred and crossbred groups. Numbers of B-cells were highest ($P < 0.05$) for JH (0.97 ± 0.06) compared to HH, HJ, and JJ (0.58 ± 0.05, 0.67 ± 0.06, and 0.71 ± 0.09, respectively). Fecal scores were greater ($P < 0.02$) for HH (1.75 ± 0.06) compared to JH (1.45 ± 0.07). White blood cell counts and monocyte numbers did not differ among treatments. All parameters measured varied ($P < 0.001$) over time. In general, JH calves had higher serum protein concentrations and B-cell numbers and lower fecal scores compared to HH calves, with HJ and JJ being intermediate. These results may indicate better health of JH calves, possibly contributing to greater survival of crossbred calves compared with purebred Holsteins.

Key Words: Immune, Calves, Crossbred

115 Effect of supplemental energy source on the performance of lactating dairy cows fed diets based on sorghum and ryegrass silage. J. Boyd* and J. Bernard, *The University of Georgia*, *Athens*.

Two trials were conducted to evaluate the effect of energy supplement source and forage combination on performance, ruminal fermentation, and apparent digestibility. In trial 1, 41 Holstein cows were fed a standardized diet for 2-wk and then assigned randomly to one of 6 treatments for the following 5 wk. Treatments were arranged as a 2 x 3 factorial and included two combinations of sorghum and ryegrass silage (50:50 or 75:25) supplemented with one of three energy sources (finely ground corn [GC], hominy [H], or a 50:50 blend of GC and H [B]). There were no differences in DMI or milk yield observed among treatments. Milk protein percentage was higher (*P<0.004*) for diets based on 50:50 compared with 75:25 when supplemented with B. No differences were observed in concentrations of milk protein, lactose, or SNF. Yield of milk fat (*P<0.05*), and energy-corrected-milk (*P<0.03*), and efficiency of milk production (*P<0.02*) were higher for cows fed diets based on 75:25 than 50:50. In trial 2, three ruminally cannulated Jersey cows were used in a 3 x 3 Latin square trial to determine the effects of energy supplement source (GC, H, or B) to the diet based on 50:50 ryegrass and sorghum silage. Ruminal pH (*P<0.06*) and molar proportions of propionate (*P<0.02*) were higher and ammonia (*P<0.04*) and molar proportions of butyrate (*P<0.002*) were lower for cows supplemented with B compared with GC and H. No differences were observed in total VFA or molar proportions of acetate, isovalerate, and valerate among supplements. Nutrient intake and total tract digestibility and ruminal pH, ammonia, and proportions of VFA were similar among energy supplements. Results of these trials indicate that a higher proportion of forage should be provided by sorghum silage than ryegrass silage when these forages are fed together. Source of energy supplement did not alter animal performance although ruminal fermentation was altered.

Key Words: Silage, Hominy, Ruminal Fermentation

116 Effects of starch sources on nitrogen capture in dairy cows on pasture. A. M. Gehman*, J. A. Bertrand, T. C. Jenkins, and B. W. Pinkerton, *Clemson University*, *Clemson, SC*.

The objective of this experiment was to determine if feeding starch sources more rapidly degraded than corn affected N utilization in dairy cows grazing ryegrass pasture and, therefore, milk yield and components. Fifteen cows were used in a 3x3 Latin square design with 3 21-d periods. Treatments were grain supplements based on: (1) corn (C), (2) barley (B), or (3) citrus pulp (CP). For B and CP, diet composition was the same as C except half the ground corn was replaced with rolled barley and molasses or citrus pulp and molasses. Cows were fed the supplement after milking at 0700 h and 1600 h and grazed from 0830 h to 1530 h and 1730 h to 0630 h. Milk samples were collected on d 18 to 20 and analyzed for total fat, fatty acids, protein, and milk urea nitrogen (MUN). Milk yield was recorded daily, and 3.5% fat corrected milk (FCM) and energy corrected milk (ECM) were calculated. For milk fatty acids, there were no significant differences ($P > 0.05$) in C14:0, C16:0, C18:0, C18:1, or *cis*-9, *trans*-11 CLA. Inclusion of citrus pulp in the supplement for grazing dairy cows decreased milk protein % as compared to the all-corn supplement but did not affect nitrogen capture, milk yield or other components. Addition of barley increased MUN levels as compared to corn but did not affect milk yield or components.

	C	B	CP	SEM
Milk Yield (kg/d)	30.6	29.9	30.0	3.44
FCM (kg/d)	28.9	28.6	28.5	2.42
ECM (kg/d)	31.3	31.0	30.9	1.74
Milk Fat (%)	3.20	3.27	3.26	0.15
Milk Protein (%)	2.81^{a}	2.77^{ab}	2.70^{b}	0.08
MUN (mg/dL)	10.05^{a}	11.43^{b}	9.85^{a}	0.42
MUN (mg/dL)	10.05^{a}	11.43^{b}	9.85^{a}	0.42

[a,b]Least square means in the same row with different superscripts differ ($P < 0.05$)

Key Words: Pasture, Nitrogen Capture, Starch

Graduate Student Competition: ADSA-ASAS Northeastern Branch

117 The effects of damaging ears of corn in the field and the use of potassium sorbate on the fermentation, aerobic stability, and production of mycotoxins in corn silage. R. S. Teller*[1], R. J. Schmidt[1], B. M. Moulder[1], C. N. Mulrooney[1], V. R. Veenema[1], L. Kung, Jr.[1], and L. S. Whitlow[2], [1]*University of Delaware*, *Newark*, [2]*North Carolina State University*, *Raleigh*.

We studied the effects of damaging ears of corn in the field and the use of potassium sorbate (PS) on silage fermentation and the production of mycotoxins in whole plant corn. Ears of corn were left alone or were slashed, 27 d or 9 d prior to harvest, exposing damaged kernels to the environment. Whole plants were harvested at 36% DM and ensiled in vacuum-sealed bags (6 and 18 d) and 20-L laboratory silos (95 d) in a 2 × 3 × 3 factorial arrangement of treatments. Factors were no additive or 0.1% (fresh wt.) PS, time of damaging the ears (27 d, 9 d, or no damage) relative to harvest, and d of fermentation. After 95 d of ensiling, silages treated with PS had a greater DM recovery (100 vs. 96% $P < 0.05$), fewer yeasts (0.28 vs. 4.89 $\log_{10}$ cfu/g, $P < 0.05$) and molds (1.18 vs. 3.90 $\log_{10}$ cfu/g, $P < 0.05$) and took longer to heat after exposure to air (157 vs. 35 h, $P < 0.05$) than silage without the additive. At harvest, concentrations of deoxynivalenol (> 20,000 ppb vs. < 1500 ppb, $P < 0.05$) and fumonisin B1 (FB1; 12.5 ppm vs. < 1.5 ppm, $P < 0.05$) were greatest in fresh forage that had ears damaged at 27 d. Concentrations of mycotoxins remained relatively constant throughout the ensiling period (0, 6, 18 and 95 d) and after 48 h of aerobic spoilage with the exceptions that the concentration of T2 trichothecenes were greater after 95 d of ensiling and the concentration of FB1 increased after 48 h exposure to air ($P < 0.05$). The addition of PS, at the time of ensiling, decreased the numbers of yeasts and molds and increased the aerobic stability of silage but had no effect on the concentrations of mycotoxins. Prolonged damage of ears in the field resulted in the production of mycotoxins. Aerobic deterioration of silage may also lead to production of specific mycotoxins.

Key Words: Potassium sorbate, Mycotoxins, Aerobic stability

118 Effects of energy status, breed and plasma metabolites on new intramammary infections in periparturient Holstein and Jersey dairy cows during the transition period. P. Rezamand*[1], S. M. Andrew[1], K. M. Moyes[2], and R. M. Clark[1], [1]*University of Connecticut*, *Storrs*, [2]*University of Illinois*, *Urbana*.

The objectives of this study were to determine if plasma concentrations of lipid metabolites and lipid-soluble vitamins differed for Holstein and Jersey cows that were selected for new intramammary infection (new IMI) status and to determine factors affecting the risk for developing a new IMI during the transition period. Using a subset of cows from a larger study, 10 Holstein and 10 Jersey multiparous cows, of which 5 Holstein and 4 Jersey cows had developed a new IMI, were fed similar rations from dry-off (wk -9) through 8 wk postpartum. Lacteal secretions collected aseptically at wk -9, 1, 4, and 8 were analyzed for mastitis pathogens. A new IMI was defined if the pathogen isolated postpartum differed from wk -9 culture results. Body condition score (BCS), plasma concentrations of cholesterol, phospholipids, triacylglycerols, α-tocopherol, β-carotene and retinol were measured at wk -2, 1, 2, 4, and 8. Breed differences were analyzed using the repeated measures of ANOVA. Logistic regression was used to determine significant factors associated with an increased risk for a new IMI. Jersey cows had greater plasma retinol (1.46 vs. 1.25 μg/ml, P = 0.009) and β-carotene (6.41 vs. 4.42 μg/ml, P = 0.005) concentrations compared to Holstein cows, respectively. Plasma cholesterol concentrations were significantly greater for Holstein cows at wk 4 and 8 postpartum compared to Jersey cows (P < 0.01). Cows that had developed a new IMI had a significant delay in recovery of postpartum plasma β-carotene to prepartum levels (P < 0.01) compared to cows which did not develop a new IMI. A greater BCS at wk -9 was associated with an increased risk for developing a new IMI for both breeds (P = 0.03). Holstein and Jersey cows differed in plasma concentrations of several lipid metabolites and lipid-soluble vitamins. However, an increase in prepartum BCS similarly increased the risk for developing a new IMI postpartum for both breeds.

Key Words: Retinol, β-carotene, New intramammary infection

119 Effect of ruminally degraded protein source on production performance in Holstein cows. A. B. Peterson*[1], R. L. Baldwin, VI[2], and R. A. Kohn[1], [1]*University of Maryland*, *College Park*, [2]*USDA-ARS*, *Beltsville, MD*.

To evaluate the effect of two ruminally degraded protein (**RPD**) types (amino acids vs. non-protein N) eight early lactation Holstein cows were arranged in a repeated 4x4 Latin square design balanced for carryover effects with 21 d periods. All diets were isoenergetic (1.71 Mcal/kg) and had the same RUP content (5.6%). Cows were fed either a base diet containing 12.8% CP or one of three treatment diets containing 16% CP supplemented with urea, casein or both. Dry matter intake (**DMI**) was lowest for cows fed the base diet (16.8 kg/d) while cows fed the urea and urea/casein diets had the highest DMI at 18.8 and 18.6 kg/d, respectively ($P < 0.05$). Cows fed the casein diet consumed less than cows fed the urea diet (18.2 kg/d; $P < 0.05$) however this cannot be explained by apparent dry matter or NDF digestibility as they were not affected. Milk yield averaged 29.0 kg/d (SEM=2.6) for cows fed the base diet compared to cows fed the urea/casein diet which averaged 33.9 kg/d ($P < 0.05$). Cows fed the urea and casein diets yielded 32.9 and 32.6 kg/d of milk, respectively, which were not different from each other but were higher than the base diet and lower than the urea/casein diet ($P < 0.05$). Milk fat and protein percentages did not differ among treatments. Milk urea nitrogen (**MUN**) was lowest for cows fed the base diet averaging 6.6 mg/dl ($P < 0.05$) while MUN from cows fed the other diets averaged 12.5 mg/dl and did not differ from each other. Though the energy content of the diets was the same, the urea/casein diet may have provided a better combination of available ammonia and amino acids to the rumen microbes which may have increased microbial yield and therefore milk production. The type of RDP affects DMI and milk yield as cows may require both readily available amino acids as well as a source of ammonia for maximum yield.

Key Words: Rumen degraded protein, Milk yield, Amino acid

120 Effect of forage processing and corn particle size on milk production and composition, and nutrient digestibility for high producing Holstein dairy cows. N. E. Brown*, V. A. Ishler, Y.-H. Chung, T. W. Cassidy, K. S. Hyler, and G. A. Varga, *Pennsylvania State University*, *University Park*.

A replicated 4 X 4 Latin Square design experiment was conducted to evaluate either grass silage (GS) or grass hay (GH) with fine ground or cracked corn in diets for lactating dairy cows. One replicate contained four rumen cannulated cows. Cows averaged 76 ± 11 d in milk. Diets were formulated to contain 50% forage on a DM basis, (50% GH or GS and 50% corn silage). Within each forage source either fine ground corn or coarse corn was provided. The diets were formulated to contain 16% CP, 32 % NDF, and 1.64 NEL Mcal/kg DM. Each period lasted 28 d, the final 7 d were for sample collection of milk yield and components, rumen measures and fecal output. Dry matter intake (DMI) was lower (P<.01) for cows fed GH diets (20 vs. 23 kg/d), while amount of NDF consumed did not differ across diets. Milk yield (37.2 ± 1.37 kg/d) and fat corrected milk yield (FCM; 36.7 ± 3.3 kg/d) did not differ. Dry matter efficiency (FCM/DMI) was higher (P=.08) for cows fed GH vs. GS diets (1.92 vs. 1.54). Dry matter digestibility was higher for (P<.03) GS diets (54.7 vs. 48.4%), however no differences were observed for NDF digestibility across diets (37.8% ± 3.36). Fecal output (% DM basis) was highest (P<.02) for the GH diet with coarse corn compared to the other three diets (13.8 vs. 9.85 kg/d). Numerical trends were observed for ruminal contents (as is basis) such that cows provided the GS diets had greater amounts of ruminal digesta than cows provided GH diets (90.4 vs. 75.6 kg). Propionic acid concentration was higher (P<.01) for cows provided diets containing fine ground corn vs. cracked corn. Higher concentrations of total VFA and isoacids were observed for diets containing GS vs. GH. Opportunities exist to provide greater quantities of GH in lactating cow diets without compromising milk volume or components and enhancing DM efficiency provided that ruminal fermentability of carbohydrates are matched for the forage utilized.

Key Words: Grass silage, Alfalfa silage

121 Lactoferrin addition to an intensified milk replacer feeding regimen. K. Cowles*, R. White, N. Whitehouse, and P. Erickson, *University of New Hampshire*, *Durham*.

The objective of this study was to evaluate lactoferrin (L) addition to milk replacer (MR) on DMI, growth, and days medicated. Thirty three Holstein heifer calves were assigned to 4 treatments in a 2x2 factorial arrangement of treatments in a randomized complete block design. Treatments were: 586 g conventional MR (20% CP/20% fat) ±1g L daily (C1, C0 n=9, 8) or high protein MR (28% CP/20% fat) fed on an ME basis, 0.2 Mcal/kg $BW^{0.75}$, and from d10 to d42, at 0.27 Mcal/kg $BW^{0.75}$, ± 1g L (H1, H0 n=8, 8). Calves were fed starter (25 % CP) in 227.5 g increments beginning on d 2 and had free access to water. Weaning was as follows: 1X feeding on d 42 for 7 d (weaning), on d 49 calves were weaned. Calves were on the study for 14 d postweaning. DMI was determined daily. Growth measurements were taken weekly. Calves on C treatments ate more starter preweaning (402 g vs. 170 g, $P \leq 0.001$) weaning (1256 g vs. 635 g, $P \leq 0.001$), and postweaning (1927 g vs. 1585 g, $P \leq 0.001$). Preweaning, H calves had higher DMI (1251 g vs. 951 g, $P \leq 0.001$). Weights of H calves were greater at weaning (78 kg vs. 74 kg, $P \leq 0.001$). H calves had greater ADG preweaning (753 g/d vs. 464 g/d, $P \leq 0.001$) and overall (577 g/d vs. 497 g/d, $P = 0.03$). H calves were more efficient preweaning (0.59 vs. 0.49, $P = 0.003$), but C calves were more efficient during weaning (0.44 vs. 0.03, $P = 0.04$). H calves had greater hip heights during weaning (94.9 cm vs. 91.9 cm, $P = 0.04$) and postweaning (96 cm vs. 94 cm, $P = 0.04$). H calves had greater heart girths preweaning (90 cm vs. 86 cm, $P = 0.002$), weaning (98 cm vs. 93 cm, $P = 0.001$) and postweaning (100 cm vs. 96 cm, $P = 0.05$). Days medicated were higher preweaning (2.7 d vs. 1.4 d, $P = 0.02$) and overall (3.2 d vs. 1.7 d, $P = 0.05$) for calves fed H. There were no effects of L on any experimental variable. H calves consumed less starter but had higher ADG overall. H calves had larger frames and greater BW than C calves.

Key Words: Lactoferrin, Calves, Milk replacer

ADSA-SAD-Dairy Production (Undergraduate)

122 Shorter dry periods: A different approach to dry cow management. C. Lilly*, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The dry period length of 45-60 days has been much debated. This standard recommendation of 60 days was not based on research field trials but by analyzing DHIA records. When these records were analyzed the majority of farms used were already managing for a 60-day dry period. Under this system cows that fell into the short or reduced dry period were those whose dry period was compromised by abortion, incorrectly recorded calving dates, or calving unusually early. These factors may reduce a cow's performance in the lactation that follows. With cows producing more today than years ago, cows are being dried off producing more milk per day. Persistency of the lactation has also been prolonged with the use of bST. Recent studies are showing that a shorter dry period is possible. Wisconsin research examined six studies that looked at dry period length. Four of six studies reported no significant difference in milk production of cows with a short dry period as compared to cows with a long dry period. However, none of the studies included milk produced by short dry period cows during their extra days in the milking herd. The short dry period cows were equal to or greater in fat and protein production than the standard dry period cows. A Florida study reported short dry period cows lost 5% of their body score as compared to 11% of the standard dry period cows. Shorter dry periods would simplify feeding management as a far off dry group would not be required. This would help an expanding herd compensate for crowded dry cow facilities and would require only one ration to be formulated. In addition dry cows would only need to adjust rumen mircoflora twice as compared to a herd managed for a far off dry group and a close-up group. Under the right management conditions, shorter dry periods should be considered.

Key Words: Dry Period

123 Manure as Energy: Converting an abundant waste product to a beneficial energy source. A. Bush*, *University of Kentucky*, *Lexington*.

A growing number of dairy farms are incorporating methane gas recovery as a secondary source of income, as well as a practical means of waste disposal. After manure is washed form the parlor and freestall barns, it is fed into a digester that can recover the methane produced when bacteria break down the manure. The methane can be used to fuel a combustion engine for electrical energy, heat water, or be burned off and released as carbon dioxide. A dairy milking 300 cows can produce enough power to offset energy costs for its own operations, and sell the excess to a local electric provider. Because manure is broken down by methanogenic bacteria, the digester is held at 95-105° F. This temperature is high enough to kill many pathogens and weed seeds. This means any digested manure applied as fertilizer will be less hazardous to water sources, contain fewer active weed seeds, and could retain more nitrogen than typical manure. Anaerobic manure digestion also reduces odor by 97% and prevents the release of methane gas into the atmosphere. Installation of the system is still rather costly, but with a 5-10 year payoff, and thousands of dollars available in state and federal grants, methane gas recovery is something to be considered by the dairy industry.

124 Accelerated calf growth: You make the call. T. Bridges* and C. Williams, *Louisiana State University*, *Baton Rouge*.

The goal of a successful heifer rearing program is to provide the opportunity for the animals to develop full genetic potential for milk production at the desired age with minimal expense. The first and most important step is the development of the young calf. On most farms, calves receive colostrum for the first 24 to 48 hours, followed by milk replacer or whole milk. Conventional feeding programs typically consist of feeding 1 pound of milk replacer containing 20% protein and 20% fat daily along with free access to calf starter. In recent years, a new feeding system has become the buzzword in calf rearing programs. Accelerated growth programs, or intensified early nutrition, have been introduced to increase weight gain in neonatal calves. The goal of this feeding system is to capitalize on rapid early lean growth potential of young calves and allow greater lean growth without fattening. Accelerated feeding programs advocate feeding milk replacers containing 25 to 30% protein and 20% fat at the rate of 2 to 2.5 pounds per day. Because of potential problems, an accelerated feeding system must be carefully examined prior to implementation. Potential advantages of this program include decreased time to breeding and first calving, increased efficiency of body size gain, improved health and immune system, and enhanced milk production ability at calving. Conversely, disadvantages of this program include increased costs during the milk feeding period, increased scouring and rough-looking calves, delayed rumen development, and increased management. Dairies with intensive management systems would be the farms most likely to consider this system. If raising bigger, taller, longer heifers is the goal, then accelerated feeding programs make sense. However, if goals are economic and centered more toward animal health, then accelerated feeding programs must be carefully evaluated. In deciding whether to implement the intensified early nutrition programs, dairy producers must consider their goals. In a rapidly evolving industry, new management strategies for calf rearing continually appear. Dairy producers must make the call as to whether an accelerated calf feeding program is right for them.

Key Words: Calves, Growth, Accelerated

125 Prevention and control of the Bovine Viral Diarrhea virus. J. Sackmann*, *Washington State University*, *Pullman*.

The Bovine Viral Diarrhea (BVD) virus is an RNA virus of the *Pestivirus* genus of the *Flaviviridae* family of viruses. This virus, as a disease agent causes respiratory and reproductive problems in cattle that can be economically devastating. The BVD virus affects animals at various stages of life. Pregnant cowsâ•™ fetuses can become infected during the latter stages of gestation, resulting in an aborted calf, or a calf that is persistently infected, a carrier. Carrier calves fail to thrive and can die before maturity. Carrier animals shed the virus in their feces, blood, nasal mucus, saliva and urine. Testing is possible in blood and tissue samples. Once an animal has become infected, it must be removed from the herd, as there is no cure for the infection. However, there are methods of preventing BVD. Over 140 vaccines are available in the United States to help build an animalâ•™s resistance. These BVD vaccines are available as killed or modified live. Though there are various vaccination programs available for prevention of BVD, a vaccination program alone is not a herd health program. Strict screening processes, testing all calves, coupled with culling of positive calves and implementing a closed herd policy, are methods of limiting the exposure of unaffected cattle. Implementing a vaccination program for incoming cattle, as well as segregating them from the herd until determined to be BVD negative, is also a method of preventing spread. Although there are various methods of prevention and control for this disease, an alarmingly low percentage of dairies utilize prevention and control methodsâ•"as many as 75.5% of herds do not require testing of animals before incorporation into a herd. Only 10% of beef and dairy operations tested for BVD in purchased cattle in 2001. In summary, BVD is a viral disease decreasing the profitability of cattle; however, simple strategies for prevention and control of this disease are available. Therefore, it would be economically advantageous for producers to implement BVD prevention and control measures.

Key Words: BVD, Prevention, Control

126 The effects of heat stress on reproductive efficiency in dairy cattle. L. Buttles*, *University of Wisconsin*, *River Falls*.

Heat stress causes many negative effects within dairy cattle. These negative effects include, but are not limited to, decreased milk production, decreased reproductive efficiency, increased semen cost, and uneven calving intervals. Activity levels decline during estrus within periods of heat stress. Furthermore, the fertility of ova produced is also compromised. Synchronization protocols and embryo transfer offer options to combat reproductive problems related to heat stress but are associated with higher cost to the producer. Misters and fans are additional tools used to combat heat stress.

Key Words: Reproduction, Heat Stress

127 Management considerations with shortened dry periods. D. Maulfair*, *Penn State University*, *University Park*.

Recent studies have indicated that dry periods shorter than 60 d may be profitable. Research trials in Florida, Arizona, and Wisconsin have shown that although cows produce up to 4% less in the next lactation following a 30 d dry period, this is more than offset by the income from extra days added to the current lactation. Break-even milk yield based on production and expected calving date should be a primary determinant in shortening dry periods. Parity is another consideration because studies suggest that 30 d dry periods between the first and second lactation are not as economical; these cows show a larger drop in milk yield than older cows in the next lactation. Other management factors to consider include accuracy of breeding records, antibiotic use, feeding programs, and housing utilization. The importance of accurate breeding records is multiplied because there is much smaller margin for error with a shorter dry period. Because some dry cow treatments have withholding times longer than 30 d, their use must be carefully monitored. The dry cow ration also requires attention because these cows may be able to be fed a high energy ration for their entire dry period. Lastly, capacity of the parlor and cow facilities must be taken into account because shortening dry periods effectively increases milking herd size, possibly resulting in excessive overcrowding.

Key Words: Dry Period, Milk Production

128 National Animal Identification: What is its future? M. Aguiar* and E. Jaster, *California Polytechnic State University*, *San Luis Obispo*.

The subject of animal identification is not new to the dairy industry. However, with such recent events such as the outbreak of Foot and Mouth Disease in the United Kingdom and the detection of Bovine Spongiform Encephalopathy (BSE) in the U.S., the dairy and animal industry has been alerted to the potentially devastating effects of an outbreak in the United States. Dairy producers within the U.S. have voluntarily participated in the Dairy Herd Improvement Association (DHIA) Programs for over 30 years. Being enrolled in DHIA requires the dairy producers to have individual animal identification with attached readable tags. Although DHIA provides an identification and tracking program at present it is a voluntarily operation and does not include the entire dairy and beef industry. Therefore, a reliable program that would trace any possibly infected animals is necessary to reduce economic losses and minimize loss of consumer confidence in dairy and beef products. With the implementation of an effective National Animal Identification System (NAIS) any animal suspected of being infected could be traced to its point of origin. This information could be used to determine all animals that have been exposed to this suspected animal. This would allow for immediate quarantine of suspected populations and or recall adulterated products. This early detection and remediation would drastically reduce the negative effects on producers.

Key Words: National Identfication, Dairy Cattle

Breeding and Genetics: Sheep, Swine, and Dog Breeding

129 Assessing connectedness in across-flock genetic evaluations. R. M. Lewis*[1,3], R. E. Crump[2], L. A. Kuehn[1], G. Simm[3], and R. Thompson[4], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*AGBU, University of New England*, *Armidale, Australia*, [3]*Scottish Agricultural Colle*, *Edinburgh, UK*, [4]*IACR-Rothamstead*, *Harpenden, UK*.

Reliability of across-flock genetic evaluations depends on the extent of genetic connections among animals in separate flocks. Our objective was to assess the relationship between connectedness and errors of prediction of differences in EBV ($a\hat{}_i - a\hat{}_j$) between pairs of animals (i,j) in different flocks. Fifteen flocks of 40 to 120 ewes were simulated for a trait with heritability of 0.25 within-flock. Flock genetic means were drawn from a normal distribution with mean 0 and scaled variance 0.25. Flocks had opportunity to link by sharing rams from a team of 6 reference sires (RS). Selection ensued for 15 yr. Six scenarios producing from no (no RS used) to strong (3 RS each mated to 10 ewes) across-flock connectedness were used. Connectedness was measured as the average prediction error correlation (r_{ij}) between flocks. In simulation, true breeding values (a) are known and the statistic $L_{ij} = (a\hat{}_i - a\hat{}_j) - (a_i - a_j)$ was obtained with expectation zero. The average square of L_{ij} for all i,j quantifies the mean square error of prediction [$M(L_{ij})$]. For each of 25 replicates of each scenario, r_{ij} and $M(L_{ij})$ were obtained for lambs born in yr 25 and summarized by flock. As RS use increased, r_{ij} increased and $M(L_{ij})$ decreased ($P<0.01$). Their relationship was modeled as $Y = b + ce^{-kX}$ where Y was the value of $M(L_{ij})$, b was the asymptote, $b + c$ the intercept, k the rate parameter, and X the value of r_{ij}. The b reflects variance, and c the squared bias without connectedness, of prediction. The function fitted well (R^2=0.97) with values of b, c and k of 0.372±0.0161,

0.142±0.0214 and 379±149, respectively, although *b* and *k* were highly correlated (0.81). The asymptotic value of *b* was approached with only 1 RS mated to 5 ewes. In conclusion, the bias of comparisons of EBV quickly fall as connectedness increases, with adequate links established by limited sharing of rams among flocks.

Acknowledgements: We are grateful to the Meat and Livestock Commission for funding.

Key Words: Connectedness, Prediction Error, Sheep

130 Evaluating connectedness over time in a group breeding scheme using a sheep paradigm. L. A. Kuehn*[1], R. M. Lewis[1], and G. J. Nieuwhof[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Meat and Livestock Commission*, *Milton Keynes, UK*.

Poor connectedness between animals in separate flocks lowers reliability when comparing EBV across flocks. The objective of this study was to assess the increase in connectedness between flocks of sheep participating in a sire referencing scheme (SRS). Pedigree and performance data for a single trait with a within-flock heritability of 0.25 were simulated (25 reps) for 15 flocks with 40 to 120 ewes per flock. Founder genetic means for each flock were sampled from a normal distribution with mean zero and SD equal to the trait's genetic SD. After 10 yrs of random mating, flocks had opportunity to join a SRS and selection began for the simulated trait. Six yearling rams were chosen as reference sires randomly from the top one-sixth of the population ranked on BLUP EBV. Every year, in each flock, three reference sires were each mated to 10 ewes. Remaining ewes were mated to homebred or purchased rams of unknown pedigrees. Connectedness was measured as the average prediction error correlation of flock genetic means (flock connectedness) or of EBV for the current crop of ram lambs EBV (lamb connectedness). Four sire referencing scenarios were considered in which all flocks participated in a SRS for: i) 15 yr (ALL); ii) 5 yr and discontinued the scheme for 10 yr (OFF5); iii) 10 yr and discontinued for 5 yr (OFF10); and, iv) 0 yr since scheme not formed (OFF). Genetic gain was on average 1.19 times higher ($P<0.01$) at yr 15 of selection in the ALL as compared to the OFF scenario. Genetic gain was intermediate in the OFF5 and OFF10 scenarios. Flock connectedness increased linearly in all scenarios while SRS was underway and leveled off when flocks discontinued SRS. Lamb connectedness increased rapidly as soon as the SRS was implemented and decreased substantially the year the flocks left the scheme ($P<0.01$). Through group breeding schemes, connectedness is rapidly increased thereby allowing producers to make equitable genetic comparisons between their breeding animals.

Acknowledgements: We are grateful to the Meat and Livestock Commission for funding.

Key Words: Connectedness, Simulation, Sheep

131 Evaluating parameters affecting on economical attributes of kordian sheep in order to estimating of genetic trend in shirvan station. S. A. Shiri*, *Agricultural & Natural Resources Research Center of Khorasan*, *Mashhad, Iran*.

Data from 6215 Kordian sheep collected over 13 yr (1991-2004) at the animal breeding station of Shirvan were analysed by using the DFREML 1997 package. Traits analysed were: birth weight (BW), weaning weight (WW),pre-weaning gain (G1), post-weaning gain (G2), lamb fleece weight (LF),and adult fleece weight (AF). Effects of sex, age of dam, birth type and birth year for all growth traits were significant (P<0.05). Estimates of direct heritability were obtained with univariate and bivariate animal models. Heritability estimates from the univariate animal model were 0.18, 0.29 ± 0.06, 0.05 ± 0.02, 0.47, 0.37 ± 0.11, 0.09, 0.21; and from the bivariate animal model were 0.25 ± 0.05, 0.30 ± 0.01, 0.04 ± 0.004, 0.32 ± 0.03, 0.11 ± 0.003, 0.19 ± 0.02; for BW, WW, G1, G2, LF, and AF, respectively. Estimated repetability of WW, G1, LF and AF were 0.46 ± 0.11, 0.23 ± 0.39, 0.11 ± 0.18, 0.26 ± 0.07, respectively. Genetic and (phenotypic correlations) between BW & WW, WW & 6-mo weight, G1 & G2, BW & LF, LF & AF were: 0.11 ± 0.16 (0.25), 0.89 ± 0.05 (0.62), -0.39 ± 0.26 (-0.43), 0.54 ± 0.29 (0.05), 0.30 ± 0.40 (0.06), respectively. Genetic trends in WW, G1, LF and AF were significant(P<0.05) with trend in growth traits being positive and wool traits having negative genetic trend after 1995.

Key Words: Kordian Sheep, Genetic Trend, Animal Model

132 Genetic (co)variance components for ewe productivity traits in Katahdin sheep. H. B. Vanimisetti*, D. R. Notter, and L. A. Kuehn, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Total litter weight weaned by a ewe is an economically important trait in sheep production but records of zero when no lambs are weaned, missing weaning weight records, or invalid weight records taken outside acceptable age windows complicate direct genetic analysis of this trait. The objective of this study was to estimate genetic (co)variance components for total litter weaning weight per ewe lambing (TW) and its components, number of lambs born (NB), number of lambs weaned (NW), and average lamb weaning weight (AW) for Katahdin sheep. The TW was the sum of 60-d age-adjusted weights of all lambs weaned in the litter; these weights were also adjusted for ewe age and lamb sex. The AW was the average 60-d age-adjusted weight of all lambs weaned in the litter; these weights were adjusted for ewe age, lamb sex, and type of birth and rearing. A total of 2,995 NB and NW records, but only 2,714 AW and 2,622 TW records, were available from 1,549 ewes over 4 yr. Ewes were progeny of 382 sires. Initially, heritabilities were estimated for each trait from univariate REML analyses. Initial estimates of genetic correlations were obtained from bi- and trivariate analyses and then used in a final four-trait analysis. The model for NB, NW, and TW included fixed contemporary group (CG) and ewe age effects and random ewe additive and permanent environmental effects. A random service sire effect was also fitted for TW. The model for AW included fixed CG and random ewe additive and permanent environmental and service sire effects. Heritabilities of TW, NB, NW, and AW from univariate analyses were 0.14, 0.13, 0.10, and 0.14 (all $P < 0.01$), respectively. Genetic correlations of TW with NB, NW, and AW were 0.42, 0.94, and 0.77, respectively, those of NB with NW and AW were 0.50 and 0.16, respectively, and that between NW and AW was 0.52. Using these genetic correlations, TW EPD can be predicted from its components by a selection index approach, thereby utilizing all available data for genetic evaluation of ewe productivity.

Key Words: Heritability, Productivity, Sheep

133 Genetic factors influencing body weights and condition scores in adult Targhee ewes. R. C. Borg*[1], D. R. Notter[1], R. W. Kott[2], and L. A. Kuehn[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Montana State University*, *Bozeman*.

Genetic and phenotypic relationships among adult BW, condition score (CS), and EBV for currently evaluated production traits were analyzed in Targhee sheep. A total of 1,094 records were collected from 513 ewes over 5 yr. Ewe BW and CS (1-5 scale) were recorded three times each year: late gestation (G), early lactation (L) and post-weaning (P). Data included 863 G and P records and 1,078 L records for BW and CS. A multivariate model including fixed effects of year, ewe age, and litter size was simultaneously fit to each BW and CS. Regressions of BW and CS on EBV were also estimated in individual models including these fixed effects. The EBV were for 120-d weaning weight, maternal milk, yearling weight, yearling gain, fleece weight, fiber diameter, staple length, and prolificacy (lambs born/100 ewes lambing). Heritabilities and permanent environment effects were estimated in univariate analyses with the same fixed effects. Means for BW were 71.3, 61.3 and 67.3 kg for G, L and P, respectively, and for CS were 3.1, 2.6 and 2.8 for G, L and P, respectively. Residual correlations (r) among adjacent BW and CS measures averaged 0.74 ($P<0.05$) and 0.26 ($P<0.05$), respectively; for BW and CS measures taken at the same time averaged r = 0.33 ($P<0.05$). On average, BW increased 4.7 kg for each scoring unit increase in CS ($P<0.05$). No antagonistic relationships existed between CS and any EBV; most regressions did not differ from zero ($P<0.10$).

However, BW was associated ($P<0.05$) with differences in all EBV except those for fiber diameter and staple length. Ewes with single litters had higher CS during L than ewes with larger litters ($P<0.05$). Heritability estimates for CS were 0.10, 0.15 and 0.16 for G, L and P, respectively. Permanent environment effects were not significant ($P<0.10$). The genetic relationships that exist between performance potential, BW, and CS may be useful in estimating adult ewe performance.

Key Words: Sheep, Heritability, Body Weight

134 Genomic organization and six exonic polymorphisms of the pig SLC11A1 gene. W. Zhen-Fang*, L. Wen-Hua, Z. Xi-Chuan, and Y. Guan-FU, *South China Agricultural University*, *Guangzhou, Guangdong, China*.

SLC11A1 gene plays a crucial role in animal disease resistance to several intracellular pathogens such as Mycobacterium, Leishmania and Salmonella. In this study, PCR amplification and sequencing were performed to obtain the genomic organization of pig SLC11A1 gene by comparative genomic analysis. Results showed that pig SLC11A1 gene consists of 15 exons and 14 introns, which is consistent with the mouse, human SLC11A1 gene. All of the introns sequence acquired have been submitted to GenBank and assigned the accession numbers AY368468, AY368469, AY368470, AY368471, AY368472, AY368473, AY368474, AY368475, AY556536, AY368476, AY368477, AY368478, AY368479, AY368480,respectively. The full gene spans 12,267 bp. Mutational analysis was performed on the exonic regions. Six single nucleotide polymorphisms (SNPs) are identified, two are nonsynonymous, three are synonymous, and one is in 3'UTR region. The SNP G80C in exon2 results in the change Asp6 to His6; and G587A in exon6 results in the change of Val175 to Ile175. The availability of the fine genomic organization of the pig SLC11A1 gene and the identification of polymorphisms will facilitate the evaluation of its functional role in several diseases resistance or susceptibility.

Acknowledgements: We thank Dr Shu-Hong Zhao from college of animal science, Huazhong Agricultural University, china, and Dr Jin-Zeng Yang from Dept of Human Nutrition, Food and Animal Sciences, University of Hawaii, USA for valuable suggestions to this paper.. This study was supported in part by an agricultural key Grant-in-aid project (2002C20202) from the office of science and technology, Guangdong province,china

Key Words: Pig SLC11A1 Gene, Genomic Organization, Single Nucleotide Polymorphism

135 Detection of imprinted quantitative trait loci for growth, carcass, and meat quality traits in swine. N. Vukasinovic*[1], A. Clutter[1], F. Du[1], M. Lohuis[1], L. Messer[1], J. Bennewitz[2], N. Borchers[2], N. Reinsch[2], G. Otto[2], K. Sanders[2], and E. Kalm[2], [1]*Animal AG, Monsanto*, *St. Louis, MO*, [2]*University of Kiel*, *Kiel, Germany*.

Detection of imprinted quantitative trait loci (QTL) affecting growth, carcass, and meat quality was conducted in an F2 population created by crossing Pietrain boars with Large White x Landrace hybrid sows. 1014 F2 animals, their parents and grandparents were genotyped for 27 microsatellite markers on chromosomes 2, 6, and 7. Phenotypes on 31 growth, carcass, and meat quality traits were available. Imprinting analysis was performed using the following methods: (1) the imprinting effect was fitted along with additive and dominance effect; imprinting was inferred if the model with imprinting was significantly better than the null model without QTL and the Mendelian model without imprinting (Knott et al., Genetics 149, 1998); (2) maternal and paternal allele effects were fitted separately; imprinting was declared if the full model (with paternal, maternal, and dominance effect) was significantly better than the model with only one parental component and no dominance (De Koning et al., JAS 79, 2001); and (3) Mendelian, full, paternal, and maternal models were evaluated using a decision tree to determine presence and mode of inheritance of QTL (Thomsen et al., WCGALP Proceedings, 2002). All three methods detected several QTL for growth, fatness, and meat color and conductivity on SSC2, most of which were (paternally) imprinted. With method (3), QTL for abdominal fat, loin eye area, and meat color were partially imprinted. Methods (1) and (2) did not infer imprinting for QTL affecting backfat, meat color, and meat reflectance. No QTL was detected on SSC6, except for a paternally imprinted QTL for birth weight detected by method (3). On SSC7, all three methods detected Mendelian QTL affecting carcass length and backfat; in addition, method (3) detected partially imprinted QTL for ham weight and percentage, and loin eye area. These results confirmed previous findings of paternally imprinted QTL for growth and fatness on SSC2 and provided evidence of additional imprinted QTL.

Key Words: Imprinting, QTL Mapping, Swine

136 Discrete time survival analysis of longevity in a colony of dog guides. J. Cole*[1], B. Southey[2], D. Franke[3], and E. Leighton[4], [1]*Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*, [2]*University of Illinois*, *Urbana*, [3]*Louisiana State University*, *Baton Rouge*, [4]*Seeing Eye, Inc.*, *Morristown, NJ*.

Working life for 1,177 German Shepherd (GS) and 1,724 Labrador Retriever (LR) dogs that worked as guides for the blind was studied using discrete time survival analysis. Total years worked after graduation, total months worked after graduation, months worked between graduation and 18 mo (EWL), and months worked beyond 18 mo (LWL) were analyzed using complementary log-log animal and maternal effects models. Animals working 10 or more years were combined in a single group. Censoring rates were 91.76% (44.87%) and 94.90% (48.90%) for EWL (LWL) in GS and LR, respectively. Explanatory variables were duration of time interval (months or years), contemporary group, sex, and inbreeding coefficient. Estimates of explanatory variables obtained within the same period across models and different time intervals were similar. No sex differences were observed and the hazard of culling increased with increasing inbreeding coefficient. Maternal effects were small and non-significant in both breeds for all traits. Heritability estimates ranged from 0.05 to 0.12 in GS and 0.04 to 0.15 in LR and were lowest for later working life, intermediate for total working life in months or years, and highest for early working life. These estimates were higher than the previously reported estimates of 0.03 (0.02) and 0.05 (0.03) for EWL (LWL) in GS and LR, respectively, that were obtained with a Weibull sire model. Pearson's product-moment correlations among sire estimated breeding values for EWL and LWL were 0.92 and 0.83 for GS and LR, respectively, suggesting that EWL and LWL are biologically different traits. These results suggest that there is sufficient genetic variability that can be exploited to genetically improve working life.

Key Words: Dog, Heritability, Longevity

Breeding and Genetics: Statistical Methods II

137 Bayesian inferences on major genes affecting polygenic binary traits: comparison of models and application to osteochondral diseases in pigs. H. N. Kadarmideen*[1] and L. L. G. Janss[2], [1]*Swiss Federal Institute of Technology*, *Zurich, Switzerland*, [2]*Wageningen University and Research Centre*, *Lelystad, The Netherlands*.

The main objective of this study was to develop and apply Bayesian segregation analysis (BSA) method to detect major genes for binary polygenic traits and to investigate different BSA models. In order to apply developed methods, osteochondral (OC) diseases in pigs (as scores or binary data) were modeled by a mixture inheritance linear model (MILM) and threshold model (MITM) and analyzed by Bayesian-Gibbs sampling algorithms. Data, on 1163 pigs with OC (pedigree with 2891 animals), were from company, SUISAG. Both MILM and MITM included systematic environmental effects, animals polygenic effects and a major gene effect with *Mendelian* transmission probabilities. Results showed familial transmission and evidence for segregating major gene with

significant major gene variances; range of MILM parameters was, additive effect = 0.466 to 0.587, dominance effects = -0.587 to -0.468, additive major gene variances = 0.011 to 0. 0.162, dominance major gene variances = 0.016 to 0.058 and disease allele frequencies = 0.45 to 0.83. Magnitudes of parameters were higher for MITM than MILM, as expected. BSA based on *individual animal model* analysis on very low incidence (2.0-4.0%) data caused poor mixing and convergence of Gibbs chains, mostly with MILM than MITM. Further, polygenic variances were outside bounds or overestimated. A variant of BSA, *the informative prior model*, with a *prior* and weight for polygenic variance provided significant improvements. Another variant, the *reduced animal model* was implemented to sample *transmitting abilities* of only parents (major gene probabilities were still sampled for each animal); results showed improvements with larger family sizes. Results from this study provided better insights into BSA for binary traits which would be useful across many animal species as well as humans.

138 Statistical analysis of relative quantification of gene expression using real time RT-PCR data. J. Steibel*, R. Poletto, and G. Rosa, *Michigan State University*, *East Lansing*.

The objective of this work is to assess the use of linear models for the analysis of RQ-RT-PCR experiments. Reverse Transcription (RT) followed by the polymerase chain reaction (PCR) is the most accurate and sensitive method to quantify relative or absolute levels of mRNA transcription of selected genes. The relative quantification (RQ) is based on the comparative expression (fold change) of a target gene under two conditions, avoiding the production of costly standard material necessary for absolute quantification. Complex hypotheses are usually tested in gene expression studies using factorial experimental structures and hierarchical levels of replication, which require suitable analysis. In the literature, however, the statistical procedures used for RQ-RT-PCR data either ignore the distinction between technical and biological variability or are restricted to simple cases where only two experimental groups are considered. As a consequence, estimated fold changes and associated p-values are generally invalid. Here we discuss linear models for the analysis of RT-PCR data, under two alternative specifications: a) models assuming normality of the mRNA concentration, and b) models assuming normality in the log scale. Variable definition, hypothesis testing and fold-change estimation are presented for each case. Normality tests are used to determine the most appropriate scale and analysis approach. The implementation of the different procedures is illustrated using data from an experiment on gene expression in brain of piglets subjected to social isolation and weaning. The experiment involves a 2′2′2 factorial structure in a split-plot design. The results show that, as opposed to the traditional methods, a linear model fitted to the log scale can be used to test any linear hypothesis about differential expression and to obtain point estimates and confidence intervals of the fold change for any pair-wise comparison of RQ-RT-PCR data. Moreover, this model allows the inclusion of genetic and environmental effects (such as litter) and leads to valid inferences by appropriately modeling the different levels of replication.

Key Words: RT-PCR, Relative Quantification, Statistical Analysis

139 Exploiting non-additive effects of imprinted QTL in marker-assisted selection by genetic algorithm. Y. Li*[1], H. N. Kadarmideen[1], J. H. J. van der Werf[2], and B. P. Kinghorn[2], [1]*Swiss Federal Institute of Technology, ETH-Zentrum*, *Zurich, Switzerland*, [2]*University of New England*, *Armidale, Australia*.

Incorporation of quantitative trait locus (QTL) in conventional breeding program is a focus in modern animal breeding. Imprinted QTL has been detected in some animal species. The objective of this study was to investigate superiority of mate selection with an imprinted QTL over index selection in a model including polygenic effects and QTL effect in overlapping generations. Benefit from mate selection was optimized by using a genetic algorithm according to total benefit (including those from polygenes and QTL) from progeny generation while index selection was conducted with an index consisting of sum of BLUP (best linear unbiased prediction) estimated breeding values of polygenes and breeding value of the QTL. Polygenic effects were assumed to follow an infinitesimal model with 0.3 of heritability. A maternal imprinted QTL was assumed with inactive allele inherited from female parent. The additive effect of the allele inherited from male parent was 1.0 of the additive standard deviation of polygenes. A population with 200 dams and 20 sires at 4 age groups in overlapping generations were used, 50 dams and 5 sires being selected each year. The number of progeny per family was 2. Initial frequency of the favorable allele of the QTL was 0.1. Mate selection produced about 40% extra benefit over index selection was achieved. When the QTL is maternally imprinted, selection pressure on QTL was put on the male parents because the allele inherited from the female parents was silent, therefore, genotype of the QTL was optimized in selection of sires and in mating allocation in the mate selection.

Key Words: Imprinted QTL, Marker-Assisted Selection, Genetic Algorithm

140 Experimental design for estimation of breed, heterosis, and QTL effects in cattle. R. M. Thallman*, L. V. Cundiff, and G. L. Bennett, *USDA-ARS-USMARC*, *Clay Center, NE*.

Generation of data to provide ties between breeds and breed-specific heterosis estimates for support of multibreed national cattle evaluation has become a primary objective of the Germplasm Evaluation Program (GPE) at the U.S. Meat Animal Research Center. Consequently, more emphasis will be placed on continual re-sampling of highly influential purebred sires with high accuracy EPD. A change in design that incorporates the following elements is being considered: Purebred cows and cows 75% or slightly more of their sire breed (SB75) would be bred AI to bulls of a different breed to produce progeny 50% or slightly more of their sire breed (SB50), which would in turn be bred AI to bulls of their sire breed to produce SB75 progeny. Approximately 25% of the cow herd would be purebreds of four breeds, 40% would be SB50, and 35% would be SB75. All AI sired heifers would be retained in the herd for maternal evaluation and (with the exception of some purebred cows) all cows would be AI-sired. Substantially greater information can be generated from the same number of cows by designing the population in such a way that every calf contributes to estimates of both direct and maternal effects. This design would provide a set of powerful resource populations with extensive phenotypes for detection and characterization of QTL. Sampling highly influential sires would ensure that the population segregated most polymorphisms relevant to the U.S. beef industry. Progeny of F_1 cleanup bulls would contribute directly to project objectives by providing large paternal half-sib families with complete carcass phenotypes. Different subsets of the population would be most effective for each of several genomics objectives. Direct and maternal breed-specific heterosis, as well as breed effects and QTL effects, should be estimable under the proposed design using a model accounting for breed contributions and expected heterozygosity. Using the same population for several complementary objectives is the most efficient use of limited resources.

Key Words: Breed Evaluation, Heterosis, QTL

141 Hierarchical Bayesian model for analysis of gene expression data. R. Rekaya* and W. Zhang, *University of Georgia*, *Athens*.

In the last few years several ANOVA based models have been proposed both for spotted cDNA microarray and for oligonucleotide data analysis. Estimating all effects, including gene effects, in a global ANOVA model is computationally challenging due to the large number of parameters to be inferred. Consequently, ANOVA analyses for microarray data are usually implemented in two stages. The first stage consists in modeling global effects affecting the expression levels fellowed by a within gene model that fits the data of each gene separately. Although this approach helps solve the computational challenge, it has two major problems: 1) the residual terms of the first stage model are usually assumed non-correlated. Such assumption is often not true, especially when the gene effects within array are not included in the model 2) the fitted residuals of the first stage are used as dependent variables of the second stage model with-

out consideration of their uncertainty. To overcome these two problems a hierarchical Bayesian model with three stages was proposed where the extra stage was included to account for the potential correlations between expression levels of a gene within the same array. To evaluate the performances of the proposed model, a simulation was conducted. Given the complexity of simulating microarray data, a novel approach was developed. It consisted in using real gene expression data from which only records corresponding to one treatment level (reference treatment level) were kept. Records for each of the other treatment levels were generated by adding a random quantity (difference between the effect of the reference level and the new treatment level for which data is being generated) to the observed expression for the reference treatment level. The performances of the proposed and classical two stage models were evaluated based on their ability in correctly estimating the true differences between treatment levels. In all cases, the proposed approach proved to be superior to the classical two stage model. Such superiority ranged from 10 to 37% depending on the simulation parameters

Key Words: Hierarchical Model, Bayesian, Gene Expression

142 A simulation study for analysis of uncertain binary responses using fuzzy logic classification. R. L. Sapp*, M. L. Spangler, R. Rekaya, and J. K. Bertrand, *The University of Georgia*, *Athens*.

A simulation was carried out to investigate methods of analyzing uncertain binary responses for first insemination success (FIS). A linear mixed model that included herd, year, and month of mating as fixed effects; and unrelated service sire, sire and residual as random effects were used to generate binary data. Binary responses were assigned using the difference between days to calving (DC) and average gestation length (GL). If the difference between DC and average GL was less than or equal to 21 days then FIS = 1, otherwise FIS = 0; in other words, a successful FIS event was defined as conception occurring during the first 21 days of the breeding season. Females deviating from average GL leads to uncertain binary responses. The methods investigated were: 1) threshold model (TM) fitted to certain (no uncertainty) binary data (M1); 2) TM fitted to uncertain binary data ignoring uncertainty (M2); and 3) analysis of uncertain binary data, accounting for uncertainty from day 16 to 26 (M3) or from day 14 to 28 (M4) after introduction of the bull, using a TM with fuzzy logic classification. Three different fuzzy logic functions were utilized to account for uncertain FIS responses. There was virtually no difference between point estimates obtained from M1, M3, and M4 with the true values used in the simulation. When uncertain binary data were analyzed ignoring uncertainty (M2), sire variance and heritability were under estimated by 22 and 24%, respectively. In this study, the mean and standard deviation of GL were used to assess the probability of miscoding of FIS via fuzzy logic classification. There did not appear to be large differences between the intervals (14 to 28 days vs. 16 to 26 days) or fuzzy logic functions (two linear and one non-linear) used to account for uncertainty of FIS. The results of this study suggest that when analyzing binary data with uncertainty, a standard TM could lead to biased inferences. Bias could be avoided using a statistical model that contemplates uncertainty through fuzzy logic classification.

Key Words: Binary Response, Fertility, Fuzzy Logic

143 Dealing with extreme case problem in the analysis of binary responses. W. Zhang*, R. Rekaya, and K. Bertrand, *The University of Georgia*, *Athens*.

Binary responses, such as health and fertility traits, are often included in the routine genetic evaluation of livestock. The latent model postulates a continuous variable (liability) underling the discrete measurement and has been widely used in genetic analysis. When the occurrence rate of one binary outcome (+ or -) is low, observations in some contemporary groups, especially those with small size, can fall into the same category. In this situation, the maximum likelihood estimates of the associated location parameters do not exist theoretically, yielding the so-called "extreme case problem (ECP)". Two novel ad hoc methods for addressing ECP within the framework of a Bayesian approach are proposed: 1) adopting g-priors for the location parameters associated with ECP, 2) inserting a pseudo record for each ECP class with an approximate liability derived from a α% (such as 5%) upper limit of the probability of the unobserved response in ECP classes according to a Poisson model. Both methods are based on the assumption that the effects associated with ECP classes are finite and the large estimates with regular methods are due to abnormality in the likelihood. Thus, the proposed methods tend to restrict the estimates of the location parameters for ECP classes. In other words, the extreme case problem is simplified to a zero-numerator problem, which postulates that an event is conceivably possible but has not yet occurred in the available data. The analyzed data was simulated with a sire model, 8-50% ECP ratio, and 0.125-0.5 additive genetic variance (VA). The results indicate that both methods performed well in alleviating the bias associated with ECP in all scenarios. The bias in VA estimates was reduced from 15-190% to 0-90% depending on the simulation parameters, structure and size of data sets. The second method outperformed the first in the cases of lower VA (.125) and/or higher ECP ratio (>30%). Estimates of the location parameters for ECP classes showed regular patterns. No changes in predicted breeding values were observed when ECP was considered. It is concluded that the proposed methods proved to be effective in addressing ECP.

Key Words: Binary Responses, Extreme Case Problem, Bayesian Approach

144 Analysis of binary responses in presence of extreme case problem classes. R. Rekaya, R. L. Sapp*, and J. K. Bertrand, *The University of Georgia*, *Athens*.

A simulation was carried out to investigate methods of analyzing binary responses when extreme case problem (ECP) classes (all observations in a given class were zeros or ones) were present. A linear mixed model that included a fixed effect and random effects of sire and residual at the liability scale was used to generate binary data. Four simulation scenarios were conducted based on varying percentage of ECP: 1) 5% (5E); 2) 10% (10E); 3) 20% (20E); and 4) 30% (30E). A generalized prior (g-prior) with varying weight was used for the ECP classes: 1) 0% or no g-prior (NG); 2) 5% (5G); 3) 10% (10G); and 4) 15% (15G). Five replicates of each data set were generated and analyzed with all four g-priors. In all cases, a standard threshold model was used for analysis. Point estimates of sire variance obtained from 5E, 10E, 20E, and 30E using NG (flat prior for fixed effects) were, as expected, severely biased. Depending on the percentage of ECP, these estimates were over estimated by 68 to 148% when NG was used. When a g-prior was used, the bias was reduced and even eliminated depending on the percentage of ECP and the weight assigned to the g-prior. Using 15G, bias was completely eliminated independently of the percentage of ECP. For 10G, the bias was eliminated for data sets with 5E and 10E and significantly reduced for data sets with 20E and 30E. With 5G, bias persisted using all four data sets. Pearson correlations between true and estimated fixed effects for 5E, 10E, 20E, and 30E were the lowest when NG was used; further, the correlations were similar when 5G, 10G, or 15G was used for the varying percentage of ECP data. However, Pearson correlations increased dramatically for all levels of ECP when 5G, 10G, or 15G was included in the analysis to account for ECP. The results of this study suggest that when analyzing binary data with ECP, bias in the estimation of variance components could be eliminated, or at least significantly reduced, using a g-prior. Further work is being conducted to apply this methodology to a more realistic scenario (animal model and joint analysis of binary and continuous traits).

Key Words: Binary Response, Generalized Prior, Simulation

145 Investigation into a regression model for crossbred performance. T. Lewis*[1,2], J. Woolliams[2], and J. Wiseman[1], [1]*University of Nottingham*, *Loughborough, Leicestershire, UK*, [2]*Roslin Institute*, *Roslin, Midlothian, UK*.

Heterosis is often calculated using F1 and F2 crosses. Since pig breeding schemes produce many types of cross, is it possible to exploit such data to determine the sufficiency of various heterosis models? The aim of the study was to estimate

litter number born alive (NBA) of 9 different cross-bred classes of Large White (LW) and Pietran (Pt) pigs, to estimate classical heterosis and determine the presence of epistasis via recombination loss.

51,180 records of LW and Pt pure and crosses were taken from a database provided by JSR Genetics Plc. NBA estimates for 9 types of cross (pure LW & Pt, F1, and backcrosses 1, 2 & 3) were made using a full linear mixed model with parity, serve number, mating method (AI or natural) and type of cross as fixed effects. An alternative reduced model was fitted with LW fraction, heterosis and recombination loss included as covariates. The fitted values obtained from the reduced regression model were compared to cross type estimates from the factor model. The regression model was also run using an extended dataset including records from 95 animals of the same LW fraction but different cross types.

Regression co-efficients of heterosis, recombination loss and LW fraction on NBA; and NBA means (under LW fraction = 1) and estimated differences from the mean across all LW fractions are shown in the table.

Regression estimates indicate a significant heterotic effect on NBA. Recombination loss effects appear large, suggesting strong additive x additive epistatic effects but large standard errors mean they can only be determined as significantly different to zero using the extended data. The reduced regression model provided a similar pattern of responses to the full model.
NBA means and estimated differences

LW fraction	Factor	Regression	Extended
1	8.449	8.347	8.411
0.9375	0.249	-0.216	-0.280
0.875	-1.151	-0.340	-0.450
0.75	0.434	-0.317	-0.461
0.5	0.805	0.821	0.832
0.25	-0.808	-0.354	-0.480
0.125	-0.468	-0.396	-0.478
0.0625	-0.467	-0.281	-0.312
0	-0.056	-0.075	-0.038
Regression Estimates			
LW Fraction	-	0.075 (0.19)	0.038 (0.19)
Heterosis	-	1.717 (0.44)	1.701 (0.44)
Recombination Loss	-	-5.819 (3.09)	-7.014 (2.96)

Key Words: Heterosis, Litter Size, Pigs

146 Blup with SAS. Z. Zhang*, *Cornell University*, *Ithaca, NY*.

The SAS procedure Mixed and statistical models with genetic correlated random effect are intensively and independently used in biological research. The limitation factor for the joint application is the complexity to construct variance of genetic correlated random effect among individuals. A computer program LORG in the form of SAS macro is presented to facilitate the joint applications. The macro automatically constructs a SAS dataset that defines the variance structure of genetic correlated random effect. The SAS dataset can be imported by SAS procedure Mixed with the option of GDATA or LDATA. The macro is flexible enough to allow users to select type of pedigree to calculate probability of identity by decent and fit multiple traits and multiple genetic correlated random variables. The use of the macros is demonstrated through an illustrative example on simulated data.

Key Words: Mixed Model, SAS, Pedigree

Dairy Foods: Products and Processing

147 Development of cold resistant strains of bifidobacteria by natural selection. S. Ibrahim*, *North Carolina Agricultural and Technical State University*, *Greensboro*.

Recent studies have shown the health benefits associated with regular consumption of dairy food products containing bifidobacteria. Because they provide a very favorable growing environment, dairy products have been the preferred medium to reintroduce viable populations of bifidobacteria into the GI tract. To provide health benefits, bifidobacteria must remain viable in large numbers in the carrier food. Consequently, it is important to establish the survival and viability of these cultures when subjected to refrigerated storage. The objectives of this study were to investigate whether the survivability or resistance of bifidobacteria in cold storage could be improved by natural selection and to test a cold resistant strain for β-galactosidase activity and autoaggregation behavior. Twenty-nine different bifidobacteria cultures were propagated in TPY broth. Strains were transferred daily for 29 weeks into fresh TPY broth and incubated at 37C. Natural selection of the bacteria was achieved by making daily transfers of the cultures into fresh TPY and by lowering the growth temperature two degrees every week. Growth was monitored by measuring the optical density (O.D.) at 610nm. Results indicated that all 29 strains were able to grow at lower temperatures (<37 C) and achieve high cell density. However, only 10 of the strains were able to survive growth temperature below 20 C and maintain high cell density (O.D. > 0.90). Five strains were able to survive temperatures below 15 C and had high cell density (O.D. > 0.80). Two strains were able to grow at 7 C and reached high cell density (O.D. >0.80). The β-galactosidase activities of these strains were similar to the wild strains and showed a marked ability to autoaggregate in TPY. These results suggest that some strains of bifidobacteria are cold resistant and that their growth can be further improved through by a natural selection process that favors the growth of cold resistant bacteria. These findings further suggest that bifidobacteria can survive and thrive in limited time cold storage, which supports their use in dairy products as a health promoting probiotics.

Key Words: Cold Resistant, Bifidobacteria

148 A unique Japanese functional yogurt containing specific egg yolk immunoglobulin to suppress *Helicobacter pylori* in humans. A. M. Abdou*[1], K. Horie[1], N. Horie[1], Y. Kodama[2], Y. Hoshikawa[3], T. Yamane[4], A. Hansen[2], and M. Kim[1], [1]*Pharma Foods International Company, Ltd.*, *Kyoto, Japan*, [2]*Ghen Corporation*, *Gifu-City, Japan*, [3]*Glico Dairy Products Company, Ltd.*, *Tokyo, Japan*, [4]*Matsushita Memorial Hospital*, *Osaka, Japan*.

Health-conscious consumers increasingly looking for foods that promote good health and could reduce risk of diseases. Dairy products are excellent media to generate an array of products that fit into the current consumer demand. In particular; scientific and clinical evidence is mounting to corroborate the consumer perception of health from yogurt.

Hyperimmunization of hens could provide a convenient and economic source of immunoglobulin in their egg yolk (termed IgY). Accordingly, a novel approach in prevention and reduction of *Helicobacter pylori* (a gastro-duodenal ulcer pathogenic bacterium that infects over 50% of the population worldwide) has been achieved based on production of urease-specific IgY (IgY-urease) that prevent *H. pylori* colonization in the gastro-duodenal mucosa.

Specially designed yogurt containing 2 g IgY-urease egg yolk was produced commercially in Japan. IgY-urease activity showed stability in the product up to 7 d, and then decreased to 85% after 3 wk of storage. A clinical study was conducted to determine the effect of IgY-urease yogurt to suppress infection in humans. One hundreds seventy-four volunteers were screened using a 13C-urea breath test (UBT). Heavily infected volunteers with UBT values over 30 were selected (16 subjects) and recruited. Each volunteer consumed 1 cups of yogurt twice daily (4 g/ d egg yolk containing 40 mg IgY-urease) for 12 wk. Volunteers were tested after 4, 8 and 12 wk. UBT values significantly decreased after 8 and 12 wk. The study demonstrated that administration of a specially designed yogurt augmented with highly specific antibodies from egg yolk could effectively suppress *H. pylori* infection in humans.

Key Words: *Helicobacter pylori*, Egg Yolk Immunoglobulin, Functional Yogurt

149 Evaluation of process cheese food funtionality using various melt-tests. A. C. Biswas*[1], R. Kapoor[2], L. E. Metzger[2], and K. Muthukumarrapan[1], [1]*South Dakota State University*, *Brookings*, [2]*University of Minnesota*, *St. Paul*.

The melt characteristics of process cheese are an important functional attribute. However measurement and interpretation of cheese melt characteristic is difficult and a variety of methods can be used. The objective of this study was to evaluate and compare the meltability of process cheese foods (PCF) using various available meltability tests. The melt properties of 24 different PCF samples were analyzed using modified Schreiber test, melt profile analysis, meltmeter, and rapid visco analyzer (RVA). Total melt area was determined using modified Schreiber melt test at 90°C, softening temperature and time, cheese melting temperature and time, flow rate, and extent of flow were determined using melt profile analysis, melt/flow behavior was determined by meltmeter at 60°C, and hot apparent viscosity (HAV) and time at 5000 cP were determined using RVA melt test. There were high correlations between modified Schreiber melt area (MSMA) and RVA melt test (0.72, and 0.79 for HAV and time at 5000 cP respectively). In melt profile analysis cheese melting time and flow rate had a good correlation with other melt tests, (0.60 and 0.71 for MSMA, 0.60 and 0.62 for HAV, and 0.64 and 0.70 for time at 5000 cP respectively). The meltmeter data was not highly correlated (<0.46) with the data from the other melt tests. The results of this study indicate that in numerous cases the different melt tests are measuring similar cheese properties. Consequently, the preferred melt analysis technique for a particular application depends on equipment availability, personal expertise and time constraints.

Key Words: Process Cheese, Melt Analysis

150 Influence of brine concentration, brine temperature, and presalting on salt uptake by Ragusano cheese. C. Melilli[1], D. M. Barbano[2], M. Caccamo[1], G. Licitra*[1,3], and S. Carpino[1], [1]*CORFiLaC*, *Ragusa, Italy*, [2]*Cornell University*, *Ithaca, NY*, [3]*D.A.C.P.A., Catania University*, *Catania, Italy*.

Thirty 3.6-kg blocks of Ragusano cheese were made on each of 6 days. On 3 days cheeses were not presalted while on other 3 days were presalted (PS) prior to stretching. Blocks (15) were placed in 18% brine (18%B) and the other 15 into saturated brine (SB). For the 15 blocks within each of the 2 brine concentrations (BC), 5 blocks were placed in brine at 12, 5 at 15, and 5 at 18°C. A block was removed from each brine tank after 1, 4, 8, 16, and 24 d, to be analyzed. Moisture loss was higher for cheese in SB. More than 50% of the moisture loss occurred in the first 8 d of brining. Cheese kept in SB for 24 d had 2.6% more weight loss (i.e., moisture loss) than cheese kept in 18%B. This reflects an important loss of cheese yield when using SB. Cheese blocks were divided into equal portions P1 to P4, with P1 representing the exterior quarter and P4 the interior quarter of the block. PS increased the salt content of all 4 portions of the block equally (ca. 1%) before brining, but PS did not reduce subsequent uptake of salt from brine. After 24 d of brine salting, the PS cheese had 3.1% salt, while the cheese that was not PS had only 2.3% salt. The PS cheese had 1.5 to 2 times the salt content in P4 than cheese that was not PS. PS and lower BT reduced early gas formation. Total salt uptake from brine (g) was influenced by BC but not directly by BT and PS. Salt uptake was faster for cheese in 18%B than for cheese in SB. PS cheese achieved a higher total salt content in less time than cheese that was not PS. PS had the largest and most immediate impact on increasing salt content in P4. While 18%B had a faster rate of salt penetration into the block than SB, there may be other challenges in controlling microbial growth in 18%B. Thus, the combination of PS and BT (≤ 18°C) may be more effective in reducing early gas formation than using 18%B to increase the rate of salt penetration.

Key Words: Presalting, Brine Temperature, Brine Concentration

151 Flow cytometry enumeration of individual bacteria in bulk tank raw milk produced in Minas Gerais, Brazil. C. Fonseca, L. Fonseca*, W. Santos, and R. Rodrigues, *Laboratory of Milk Quality Analysis-DTIPOA, School of Veterinary Medicine, UFMG/FUNDEP*, *Belo Horizonte-MG-Brazil*.

Brazil has a growing dairy industry, with annual production of 23 billion liters. To improve the milk quality and reach international standards, new laws are being gradually implemented in Brazil. The objective of the present work was to evaluate the microbial quality of the bulk tank raw milk produced in Minas Gerais, Brazil, and to compare the current findings with the legal requirements to be implemented on July 2005. From December 2003 to January 2005, 51,090 samples from thirteen dairy industries were evaluated for individual bacteria count (IBC). The dairies were located in the Minas Gerais State, whose production shares 30% of the milk produced in Brazil. The raw milk samples, preserved with azidiol (sodium azide, chloramphenicol), a bacteriostatic, were collected by the dairies and sent to the Laboratory for Milk Quality Analysis (DTIPOA/School of Veterinary Medicine/UFMG), not more than 72 hours after collection, in insulated boxes with reusable ice. The analyses were done by flow cytometry, with a BactoCount IBC (Bentley®), calibrated to obtain statistical transformation of IBC per mL to colony forming units per mL (CFU). Geometric and arithmetic means for microbial population were, respectively, 139,000 CFU/mL and 687,000 CFU/mL (standard deviation of 1,323,000). There was seasonal influence, with monthly geometric mean ranging from 59,000 CFU/ml during dry season to 390,000 CFU/mL during raining season, when hygienic conditions usually worsen. A total of 18.6% of the samples were in disagreement with the initial standard, which is 1,000,000 CFU/ml as geometric mean, and this was a result of improper hygienic milking, storage, and transportation of the milk. However, there was a decreasing tendency of counting during the evaluated period. The results show that, although the average quality of the milk produced in the state needs improvement, the majority of the dairy producers are in compliance with the new Brazilian regulations. Additionally, new studies will be necessary to evaluate the suitability of transformation of IBC to CFU.

Acknowledgements: FUNDEP/UFMG CNPq

Key Words: Milk Quality, Individual Bacteria Count, Bactocount

152 Pilot-scale production and characterization of liquid virgin whey protein concentrate. P. A. Marcelo* and S. S. H. Rizvi, *Cornell University*, *Ithaca, NY*.

The objective of this study was to produce liquid virgin whey protein concentrate (LVWPC) containing at least 90% whey protein (dry basis) and determine its physicochemical properties.
Virgin whey was harvested from microfiltration of acidified skim milk (pH = 6.1) prior to cheesemaking and concentrated to 60x by ultrafiltration and

diafiltration at 50°C using a two-stage pilot-scale process. The gross composition, viscosity and density of fresh LVWPC were determined and its pH monitored during storage at 4 °C. It was then freeze-dried and solutions containing 5-25 wt.% whey protein (WP) were prepared and their rheological properties were compared with those of WPC-80 and WPI. The temperature and enthalpy of denaturation of LVWPC proteins in 10 wt.% WP solutions were also measured using differential scanning calorimetry.

The LVWPC produced contained 26.3% total solids with 90.3 wt.% (db) WP. Its pH at 4°C was constant at 6.1 for 38 days. Its density and apparent viscosity at 20°C were 1.11 g/cm^3 and 11.7 mPa-s, respectively. The apparent viscosity of freeze-dried LVWPC solutions varied linearly with protein concentration up to 12 wt.% and exhibited close to Newtonian behavior up to 25 wt.%. The intrinsic viscosity was 3.32 cm^3/g. The activation energy of flow from 5 to 25 wt.% protein ranged between 15.77 and 17.84 kJ/mol, lower than those of WPC-80 and WPI. The average temperature and enthalpy of denaturation were 83.3°C and 10.04 J/g, respectively.

When WP is obtained as a by-product of cheesemaking, the series of processes that it undergoes cause fractional WP denaturation, which adversely affects the physicochemical properties and functionality of commercial WP products. The results of our study suggest that harvesting WP prior to cheesemaking and concentrating it by gentle membrane technology enabled the production of high-purity and essentially sterile LVWPC, a novel ingredient rich in native WP.

Key Words: Whey Proteins, Physicochemical Properties, Membrane Technology

153 Tangential microfiltration of skim milk for removal of *Bacillus anthracis* spores. N. Datta[1], P. Tomasula*[2], J. Call[2], and J. Luchansky[2], [1]*University of Queensland*, *Australia*, [2]*United States Department of Agriculture*, *Wyndmoor, PA*.

The objective of this study was to examine the use of cross-flow microfiltration as a step prior to high-temperature short-time (HTST) pasteurization to remove *Bacillus anthracis* (BA) spores that may have been added intentionally to raw milk. In experiments, 2500 mL of retail skim milk were inoculated with an average of 6.0 $\log_{10}$ spores/mL of the attenuated Sterne strain of BA. The milk was then microfiltered in a Membralox TI-70 bench scale pilot unit at 50°C using ceramic membranes with pore sizes of 0.5, 0.8, and 1.4 µm, respectively, to determine permeate flux, spore removal, and transmission of lactose, calcium, and milk proteins, at cross-flow velocities of 2, 4, and 6 m/s. The trials were conducted with or without backpulsing, a feature that prevents membrane fouling and concentration polarization effects. Samples of the permeate were collected over a period of 4.5 hrs and were direct plated onto BHI agar plates to enumerate surviving spores. Results indicated that the .5 µm membrane is unsuitable for microfiltration of milk because low permeate flux and severe pore plugging and fouling were observed after only 5 min of operation. The 0.8 µm membrane, at each cross-flow velocity studied, removed approximately 6.2 $\log_{10}$ spores of BA/mL milk that were recovered in the retentate, whereas, for the 1.4 µm membrane, the maximum number of spores, approximately 3.0 $\log_{10}$ spores of BA/mL, were removed at a cross-flow velocity of 6 m/s. Transmission of lactose, calcium and milk proteins through both membranes was 100%. Permeate flux decay was only about 4% at cross-flow velocity of 6 m/s regardless of use of the backpulse feature. As confirmed in this study, microfiltration of milk prior to HTST pasteurization can remove > 99.9999% of BA spores and thus, improve the safety and biosecurity of the milk supply.

Acknowledgements: The authors thank J. Mulherin, M. Todt, and B. Shoyer for their technical assistance in the experiments.

Key Words: Bacillus Anthracis, Microfiltration, Milk

154 Somatic cell counts and composition of bulk tank raw milk produced in Minas Gerais, Brazil. C. Fonseca, L. Fonseca*, W. Santos, and R. Rodrigues, *Laboratory of Milk Quality Analysis-DTIPOA, School of Veterinary Medicine, UFMG/FUNDEP*, *Belo Horizonte-MG-Brazil*.

Brazil is adjusting its legal requirements to reach international standards for milk quality. The objective of this work was to evaluate the composition and somatic cell count (SCC) of the bulk tank milk produced in Brazil, and to compare the current findings with the new requirements to be implemented on July 2005. From December 2003 to January-2005, 53,011 milk samples from thirteen dairy industries were analyzed. The dairies were located in the Minas Gerais State, whose production share amounts to 30% of the milk in Brazil. The raw milk samples, preserved with bronopol, were collected by the dairies, and sent to the Laboratory for Milk Quality Analysis (DTIPOA/School of Veterinary Medicine/UFMG) not more than 72 hours after collection, in insulated boxes, with reusable ice. The analyses of SCC were done by flow cytometry, and the compositional were by infrared measurement, using a calibrated Combisystem 2300 (Bentley®). The milk quality data were correlated to climatic and economic data. Average values for bulk raw milk composition were, in g/100g (average±SD): fat (3.63±0.44); protein (3.19±0.20); lactose (4.51±0.14), and total solids (12.32±0.58). The geometric and arithmetic means for SCC were, respectively, 346,000/ml and 474,000/ml. However, there was a tendency of SCC lowering, which ranged from a geometric mean of 501,000/ml on December 2003 to 229,000/ml on December 2004. There was an increase in SCC of the milk during raining season ($p \leq 0.01$). Fat and protein content reached highest values in the dry season, respectively, 3.88 g/100g, and 3.30 g/100g, although total milk production was lower during this season. For SCC, 7.3% of the samples were in disagreement with the new legal parameters (geometric mean of 1,000,000 SCC/ml on July 2005, which will gradually decrease to a standard of 400,000 SCC/ml on 2011). However, increasing awareness of the Brazilian dairy producer, improvement of milking practices, better herd health surveillance, and payment of milk based on quality, it is believed that the majority of the milk producers will soon comply with the above requirements.

Acknowledgements: FUNDEP/UFMG CNPq

Key Words: Milk Quality, Composition, Somatic Cell Count

155 Effect of formulation and manufacturing parameters on process cheese food functionality-II. Di-Sodium Phosphate. S. K. Garimella Purna*, A. Pollard, and L. E. Metzger, *MN-SD Dairy Food Research Center, University of Minnesota*, *St. Paul*.

The objective of this study was to utilize a rapid visco analyzer (RVA) to study the effect of natural cheese age, di-sodium phosphate (DSP) concentration and mixing speed on process cheese food (PCF) functionality. In this study three replicates of natural cheese were manufactured and at 2, 4, 6, 12 and 18 weeks of ripening a portion of each cheese was subjected to six different PCF manufacturing treatments. These treatments were factorial combinations of DSP at three levels (i.e. 1.5, 2.0, and 2.5%) and two mixing speeds (450 rpm and 1050 rpm). Functional properties of PCF evaluated included manufacturing properties (apparent viscosity after manufacture (VAM)); un-melted textural properties (firmness); melted cheese flow properties (hot apparent viscosity (HAV)); and cheese thickening during cooling (time at 5000cP (T5)). All four parameters (VAM, firmness, HAV and T5) were significantly ($p < 0.05$) affected by natural cheese age, mixing speed and concentration of DSP. The VAM, HAV and firmness decreased as cheese age increased, while T5 values increased as cheese age increased. Similarly firmness was increased at high mixing speed. The age and mixing speed interaction was significant ($p < 0.05$) for VAM and firmness, and as the age of the cheese increased the effect of mixing speed decreased. The age and concentration of DSP interaction was significant ($p < 0.05$) for VAM, HAV and T5, whereas the concentration of DSP and mixing speed interaction was significant ($p < 0.05$) for firmness. The effect of mixing speed as well as concentration of DSP on VAM, HAV, and firmness was larger during early ripening and significant differences between treatments were observed at two weeks, however no significant differences between treatments were observed at 18 weeks. The results demonstrate that natural cheese age, mixing speed during manufacture and the concentrations of DSP have a significant impact on process cheese functionality.

Key Words: Process Cheese, Functionality

Dairy Foods: Forum on Cheese Ripening

156 Combined abstract for forum on cheese ripening symposium presentations. W. J. Harper*[1], M. Johnson[2], J. Broadbent[3], J. Lucey[2], and M. Drake[4], [1]*The Ohio State University*, *Columbus*, [2]*University of Wisconsin*, *Madison,*, [3]*Utah State University*, *Logan,*, [4]*North Carolina State University*, *Raleigh*.

Organizer: Jim Harper, The Ohio State University, Columbus

This symposium is a forum to provide a broader discussion on this specific topic of interest-Cheese Ripening. The five participants will be discussion facilitators. This format will allow greater audience participation than normally occurs in the traditional symposium format.

Discussion facilitators and the various topics are:

a. Jim Harper, The Ohio State University, Columbus-Cheese Ripening -A Historical Perspective

b. Mark Johnson, University of Wisconsin, Madison-Milk and the Cheese Maker

c. Jeff Broadbent, Utah State University, Logan -Microbiology and Biochemistry

d. John Lucey, University of Wisconsin, Madison-Chemistry and Physical Properties

e. MaryAnne Drake, North Carolina State University, Raleigh-Flavor

f. Open Discussion with Audience Participation for the remainder of the time

Key Words: Cheese Ripening, Milk and Cheese Making, Changes during Ripening

Graduate Student Competition: National ADSA Dairy Foods

157 Identification of genes associated with *Mycobacterium avium* subsp. *paratuberculosis* entry into cultured bovine epithelial cells. D. Patel*, L. Meunier-Goddik, and L. E. Bermudez, *Oregon State University*, *Corvallis*.

Mycobacterium avium subsp. *paratuberculosis* (MAP) is the etiologic agent of Johne's disease (JD) in ruminants. The intestinal tract is believed to be an important route of MAP infection, but MAP genes with role in the invasion of intestinal epithelial cells are mostly unknown. The objective of this investigation was to create and screen the signature-tagged mutagenesis (STM) based MAP transposon library for invasion-associated genes. A mixed tag plasmid pYJ that contains transposon Tn *5367* and a kanamycin-resistance gene as a selectable marker was used for STM library. From 33 signature-tagged clones, a library of total 1980 mutants was constructed. Invasion assays were carried out for individual clones and efficiency of invasion was calculated as percentage of inoculated bacteria that entered MDBK cells after 2 h contact time compared with the wild type bacteria screened under the same conditions. Screening of 600 mutants identified clones 2C12, 2δ5, 2δ6 and 2D1 with impaired ability to enter MDBK epithelial cells ($p < 0.01$). The genes flanking transposon insertion site were identified by nucleotide sequence analysis using transposon primers. The gene sequence analysis based on BLAST program of National Center for Biotechnology resulted in the identification of mycobacterial cell entry (*mce1*D) operon, oxidoreductase operon, NADH-ubiquinone-oxidoreductase (*nuo*L), and a potassium transporter (*trk*A) as invasion-associated genes for MAP entry into MDBK epithelial cells. The cross genome comparison of identified genes suggests that role of *mce1*D in invasion may be due to its direct participation in epithelial cell entry. The role of *nuo*L and *trk*A in invasion may be through sensor response resulting in upregulation of invasion-associated genes. The role of oxidoreductase may be through catalytic protein folding influencing secretion of virulence factors. The identification of invasion-associated genes will be useful for characterizing bacterial factors associated with the MAP infection of bovine host.

Key Words: Invasion-Associated Genes, Johne's Disease, *Mycobacterium avium* Subsp. *paratuberculosis*

158 Flavor profiles of full fat, reduced fat and cheese fat made from aged Cheddar with the fat removed using a novel process. M. Carunchia Whetstine*[1], M. Drake[1], B. Nelson[2], and D. Barbano[2], [1]*North Carolina State University*, *Raleigh*, [2]*Cornell University*, *Ithaca, NY*.

Many consumers are concerned with fat intake. However, reduced fat cheeses may lack robust flavors. The objectives of this study were to characterize the flavors found in full fat cheese, cheese fat and reduced fat cheese made from aged Cheddar using a novel process to remove the fat (JDS 87:841). Two aged cheeses (12 months and 42 months) were selected, and the fat was removed using the novel fat removal process. Full fat cheeses, corresponding reduced fat cheeses and cheese fats were then analyzed using descriptive sensory and instrumental analysis. Cheeses were extracted with diethyl ether, followed by isolation of volatile material by high vacuum distillation. Volatile extracts were analyzed using gas chromatography-olfactometry (GCO) with aroma extract dilution analysis (AEDA). Selected compounds were quantified. The 12 month cheese was characterized by fruity and sulfur notes, while the 42 month old cheese was characterized by a spicy brothy flavor. Reduced fat cheeses had very similar flavor profiles to corresponding full fat cheeses. Sensory profiles of the cheese fats were characterized by low intensities of the prominent flavors found in the full fat cheeses. Instrumental analysis revealed similar trends. Consistent with sensory analysis, there were lower concentrations and log3FD factors for most compounds in the cheese fats compared to both the reduced and full fat cheeses, regardless of compound polarity. This study demonstrates that when fat is removed from aged Cheddar cheese, most of the flavor and flavor compounds remain in the cheese and are not removed with the fat.

Key Words: Reduced Fat Cheese, GC/O, Flavor Partitioning

159 Development and application of an image analysis method to quantify calcium lactate crystals on cheddar cheese. P. Rajbhandari* and P. Kindstedt, *University of Vermont*, *Burlington*.

Calcium lactate crystals that form white specks or haze on

the surface of cheese constitute a significant quality problem for producers of Cheddar cheese. Subjective methods to evaluate crystal coverage of cheese surfaces have been reported previously, but objective methods are currently lacking. The goals of this research were to develop and evaluate an objective method to measure the area occupied by calcium lactate crystals on surfaces of naturally smoked Cheddar cheese samples using digital photography and image analysis. Coefficients of variation ranged from 1.19 to 4.7% for 5 replicate analyses of 3 different cheese surfaces that ranged from ca. 2 to 49% of total surface area occupied by crystals. Thus, results showed a high degree of repeatability for the 3 cheese surfaces, which ranged from very slight and geometrically simple to very heavy and geometrically complex crystal coverage.The method underestimated total area occupied by crystals on the 3 surfaces by 0.3 to 4.8% unless the faint crystal regions that went undetected during initial thresholding were manually segmented and quantified. The wet weight of crystal substance collected per unit of surface area from 20 different cheese samples increased exponentially as the percentage of total surface area occupied by crystals increased. These data were consistent with subjective observations that crystal regions appeared to grow vertically as well as horizontally as they expanded to occupy greater surface area. Image analysis was well suited for evaluating

changes in crystal coverage during cheese aging because measurements were made nondestructively and with minimal disruption to the cheese. The area occupied by crystals on 6 different surfaces from 3 different cheese samples increased linearly (R^2 = .94 to .99) during storage at 4° C for up to 33 wk. However, the rates of increase differed significantly among the 3 cheese samples. Image analysis may serve as a useful tool to quantitatively evaluate the effects of factors such as cheese composition, packaging conditions, storage temperature, etc. on rate of crystal growth and time of crystal appearance during storage.

Key Words: Cheese, Calcium Lactate, Crystals

160 Effect of formulation and manufacturing parameters on process cheese food functionality- I. tri-sodium citrate. S. K. Garimella Purna*, A. Pollard, and L. E. Metzger, *University of Minnesota*, *St. Paul*.

The objective of this study was to utilize a rapid visco

analyzer (RVA) to study the effect of natural cheese age, tri-sodium citrate (TSC) concentration and mixing speed on

process cheese food (PCF) functionality. In this study three replicates of natural cheese were manufactured, and at 2, 4, 6, 12 and 18 weeks of ripening a portion of each cheese was subjected to six different PCF manufacturing treatments. These treatments were factorial combinations of TSC at three levels (i.e. 2.0, 2.5 and 3.0%) and two mixing speeds (450 rpm and 1050 rpm). Functional properties of PCF evaluated included manufacturing properties (apparent viscosity after manufacture (VAM)); un-melted textural properties (firmness); melted cheese flow properties (hot apparent viscosity (HAV)); and cheese thickening during cooling (time at 5000cP (T5)). All four parameters (VAM, firmness, HAV and T5) were significantly ($p < 0.05$) affected by natural cheese age and mixing speed. The VAM, HAV and firmness decreased as cheese age increased, whereas T5 values increased as cheese age increased. Similarly VAM, HAV and firmness values increased due to an increase in mixing speed, whereas T5 values decreased due to increased mixing speed. The VAM, HAV and T5 also significantly ($p < 0.05$) increased as the concentration of TSC increased, whereas firmness was not significantly ($p > 0.05$) affected by concentration of TSC. The age and mixing rate interaction was significant ($p < 0.05$) for VAM and firmness, whereas the age and concentration of TSC interaction was significant ($p < 0.05$) for VAM and HAV. It was also observed that mixing speed and concentration of TSC interaction was significant ($p < 0.05$) for firmness and HAV, whereas the three-way interaction term between age, mixing speed and concentration of TSC was significant ($p < 0.05$) for HAV. The results demonstrate that, natural cheese age, mixing speed during manufacture and concentration of TSC have a significant impact on process cheese functionality.

Key Words: Process Cheese, Functionality

161 Effect of calcium and moisture on rheological and melting properties of Mozzarella. C. Udayarajan*[1], D. S. Horne[2], and J. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Charis Food Research*, *Ayr, Scotland*.

The objective of this study was to evaluate how possible interactions between total calcium, moisture and age influence the rheological and melting properties of Mozzarella. Four types of low fat Mozzarella cheeses (~ 15% FDM) with low calcium-high moisture, low calcium-low moisture, high calcium-high moisture and high calcium-low moisture levels were manufactured and stored at 4°C for 28 d. Low and high calcium cheeses had total calcium contents ranging from 25-27 and 33-35 mg Ca/g protein, respectively. Moisture contents of low and high moisture cheeses were 45-46% and 49-50%, respectively. Fourier transform mechanical spectroscopy was used for rheological analysis over a frequency range of 0.08-4 Hz, while samples were heated from 10 to 90°C at 1°C/min. Melting properties like extent of flow and melt area were analyzed using UW Melt profiler and Schreiber test, respectively. Storage Modulus (G′) increased with frequency for all cheeses. Moisture had a significant effect on G′ values at 20, 40 and 60°C, whereas calcium had an effect on G′ values at higher temperatures, e.g. 60 and 80°C. G′ values decreased with an increase in moisture and decrease in calcium content. G′ values at 60 and 80°C decreased with increased ripening. During heating all cheeses exhibited a maximum in loss tangent (MaxLT) and the MaxLT value increased with decrease in calcium and increase in ripening. Extent of flow and melt area increased as calcium content decreased. There was a significant correlation between MaxLT and melting properties. It is likely that changes in insoluble calcium content and proteolysis contributed to the ripening effects. In high moisture cheeses the less dense protein network resulted in weaker protein interactions, which contributed to the increase in MaxLT and improved melt parameters. In high calcium cheeses, the strong calcium-protein interactions retarded rheological (e.g. MaxLT value) and melt properties and these interactions seemed to have relatively more impact at high temperatures (i.e. during melting).

Acknowledgements: Dairy Management Inc.

Key Words: Rheology, Mozzarella

162 Variations in the *trans* and CLA content of Ontario milk fat. H. Thomsen*[1], M. Hernandez[2], A. Hill[1], and J. Kramer[2], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Agriculture and Agri-Food Canada, Food Research Program*, *Guelph, Ontario, Canada*.

A survey was conducted to determine seasonal and regional

variations in fatty acid (FA) composition of Ontario bovine milk. The province was divided into five regions - north, south, east, west, and central - with 10 farms from each region and each season. Herd milk samples were preserved with Bronopol, stored at 2-4^{O}C, and shipped overnight. Total lipids were extracted, methylated with sodium methoxide, and analyzed by gas chromatography using a 100m CP Sil 88 capillary column. The data reported is from the spring (reported at AOCS 2004), summer, and fall 2003. The saturated fatty acids (SFAs) ranged from 61.3-70.5%, the *trans* 18:1 from 2.2-4.9% and 11t-18:1 from 0.58- 3.28%. The total CLA content ranged from 0.35-1.07% and the 9c11t-CLA (including 7c9t-CLA) from 0.24-0.94%: in both cases, the summer fat contained the greatest quantities. The long chain n-3 PUFA ranged from 0.08-0.96%. The north had the highest means for SFA: 68.29% (spring), 67.1% (summer), and 69.98% (fall), highest 11t-18: 1 - 1.4% (spring) and 3.28% (fall). It also had the highest amounts of total CLA: 0.88% (spring), 1.07% (summer), and 1.01% (fall) as well as 9c11t-CLA: 0.74% (spring), 0.94% (summer), and 0.86% (fall). Great seasonal and regional variability was also observed for the n-3 PUFA; the north had the highest during the spring (0.15%) whereas the east had the highest quantities for both summer and fall (0.76% and 0.96% respectively). The five regions have variances in the composition of their dietary sources (not analyzed), which is reflected in the FA composition of the milk. The north uses higher amounts of grass and forage, the east higher amounts of corn products, and the central and west regions more soybean based products. A correlation exists between 11t-18:1 and 9c11t-CLA, but not between 9c11t-CLA and 18:2n-6 or 18:3n-3. Further studies are ongoing to assess the FA composition of the 2003 winter milk for the five regions as well as breed differences.

Acknowledgements: Dr. Z. Deng

Key Words: CLA, Fatty Acid Composition, Seasonal and Regional Variability

163 Dose titration of Optaflexx®(ractopamine HCl) evaluating the effects on growth performance in feedlot steers. A. Schroeder*, D. Hancock, D. Mowrey, S. Laudert, G. Vogel, and D. Polser, *Elanco Animal Health*, *Greenfield, IN*.

The effect of feeding Optaflexx®, ractopamine HCl, (RAC), was evaluated at five geographic sites. A randomized complete block design was used at each site. This resulted in a total of 25 experimental units (8-10 steers/pen) per Optaflexx concentration. Eight hundred eighty (880) yearling steers and steer calves were assigned to one of four treatments (0, 10, 20, 30 ppm, 100% DM). The studies were conducted during different seasons for either 28 or 42 d immediately prior to harvest. Crude protein levels ranged from 13.03 to 15.23% at the various individual study sites. Least square means are given in the following table:

Steers consumed approximately 0, 100, 200 and 300 mg/hd/d of ractopamine for each Optaflexx treatment. Feeding RAC did not change feed intake. Linear contrasts showed RAC improved (P < 0.05) ADG, F/G, G/F and HCW for all treatment groups compare to controls, when fed for the last 28 to 42 days of the finishing period. Dressing percent was improved (P < 0.05) for the 20 and 30 ppm RAC groups. These data demonstrate that RAC when fed for the last 28 to 42 d of the finishing period, improves growth performance in steers.

Least Squares Means

Item	0	RAC (ppm) 10	20	30	SE
Initial weight, kg	530.44	530.07	529.76	529.44	58.51
Final weight, kg	575.52[b]	582.28[a]	582.69[a]	585.41[a]	20.87
Daily feed, kg	9.86	9.98	9.86	9.90	0.49
ADG. kg	1.27[b]	1.49[a]	1.52[a]	1.60[a]	0.15
Feed/Gain	8.10[b]	7.00[a]	6.81[a]	6.44[a]	0.41
Gain/Feed	0.126[b]	0.147[a]	0.152[a]	0.159[a]	0.009
HCW, kg	341.74[b]	344.69[a]	348.14[a]	350.00[a]	13.15
Dress, percent	61.9[b]	61.7[b]	62.2[a]	62.3[a]	0.73

[ab]Means differ (P < 0.05)

Key Words: Beef, Growth, Optaflexx, Ractopamine

164 Dose titration of Optaflexx® (ractopamine HCl) evaluating the effects on standard carcass characteristics in feedlot steers. A. Schroeder*, D. Hancock, D. Mowrey, S. Laudert, G. Vogel, and D. Polser, *Elanco Animal Health*, *Greenfield, IN*.

Optaflexx®, ractopamine HCl, (RAC), was recently approved by the US FDA CVM for feeding to cattle during the last 28 to 42 of the finishing period. The effects of feeding Optaflexx on standard carcass characteristics in beef steers assigned to one of four treatments (0, 10, 20, or 30 ppm, 100% DM), was evaluated at five different geographical sites. A randomized complete block design was used at each site. This resulted in a total of 25 experimental units (8-10 steers/pen) per Optaflexx concentration. Harvest was conducted in commercial beef packing plants. Following a 18 to 24 hour chill, carcasses were ribbed and standard carcass measurements collected. Least squares means are given in the following table:

HCW and LM area were increased (P < 0.05) by feeding RAC. 12th rib fat thickness and KPH were not affected by RAC treatments. Yield grade tended (P = 0.058) to be improved at 20 ppm and was improved (P < 0.05) at 30 ppm. Marbling score and carcass maturity were not affected by RAC treatment. Muscle color, firmness and texture were not affected by RAC treatments. These data demonstrate that feeding RAC increased HCW, LM area and conformation scores without impacting carcass quality when fed for the last 28 to 42 days of the finishing period.

Least Squares Means

Item	0	RAC (ppm) 10	20	30	SE
HCW, kg	341.74[b]	344.69[a]	348.14[a]	350.0[a]	13.15
12th rib fat, cm	1.45	1.42	1.42	1.42	0.13
KPH,%	1.83	1.83	1.86	1.77	0.13
LM area, cm^2	77.4[b]	79.3[a]	80.0[a]	80.6[a]	2.77
Yield grade	3.32[b]	3.24[b]	3.22[b]	3.18[a]	0.17
Marbling score	Sm[33]	Sm[28]	Sm[31]	Sm[25]	18.2
Maturity	A[56]	A[55]	A[57]	A[55]	2.5
Conformation	low Ch[80b]	low Ch[93b]	ave Ch[14a]	ave Ch[17a]	0.34
Muscle color[c]	6.0	6.1	6.1	6.0	0.12
Muscle firmness[c]	6.1	6.3	6.2	6.2	0.13
Dark cutters, %	5.1	2.7	2.3	3.2	

[ab]Means differ (P < 0.05) [c] scale: 1 = undesirable, 7 = most desirable

Key Words: Beef, Carcass, Optaflexx, Ractopamine

165 Dose titration of Optaflexx® (ractopamine HCl) evaluating the effects on composition of carcass soft tissues in feedlot steers. A. Schroeder, D. Hancock, D. Mowrey*, S. Laudert, G. Vogel, and D. Polser, *Elanco Animal Health*, *Greenfield, IN*.

The effect of Optaflexx®, ractopamine HCl, (RAC), on the composition of carcass soft tissues (ST) of beef steers was evaluated at five different geographical sites. A randomized complete block design was used at each site. Steers were assigned to one of four treatments (0,10,20,or 30 ppm, 100% DM). This resulted in a total of 25 experimental units (8-10 steers/pen) per Optaflexx concentration. RAC was fed for the last 28 or 42 days of the finishing period immediately prior to harvest. Harvest was conducted in commercial beef packing plants. Up to two carcass sides were randomly selected from carcasses in each experimental unit, which had hot carcass weights (HCW) within +/-11.33 kg of the mean HCW in each block. The sides were dissected into ST (muscle and fat), bone (bone and connective tissue) and other tissues (kidney, pelvic, heart fat, diaphram and hanging tender). ST of each side was coarse ground, thoroughly mixed, reground, and sub-sampled. The subsamples were homogenized and three aliquots collected and frozen. Moisture, ether extractable lipid (EEL), protein (N x 6.25) and ash content were determined using AOAC methods. Baseline composition on contemporary animals (n=110) was collected to calculate carcass protein gain per day and efficiency of carcass protein gain per day.

Carcass bone and ash were not different between treatment groups. Carcass protein content was increased (P < 0.05) at 20 and 30 ppm RAC concentrations compared to controls. EEL was decreased (P < 0.05) at 20 ppm compared to control. Carcass protein gain per day increased (P < 0.05) by 100.9% and 114.4% at 20 and 30 ppm, respectively. Efficiency of carcass protein gained per day was improved (P < 0.05) 120% at 20 and 30 ppm. The results indicate RAC increased carcass protein (leanness) in feedlot steers when fed for the last 28 to 42 of the finishing phase.

Least Squares Means

Item	RAC (ppm) 0	10	20	30	SE
No. Pens	25	25	25	24	
No. Carcasses	50	50	49	47	
Side soft tissue, kg	140.3	139.4	140.3	141.2	4.13
Carcass bone, %	14.7	14.7	14.7	14.5	0.26
Protein, %	14.82[b]	15.15[b]	15.35[a]	15.35[a]	0.14
Moisture, %	52.5[b]	53.1[b]	53.7[a]	53.4[b]	0.58
EEL, %	31.2[b]	30.3[b]	29.5[a]	29.7[b]	0.74
Ash, %	0.8	0.8	0.8	0.8	0.02
Carcass protein gain per day, g	50.4[b]	80.3[b]	101.2[a]	108.0[a]	27.2
Efficiency of carcass gain per day	0.005[b]	0.008[b]	0.011[a]	0.011[a]	0.003

[ab]Means differ (P <0.05)

Key Words: Beef, Carcass, Optaflexx, Ractopamine

166 Effects of ractopamine fed to finishing steers, I - summary of six studies - growth performance. S. Laudert*, G. Vogel, A. Schroeder, W. Platter, and M. Van Koevering, *Elanco Animal Health*, *Greenfield, IN*.

Six large pen (60 to 112 head per pen) studies were conducted at commercial feedlot research facilities to characterize the effects of ractopamine hydrochloride (RAC) on growth performance and carcass traits of steers fed in typical feedlot conditions. Rations were representative of feedlots in the respective geographical area and met or exceeded National Research Council nutrient requirements for finishing steers. All steers were administered a terminal implant containing estradiol and trenbolone acetate at least 90 days preharvest. RAC was fed to achieve intakes of 0 (CON), 100 (LOW) or 200 (MID) mg•hd^{-1}•d^{-1} during the final 28 to 32 days of finishing. Analyses were conducted using the least squares, mixed model procedure of SAS with pen as the experimental unit and initial live weight as a covariate. RAC increased final live weight ($P < 0.05$). RAC did not impact dry matter intake ($P > 0.05$). RAC improved ($P < 0.05$) average daily gain (9.4 and 17.4%), feed:gain (9.2 and 15.9%) and gain:feed (9.9 and 17.8%), respectively, over CON. Total gain was increased by 3.6 and 6.7 kg for the LOW and MID treatments. Feeding RAC to steers for the final 28 to 32 d of the finishing period in typical feedlot conditions increases live weight gain and improves feed efficiency.

Growth performance of steers fed ractopamine

RAC, mg·hd^{-1}·d^{-1}	0	100	200	SE
No pens	32	28	32	
No head	2413	2132	2419	
Final weight, kg	586.2[c]	589.9[b]	592.9[a]	3.13
Dry matter intake, kg	9.08	9.03	9.04	0.20
Average daily gain, kg	1.38[c]	1.51[b]	1.62[a]	0.11
Feed:Gain	6.74[c]	6.12[b]	5.67[a]	0.32
Gain:Feed	0.152[c]	0.167[b]	0.179[a]	0.009

[abc] Means differ ($P < 0.05$)

Key Words: Ractopamine, Beef Steers, Growth

167 Effects of ractopamine fed to finishing steers, II - summary of six studies - carcass traits. S. Laudert, G. Vogel, A. Schroeder, W. Platter*, and M. Van Koevering, *Elanco Animal Health*, *Greenfield, IN*.

Six large pen (60 to 112 head per pen) studies were conducted at commercial feedlot research facilities to characterize the effects of ractopamine hydrochloride (RAC) on growth performance and carcass traits of steers fed in typical feedlot conditions. Rations were representative of feedlots in the respective geographical area and met or exceeded National Research Council nutrient requirements for finishing steers. All steers were administered a terminal implant containing estradiol and trenbolone acetate at least 90 days preharvest. RAC was fed to achieve intakes of 0 (CON), 100 (LOW) or 200 (MID) mg•hd^{-1}•d^{-1} during the final 28 to 32 days of finishing. Analyses were conducted using the least squares, mixed model procedure of SAS with pen as the experimental unit and initial live weight as a covariate. Frequency distributions were compared using the GLIMMIX macro of SAS. Carcasses produced by steers in the LOW and MID treatments were heavier ($P < 0.05$) than carcasses of CON steers by 2.4 and 5.6 kg, respectively. Dressing percentage was highest ($P < 0.05$) for steers in the MID treatment. Carcass loin muscle area increased ($P < 0.05$) as steers were fed higher levels of RAC (CON < LOW < MID). Marbling score and percentage of carcasses grading Choice and Prime were not affected by RAC treatment. Twelfth rib fat thickness, KPH, yield grade, carcass maturity and incidence of dark cutters were not affected by feeding RAC. These results suggest that ractopamine can increase carcass weight and loin muscle area of steers when fed at levels of 100 and 200 mg·hd^{-1}·d^{-1} and increase dressing percentage when fed at 200 mg·hd^{-1}·d^{-1} for the last 28 to 32 days of the finishing period in typical feedlot conditions.

Carcass traits of steers fed ractopamine

RAC, mg·hd^{-1}·d^{-1}	0	100	200	SE
No Pens	32	28	32	
No Carcasses	2413	2132	2419	
Hot weight, kg	374.4[c]	376.8[b]	380.0[a]	1.68
% dress	63.85[b]	63.87[b]	64.08[a]	0.24
12th rib fat, cm	1.30	1.27	1.30	0.10
Loin area, cm^2	89.0[c]	89.7[b]	91.0[a]	1.74
Yield grade	2.87	2.85	2.84	0.14
Marbling score	small[04]	small[04]	small[01]	6.40
% choice & prime	47.6	48.5	45.6	

[abc] Means differ ($P < 0.05$)

Key Words: Ractopamine, Beef steers, Carcass Traits

168 Effect of ractopamine on growth performance of calf-fed Holstein steers. G. Vogel*[1], A. Schroeder[1], W. Platter[1], M. Van Koevering[1], A. Aguilar[1], S. Laudert[1], J. Beckett[2], J. Droulliard[3], G. Duff[4], and J. Elam[5], [1]*Elanco Animal Health*, *Greenfield, IN*, [2]*California Polytechnic State University*, *San Luis Obispo*, [3]*Kansas State University*, *Manhattan*, [4]*University of Arizona*, *Tuscon*, [5]*Agricultural Technology*, *Santa Ynez, CA*.

A series of four studies using 1914 calf-fed Holstein steers (543 kg) was conducted to evaluate the effects of ractopamine hydrochloride (RAC) on growth performance when fed for the final 28 to 38 days of the finishing period. At each study site, RAC was incorporated into the ration to achieve intakes of approximately 0 (CON), 200 (MID) and 300 (HIGH) mg*hd^{-1}*d^{-1}. Each study consisted of four to eight pen replicates per treatment with 13 to 72 steers/pen depending on study site. Analyses of these data were conducted using the SAS mixed model procedure. The statistical model included treatment as an independent fixed effect, average initial live weight as a covariate, and study and replicate within study as random effects. Feed intake for steers fed either level of RAC was not different compared to the CON level. Daily gain was increased ($P < 0.05$) by 0.24 and 0.20 kg/d for MID and HIGH, respectively compared to steers in the CON treatment. Feed efficiency was improved ($P < 0.05$) by 14.4% and 14.3% for steers in MID and HIGH, respectively. Carcasses produced by steers in the MID and HIGH treatments were heavier ($P < 0.05$) than steers in the CON treatment by 4.7 and 5.1 kg, respectively. These data demonstrate that RAC improves growth performance in calf-fed Holsteins during the final portion of the finishing period.

RAC (mg•hd^{-1}•d^{-1})

RAC	0	200	300	SE
Final Weight, kg	585.8[b]	593.8[a]	592.6[a]	2.9
Daily Feed, kg	9.36	9.59	9.18	0.19
Daily Gain, kg	1.37[b]	1.61[a]	1.57[a]	0.06
Daily Gain, kg	1.37[b]	1.61[a]	1.57[a]	0.06
Feed:Gain	7.08[a]	6.06[b]	6.07[6.07]	0.25
Feed:Gain	7.08[a]	6.06[b]	6.07[b]	0.25
Gain:Feed	0.15[b]	0.16[a]	0.17[a]	0.01

Key Words: Ractopamine, Holstein, Growth

169 Effect of ractopamine on carcass characteristics of calf-fed Holstein steers. G. Vogel*[1], A. Schroeder[1], W. Platter[1], M. Van Koevering[1], A. Aguilar[1], S. Laudert[1], J. Beckett[2], R. Delmore[2], J. Droulliard[3], G. Duff[4], and J. Elam[5], [1]*Elanco Animal Health*, *Greenfield, IN*, [2]*California Polytechnic State University*, *San Luis Obispo*, [3]*Kansas State University*, *Manhattan*, [4]*University of Arizona*, *Tuscon*, [5]*Agricultural Technology*, *Santa Ynez, CA*.

A series of four studies using 1914 calf-fed Holstein steers (543 kg) was conducted to evaluate the effects of ractopamine hydrochloride (RAC) on growth performance and carcass characteristics when fed for the final 28 to 38 days of the finishing period. At each study site, RAC was incorporated into the ration to achieve intakes of approximately 0 (CON), 200 (MID) and 300 (HIGH) mg*hd^{-1}*d^{-1}. Each study consisted of four to eight pen replicates per treatment with 13 to 72 steers/pen depending on study site. Analyses of these data were conducted using the SAS mixed model procedure. The statistical model included treatment as an independent fixed effect, average initial live weight as a covariate, and study and replicate within study as random effects. Carcasses produced by steers in the MID and HIGH treatments were heavier ($P < 0.05$) than steers in the CON treatment by 4.7 and 5.1 kg, respectively. Mean LM of carcasses from the MID and HIGH treatments were 1.8 and 2.8 cm^2 larger ($P < 0.05$) than CON carcasses. Calculated yield grade was decreased ($P < 0.05$) by 0.14 units for steers in the HIGH group. Feeding RAC did not affect percent KPH, carcass maturity, or the incidence of dark cutting beef. Feeding RAC resulted in a reduction ($P < 0.05$) in marbling score of carcasses from steers in the MID but not the HIGH treatment. These data demonstrate that RAC increases carcass value in calf-fed Holstein steers by increasing hot carcass weight and ribeye area while having minimal impact on quality grade.

RAC (mg•hd^{-1}•d^{-1})

Item	0	200	300	SE
Hot Carcass Weight, kg	357.5[b]	362.2[a]	362.6[a]	1.43
Dressing Percent, %	61.2	61.2	61.4	0.49
12th Rib Fat, cm	0.66[a]	0.64[a]	0.58[b]	0.03
LM, cm^2	77.0[b]	78.8[a]	79.8[a]	1.61
Yield Grade	2.77[a]	2.71[a]	2.63[b]	0.08
Marbling Score[c]	515[a]	498[b]	507[ab]	20.7

[ab]Means differ ($P < 0.05$) [c]Marbling Score:400=slight, 500=small

Key Words: Ractopamine, Holstein, Carcass

170 Dose titration of Optaflexx® (ractopamine HCl) evaluating the effects on growth performance in feedlot heifers. A. Schroeder*, D. Hancock, D. Mowrey, S. Laudert, G. Vogel, and D. Polser, *Elanco Animal Health*, *Greenfield, IN*.

The effect of feeding Optaflexx®, ractopamine HCl, (RAC), was evaluated at five different geographical sites. A randomized complete block design was used at each site. This resulted in a total of 25 experimental units (7-10 heifers/pen) per Optaflexx concentration. Eight hundred sixty (860) yearling heifers and heifer calves were assigned to one of four treatments (0, 10, 20, 30 ppm, 100% DM). The studies were conducted during different seasons for either 28 or 42 d immediately prior to harvest. Crude protein levels ranged from 13.03 to 15.23% at the various individual study sites. Least square means are given in the following table:

Heifers consumed approximately 0, 94, 189 and 283 mg/hd/d of ractopamine based on an average consumption of 9.42 kg. Feeding RAC did not change feed intake. RAC improved ($P < 0.05$) in ADG, F/G, and G/F for all RAC treatment groups when fed for the last 28 to 42 days of the finishing period. HCW was increased ($P < 0.05$) when RAC was fed at 20 and 30 ppm for the last 28 to 42 days of the finishing period. Dressing percent was not changed in heifers fed RAC. These data demonstrate that RAC, when fed for the last 28 to 42 d of the finishing period, improves growth performance in heifers.

Least Squares Means

Item	RAC (ppm) 0	10	20	30	SE
Initial weight, kg	483.85	483.31	483.22	484.26	51.65
Final weight, kg	528.30[b]	531.34[a]	534.93[a]	537.56[a]	15.83
Daily feed, kg	9.38	9.41	9.53	9.39	0.37
ADG, kg	1.24[b]	1.34[a]	1.46[a]	1.50[a]	0.12
Feed/Gain	7.77[b]	7.23[a]	6.68[a]	6.44[a]	0.42
Gain/Feed	0.133[b]	0.142[a]	0.153[a]	0.159[a]	0.008
HCW, kg	315.48[b]	316.29[b]	318.33[a]	320.60[a]	6.49
Dress, percent	62.2	62.0	62.0	62.1	0.70

[ab]Means differ ($P < 0.05$)

Key Words: Beef, Heifer, Growth, Ractopamine

171 Dose titration of Optaflexx® (ractopamine HCl) evaluating the effects on standard carcass characteristics in feedlot heifers. A. Schroeder*, D. Hancock, D. Mowrey, S. Laudert, G. Vogel, and D. Polser, *Elanco Animal Health*, *Greenfield, IN*.

The effect of feeding Optaflexx, ractopamine HCl, (RAC) on standard carcass characteristics in beef heifers was evaluated at five different geographical sites. Heifers were assigned to one of four treatments (0, 10, 20, or 30 ppm, 100% DM). A randomized complete block design was used at each site. This resulted in a total of 25 experimental units (7-10 heifers/pen) per Optaflexx concentration. RAC was fed for the last 28 or 42 days of the finishing period immediately prior to harvest. Harvest was conducted in commercial beef packing plants. Following a 18 to 24 hour chill, carcasses were ribbed and standard carcass measurements collected.

Least square means are given in the following table:

HCW increased, ($P < 0.05$), in the 20 and 30 ppm treatment groups compared to controls. LM area was the largest, ($P < 0.05$), at 30 ppm. Twelfth rib fat thickness and KPH were not affected by RAC treatment. Yield grade tended, ($P = 0.09$), to be improved at 30 ppm. Marbling score and carcass maturity were not affected by RAC treatment. Muscle color was improved, ($P < 0.05$), with RAC treatment. Muscle firmness and texture were not affected by RAC treatments. These data demonstrate that feeding RAC increased HCW at all RAC treatments, and, LM area and conformation scores at 30 ppm RAC, without impacting carcass quality when fed for the last 28 to 42 days of the finishing period.

Least Squares Means

Item	RAC (ppm) 0	10	20	30	SE
HCW, kg	315.48[b]	316.29[b]	318.33[a]	320.60[a]	6.49
12th rib fat, cm	1.60	1.60	1.60	1.57	0.18
KPH, %	2.29	2.32	2.25	2.31	0.20
LM area, cm^2	81.27[b]	81.92[b]	81.92[b]	84.5[a]	2.77
Yield grade	3.1	3.1	3.1	3.0	0.22
Marbling	Sm[34]	Sm[36]	Sm[38]	Sm[30]	15.5
Maturity	A[56]	A[55]	A[57]	A[55]	2.1
Conformation	low Ch[77b]	low Ch[69b]	low Ch[86b]	ave Ch[12a]	0.30
Muscle color[c]	6.1[b]	6.2[a]	6.3[a]	6.2[a]	0.20
Muscle firmness[c]	6.5	6.5	6.6	6.6	0.21
Dark cutters, %	2.3	2.8	1.9	3.3	

[ab]Means differ (P < 0.05), [c]scale: 1 = undesirable, 7 = most desirable

Key Words: Beef, Heifer, Carcass, Ractopamine

Least Squares Means

Item	RAC (ppm) 0	10	20	30	SE
No. Pens	24	25	25	24	
No. Carcasses	48	49	49	50	
Side soft tissue, kg	128.2	126.8	128.0	127.8	4.13
Carcass bone, %	13.84	14.04	13.91	13.95	0.26
Protein, %	14.78[b]	14.88[b]	14.94[b]	15.33[a]	0.22
Moisture, %	51.88[b]	51.69[b]	51.68[b]	52.81[a]	0.86
EEL, %	32.19[b]	32.03[b]	31.95[b]	30.38[a]	0.67
Ash, %	0.81	0.79	0.81	0.84	0.02
Carcass protein gain per day, g	44.5[b]	45.8[b]	58.1[a]	75.8[a]	27.67
Efficiency of carcass protein gain per day	0.005[b]	0.005[b]	0.006[a]	0.008[a]	0.003

[ab]Means differ (P <0.05)

Key Words: Beef, Heifer, Composition, Ractopamine

172 Dose titration of Optaflexx® ractopamine HCl) evaluating the effects on composition of carcass soft tissues in feedlot heifers. A. Schroeder, D. Hancock, D. Mowrey, S. Laudert, G. Vogel, and D. Polser*, *Elanco Animal Health*, *Greenfield, IN*.

The effect of Optaflexx®, ractopamine HCl, (RAC) on the composition of carcass soft tissues (ST) of beef heifers was evaluated at five different geographical sites. A randomized complete block design was used at each site. Heifers were assigned to one of four treatments (0,10,20,or 30 ppm, 100% DM). This resulted in a total of 25 experimental units (7-10 heifers/pen) per Optaflexx concentration. RAC was fed for the last 28 or 42 days of the finishing period immediately prior to harvest. Harvest was conducted in commercial beef packing plants. Up to two carcass sides were randomly selected from carcasses in each experimental unit, which had hot carcass weights (HCW) within ±11.33 kg of the mean HCW in each block. The sides were dissected into ST (muscle and fat), bone (bone and connective tissue) and other tissues (kidney, pelvic, heart fat, diaphram and hanging tender). ST of each side was coarse ground, thoroughly mixed, reground and sub-sampled. Subsamples were homogenized and three aliquots collected and frozen. Moisture, ether extractable lipid (EEL), protein (N x 6.25) and ash content were determined using AOAC methods. Baseline composition on contemporary animals (n=110) was collected upon study initiation to calculate carcass protein gain per day and efficiency of carcass protein gain per day.

Carcass bone and ash were not different between RAC concentrations. Carcass protein and moisture content were increased, (P < 0.05), at 30 ppm RAC compared to controls. EEL was decreased, (P < 0.05), at 30 ppm compared to control. Carcass protein gain per day increased, (P < 0.05), by 30.6% and 70.4% at 20 and 30 ppm RAC concentration, respectively. Efficiency of carcass protein gained per day was improved, (P < 0.05), 20% and 60% at 20 and 30 ppm, respectively. The results indicate feeding RAC at 30 ppm increased carcass protein (leanness) in feedlot heifers when fed for the last 28 to 42 of the finishing phase.

173 Effects of ractopamine and steroidal implantation on nitrogen retention and blood metabolites in holstein steers. D. K. Walker*, E. C. Titgemeyer, B. J. Johnson, and J. J. Higgins, *Kansas State University*, *Manhattan*.

Our experiment evaluated interactions between steroidal implantation and feeding ractopamine. Six Holstein steers (231 kg) housed in metabolism crates were used in a split-plot design with the main plot arranged as a randomized complete block design with blocks of two steers based on previous serum IGF-I concentrations. The main plot treatments were implantation or not with 120 mg trenbolone acetate plus 24 mg estradiol-17β (Revalor® S; Intervet) on d 0. The subplot treatment was feeding of 200 mg/d ractopamine-HCl (Optaflexx™; Elanco Animal Health) which was initiated on d 29 and continued through d 56 for all steers. Steers were fed a corn-based diet (62% rolled corn, 20% expeller soybean meal, and 15% alfalfa hay) twice daily with an average DMI of 4.8 kg/d. Urine and fecal samples were collected throughout the study for measuring N retention. Blood samples were collected prior to implantation and on d 14, 28, 42, and 56. There was an implant × ractopamine interaction for retained N (P<0.05); ractopamine feeding led to only a minor improvement in N balance for implanted steers (45.9 vs. 44.5 g/d), whereas ractopamine led to large increases in N balance for non-implanted steers (39.0 vs. 30.4 g/d). Fecal N output was significantly lower (P<0.01) and DM digestibility was higher (79.6 vs. 77.3%; P<0.01) when ractopamine was fed. Implantation increased (P<0.05) serum IGF-I concentration on d 14 (526 vs. 444 ng/mL) and on d 28 (659 vs. 442 ng/mL), and IGF-I remained greater for implanted steers when ractopamine was fed (545 vs. 359 ng/mL; average of d 42 and 56). Both ractopamine and implantation numerically decreased plasma glucose and urea. Ractopamine decreased serum insulin 8% in non-implanted steers (0.50 vs. 0.46 ng/mL), but decreased it 66% in implanted steers (0.40 vs. 0.14 ng/mL). The steroidal implant and the feeding of ractopamine both increased N retention in steers, but the combination did not yield an additive response.

Key Words: Cattle, Implant, Ractopamine

174 Using ultrasound measurements to determine body composition of yearling bulls. M. Baker*[1], L. Tedeschi[1], D. Fox[1], W. Henning[2], and D. Ketchen[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Penn State University*, *Statel College*.

Carcass traits have been successfully used to determine body composition of steers to allocate feed to individual animals fed in groups. In this study, the individual DM required for the observed performance of yearling bulls was assessed using ultrasound measurements as a proxy for carcass traits. One hundred eighteen spring born purebred and crossbred bulls (BW = 288 46 kg) were

sorted into three marketing groups based on projected days to USDA low Choice quality grade and fed a common high concentrate diet in twelve slatted-floor pens (10 head per pen). Ultrasound measurements (backfat (uBF), rump fat (uRmpFt), ribeye area (uREA), and intramuscular fat (IMF)), were taken at approximately one year of age. At the projected days to finish, each marketing group was harvested in a commercial packing facility. Carcass data (HCW, backfat over the 12-13th rib (BF), marbling score (MRB), and ribeye area (REA)) was collected for comparison with ultrasound data. The 9-10-11th rib section was removed and dissected into edible and non-edible portions. Chemical fat was determined by ether extract of the edible portion and used to compute carcass fat (CF) and empty body fat (EBF). The observed EBF averaged 23.7%. Multiple regression analysis indicated that carcass measurements explained 73% of the variation in EBF (EBF = 16.0583 + 5.6352*BF + 0.01781* HCW + 1.0486*MRB - 0.1239*REA). Because carcass traits are not available on bulls intended for breeding, another equation using computed HCW (cHCW; using a previously published equation between HCW and SBW) and ultrasound measurements was developed (EBF = 41.0437*uBF - 0.1384*uREA + 0.0867*cHCW - 0.0897*uBF*cHCW - 2.4225). This equation accounted for 62% of the variation in EBF. An equation previously developed to estimate EBF from carcass traits of steers over predicted the observed EBF of these bulls (28.2 vs. 23.7%, respectively). Carcass traits are sufficient to estimate EBF in yearling bulls, but further investigation is required to improve equations for EBF using ultrasound measures.±

Key Words: Beef bulls, Ultrasound, Body Composition

Meat Science and Muscle Biology: Novel Technologies in Muscle Biology/Fresh Meat Research

175 Adipocytes, myofibers, and cytokine biology: New horizons in the regulation of growth and body composition. M. Spurlock*, S. Jacobi, J. Davis, N. Gabler, and K. Ajuwon, *Purdue University*, *West Lafayette, IN*.

Muscle growth in meat animals is a complex process governed by integrated signals emanating from multiple endocrine and immune cells. A generalized phenomenon among meat animal industries is that animals commonly fail to meet their genetic potential for growth in commercial production settings. Therefore, understanding the impact of stress and disease on muscle growth potential is essential to improving production efficiency. The adipocyte in particular seems to be well positioned as an interface between energy status and immune function, and may thus regulate myofiber growth through a combination of signals which influence fatty acid oxidation, glucose uptake and insulin sensitivity. Adipocytes are active participants in the innate immune response, and as such, produce a number of metabolic regulators, including leptin, adiponectin, and proinflammatory cytokines. Specifically, adipocytes respond directly to bacterial lipopolysaccharide by producing IL-6 and TNFÎ±. However, adipocytes are also the sole source of the anti-inflammatory hormone, adiponectin, which regulates the nuclear factor kappa-B transcription factor, locally, and in myofibers. The production of such molecules strategically positions inter- and intra-muscular adipocytes to act as immunological sensors to regulate direct and indirect responses of myofibers to inflammatory signals. In this talk, we will establish critical immunological aspects of the adipocyte, and build specific linkages between these processes, cytokine production, and energy metabolism at the myofiber and whole-animal level. Finally, specific research needs will be emphasized.

Key Words: Adipocyte, Myofiber, Cytokine

176 Gene expression profiling: Insights into skeletal muscle growth and development. D. Moody, C. Stahl, and J. Reecy*, *Iowa State University*, *Ames*.

It has been appreciated for a long time that skeletal muscle has an incredible ability to adapt to the genetic and physiological demands placed upon it. However, it has only been with the advent of high-throughput gene expression analysis that a systems-based understanding of these adaptations has begun to be appreciated. For example, compensatory growth in response to an imposed load is an important and well-known biological adaptation of skeletal muscle. Skeletal muscle hypertrophy results in increased amino acid transport, satellite cell proliferation, protein accretion, and involves fiber-type switching. However, we are only beginning to understand the systemic changes in hypertrophying muscle at the molecular level. An initial gene expression profiling experiment of work overloaded skeletal muscle has led us to describe the requirement for JAK2 signaling in myoblast proliferation and differentiation. In addition, gene expression profiling has also led to the discovery of new gene families associated with muscle hypertrophy. For example, gene expression analysis of skeletal muscle following administration of the beta-adrenergic receptor agonist clenbuterol revealed a significant decrease in RNA abundance of multiple members of the novel ankyrin repeat and SOCS-box containing (ASB) gene family. Furthermore, while the need of dietary P for both soft-tissue and bone growth has been well documented, the mechanisms by which this nutrient is involved in regulating growth has only begun to be elucidated. Current research is focused on identifying these mechanisms as well as nutrition by genetic interactions, which may affect them. These results provide new information concerning changes in gene expression associated with skeletal muscle growth and development, and provide candidate genes for future hypothesis-based testing.

Key Words: Microarray, Genetic, Nutrition

177 Use of transgenic mouse models to understand proteolytic degradation systems in muscle. M. Spencer*, *University of California*, *Los Angeles*.

Investigations into mechanisms involved in muscle wasting and growth have traditionally relied on the use of inhibitors against the different proteolytic systems present in muscle. These studies, while informative, do not always provide specific information about the role of individual proteases within a class or about the contribution of different family members. Genetically modified mice, in which genes are either knocked out or overexpressed are useful tools to circumvent these problems. We have generated several lines of genetically modified mice and have used them to address questions of muscle wasting, remodeling and disease. Mice lacking (knock out) or overexpressing (transgenic) proteins of the calpain and ubiquitin ligase families are generated, characterized and then subjected to perturbations that elicit muscle wasting. These studies have shown that calpains act upstream of ubiquitin ligases in the processes of muscle wasting and growth.

Key Words: Calpain, Ubiquitin, Muscle Growth

178 Application of proteomics in meat research. R. Lametsch*, *The Royal Veterinary and Agricultural University, Department of Food Science*, *Frederiksberg, Denmark*.

The large progress in biotechnology in recent years has resulted in the development of new scientific research areas such as genomics and proteomics, which are used to study the complex patterns of gene and protein expression in cells and tissue. The technologies developed within genomics and proteomics have mainly been used in life science, e.g. to develop new drugs and diagnostic tools. However, they also have a large potential in food science as gene expression and protein composition of plants and animals have a major impact on the yield and quality of the final food products. Proteomics is the study of the proteome which is defined as the protein complement expressed by the genome of an organism.

For the consumer and the meat industry variation in meat tenderness is a well known problem. Although it is an area with high attention the mechanisms leading to tender, and sometimes unexpectedly tough, meat are not fully understood. Meat tenderizes during post mortem storage and it is well established that post mortem protein degradation plays a major role in the tenderization process. During the post mortem proteolytic processes several muscle proteins are degraded, but the number and identity of the proteins that are degraded is partly unknown. Moreover, it is still unclear which proteolytic enzymes are involved and how they are regulated. We apply proteomics to study the mechanism involved in the tenderization process in meat and to identify specific markers for the post mortem proteolytic processes. Several protein fragments that result from post mortem proteolysis have been identified and it has also been possible to assign which part of the full-length proteins the fragments were revealed from. This information was used to construct the cleavage pattern of some of the proteins involved in meat tenderization. More importantly, some of the identified fragments were significant correlated to meat texture. We also apply proteomics to study the regulation of the calpain-system, which takes part in the tenderization process.

Key Words: Proteomics, Meat, Tenderness

Nonruminant Nutrition: Weanling Pig Nutrition and Methodology

179 Fermented soybean meal as a protein source in nursery diets replacing dried skim milk. S. W. Kim*, R. D. Mateo, and F. Ji, *Texas Tech University*, *Lubbock, TX*.

Two studies were conducted to evaluate if fermented soybean meal (FSBM) successfully replace the use of dried skim milk (DSM) in nursery diets. Fermentation of soybean meal was done by *Aspergillus Oryzae GB-107*. Previous studies demonstrated that this fermentation process reduces trypsin inhibitor contents and the size of soybean peptide. In Exp. 1, 192 newly weaned pigs (21.5 ± 0.1 d, 6.35 ± 0.10 kg) were allotted to one of four dietary treatments by increasing FSBM (0, 3, 6, and 9%) whereas reducing DSM (25, 22, 19, and 16%). Each treatment had six pens with eight pigs per pen. All diets contained 1.53% lysine, 0.87% methionine+cysteine, 1.03% threonine, 0.28% tryptophan, and 3.40 Mcal/kg ME. Pigs were fed the diets for two weeks. Body weight and feed intake were measured weekly. Diarrhea score was recorded daily during the entire feeding period. Average daily gain and feed intake were the same ($P > 0.05$) among the pigs fed the diets with 0, 3, and 6% FSBM. Pigs fed a diet with 9% FSBM had a lower ($P < 0.05$) ADG and ADFI than pigs with 0% FSBM. Diarrhea scores were the same ($P > 0.05$) among the treatments. In Exp. 2, 144 newly weaned pigs (22.1 ± 0.1 d, 6.52 ± 0.11 kg) were allotted to one of three dietary treatments by increasing FSBM (0, 5, and 10%) while reducing DSM (40, 32.4, and 24.8%). Lactose was added at 0, 3.8, and 7.6%, respectively, in order to match lactose content equal to 23.5% for all diets. All diets contained 1.58% lysine, 0.91% methionine+cysteine, 1.03% threonine, 0.29% tryptophan, and 3.51 Mcal/kg ME. All detailed procedure was identical to Exp. 1. Pigs fed a diet with 5% FSBM had a greater ($P < 0.05$) ADG and gain/feed than pigs with 0% FSBM when lactose contents were the same among the treatments. Pigs with 10% FSBM had the same ADG and gain/feed to those with 0% FSBM and 10% FSBM. Diarrhea scores were the same ($P > 0.05$) among the treatments. Fermented soybean meal can be used up to 10% in a nursery diet successfully replacing the use of dried skim milk when the lactose contents were matched.

Acknowledgements: Genebiotech Co., LTD for the financial support.

Key Words: Fermented Soybean Meal, Dried Skim Milk, Nursery Pigs

180 Comparative efficacy of plant and animal protein sources on the growth performance, nutrient digestibility and intestinal morphology of the early-weaned pigs. J. H. Yun, I. K. Kwon, J. D. Lohakare, W. T. Cho, and B. J. Chae*, *Kangwon National University*, *Chunchon, Kangwondo, Korea*.

The present study was conducted to evaluate and compare the effects of various animal and plant protein sources on piglet's performance, digestibility of amino acids and gut morphology in the weaned pigs till 28 days after weaning. Two hundred seventy weaned pigs of 17 ± 3 days of age (Landrace × Yorkshire × Duroc) were allotted to five treatments with three replicates, comprising 18 pigs in each replicate. The plant protein sources used were soybean meal (SBM), fermented soy protein (FSP), rice protein concentrate (RPC); and animal protein sources tested were, whey protein concentrate (WPC) and fish meal (FM). Iso-proteinous (21%) diets were formulated and lysine (1.55%) content was same in all the diets. The level of each protein source added was 6% by replacing SBM to the same extent from the control diet containing 15% SBM. The ADG was higher ($P < 0.05$) in the groups fed animal proteins as compared with plant proteins at all the levels of measurement, except during 15-28 days. The highest ADG was noted in WPC and FM fed diets and lowest in SBM fed diet. The feed intake was higher in animal protein fed groups than plant proteins at all phases. The digestibilities of gross energy, dry matter and crude protein were higher in animal protein fed groups than to plant protein fed sources. The apparent ileal digestibilities of essential amino acids like Leu, Thr, and Met were significantly higher ($P < 0.05$) in animal proteins fed animals as compared with plant protein fed groups. But the apparent fecal digestibilities of essential amino acids like Arg and Ile were significantly higher ($P < 0.05$) in plant protein diets than animal protein sources. The villous structure studied by scanning electron microscope were prominent, straight finger-like, although shortened and densely located in FM fed group as compared with others. Overall, it could be concluded that animal protein sources in the present study showed better effects on growth performance, nutrient digestibility and gut morphology than plant protein sources.

Key Words: Plant Protein, Animal Protein, Pigs

181 Growth performance, gut health and digestive function in newly weaned pigs fed fermentable proteins and carbohydrates. E. A. Jeaurond* and C. F. M. deLange, *University of Guelph*, *Guelph, Ontario, Canada*.

Feeding fermentable carbohydrates (FC) may reduce the negative impact of enteric proteolytic fermentation in pigs. A total of 144 newly weaned pigs (6.23 kg BW; six pens per treatment; six pigs per pen) were used to determine the interactive effects of feeding fermentable protein (FP) and FC on growth performance, indicators of digestive function and intestinal health. Dietary treatments were: (1) basal diet (control), (2) control + 10% poultry meal (PM) as FP source, (3) control + 5% beet pulp (BP) as FC source and (4) control + PM and BP. Diets were formulated to be similar in digestible energy and digestible amino acid contents. In general, no interactive effects of FC and FP were observed ($P > 0.10$). During the 3-week post-weaning period, feeding FP reduced ADG (269 vs. 242g/d; SE, 7), while feeding FC increased ($P < 0.05$) ADG (243 vs. 269 g/d; SE, 7). Overall feed intake did not differ between treatments ($P > 0.10$). Based on PCR-DGGE, feeding FC and FP appeared to increase microbiota diversity in colon contents. On d 14 and 28 post-weaning, Clostridia sp. counts in colon contents, White Blood Cell counts and segmented blood Neutrophils were lowered ($P < 0.05$) by feeding FC, suggesting lower bacteriological stress. Blood urea nitrogen was increased by feeding FP (6.5 vs. 9.5 mg/dL; SE, 0.5), while ammonia concentration in colon contents was lowered ($P = 0.06$) by FC (193 vs. 154 ug/mL; SE, 14.2). Among biogenic amines, levels of tyramine (304 vs. 140 nmol/g DM; SE, 38) and spermidine (219 vs. 174 nmol/g DM; SE, 14) in colon contents were lowered by feeding FC ($P < 0.05$). Acetic, proprionic and butyric acid contents in colon contents were increased by feeding FC, while valeric acid content was decreased by feeding FP ($P < 0.05$). Feeding FC and FP had no effect ($P > 0.10$) on colon histology, pH of colon contents, fecal consistency score and organ weights. Results suggest that FP and FC have independent effects on newly weaned pigs, while effects appear to be partly related to changes in gut micro flora.

Key Words: Pig, Gut Function, Fermentration

182 The interaction of net energy concentration and feeding level in weaned pigs. I. Growth, nutrient digestibility and energy utilization. T. F. Oresanya[1,2], A. D. Beaulieu[1], and J. F. Patience*[1], [1]*Prairie Swine Centre Inc.*, *Saskatoon, Saskatchewan, Canada*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*.

The simultaneous evaluation of the impact of dietary energy concentration and feed (energy) intake is important for an accurate understanding of energy metabolism in weaned pigs. Surprisingly, there is very little information on this subject. This study investigated the interaction of dietary net energy concentration (NE) and daily feed intake on growth, nutrient digestibility and energy utilization in weaned pigs. Individually penned PIC barrows (n = 81; 31.5 ± 0.3 d; initial BW = 9.5 ± 1.0 kg) were allotted to one of nine treatments (trt) in a 3 × 3 factorial arrangement (n = 9/trt). Factors were formulated NE (low, 2.21; medium, 2.32; and high, 2.42 Mcal NE/kg) and feeding level (FL: 100%, 80% or 70%). NE was increased by a simultaneous decrease and increase of CP and fat, respectively. BW was determined twice per wk and daily feed allowance adjusted per pig on a BW basis, relative to the ad libitum intake of pigs on each diet. Pigs remained on test until they reached 25 ± 1 kg BW. ADG, ADFI and G/F were unaffected by NE (572 g/d, 781 g/d and 0.732, respectively; $P > 0.05$). ADG and ADFI increased ($P < 0.05$) with FL but not G/F ($P > 0.05$). Apparent fecal digestibility of GE, DM, fat, CP and ash increased ($P < 0.05$) with increasing NE but declined with increasing FL ($P < 0.05$) while that for crude fiber declined ($P < 0.001$) with increasing NE and FL. Estimated NE from digestible nutrients were determined to be 2.15, 2.26 and 2.37 Mcal NE/kg for the low, medium and high NE diets, respectively. Energy intake increased with increasing NE and FL ($P < 0.001$) whereas energy efficiency for growth (Mcal NE/kg BW gain) became poorer with increasing NE and FL ($P < 0.001$). In conclusion, weaned pigs were able to consume sufficient energy for growth within the range of NE investigated herein. There was no benefit of increased energy intake with increased NE concentration on growth and feed efficiency. The effects of NE concentration and feed intake on growth are additive.

Key Words: Weaned Pigs, Net Energy, Growth

183 The interaction of net energy concentration and feeding level in weaned pigs. II. Body composition, nutrient deposition rates and plasma IGF-I concentration. T. F. Oresanya[1,2], A. D. Beaulieu[1], and J. F. Patience*[1], [1]*Prairie Swine Centre Inc.*, *Saskatoon, Saskatchewan, Canada*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*.

The effects of simultaneously increasing energy concentration and changing daily energy intake through the control of feed intake in weaned pigs have not been examined. This study evaluated the interactive effect of increased dietary net energy concentration (NE) and feeding level (FL) on body composition, nutrient deposition rates and plasma IGF-I concentration. Individually penned PIC barrows (n = 60; 31.5 ± 0.3 d; initial BW = 9.4 ± 1.1 kg) were allotted to one of nine treatments (trt) in a 3 × 3 factorial arrangement or an initial slaughter group (ISG; n = 6/trt or ISG). Factors were formulated NE (low, 2.21; medium, 2.32; and high, 2.42 Mcal NE/kg) and FL (100%, 80% or 70%). Pigs were bled twice (d 7 and d 21) and remained on test until they reached 25 ± 1 kg BW, at which time they were sacrificed for carcass analysis. Carcass and empty body (EB, carcass plus organ) protein and lipid content and deposition rate (PD and LD) were determined. Carcass and EB lipid content increased (interaction, $P < 0.01$) while water content decreased in pigs with ad libitum intake on the high NE diet. Carcass and EB protein content declined with increasing NE ($P < 0.05$) but were not affected by FL ($P > 0.05$). Carcass and EB PD increased with increasing FL ($P < 0.001$) but not with NE ($P > 0.05$). Carcass and EB LD and LD/PD ratio increased (interaction, $P < 0.01$) in pigs with ad libitum intake on the high NE diet (EB LD = 44, 51 and 86 g/d and LD/PD = 0.41, 0.47 and 0.76 for ad libitum pigs on the low, medium and high NE diets, respectively). Plasma IGF-I concentration increased with increasing FL and day (interaction, $P < 0.001$) but not with NE ($P > 0.05$). In conclusion, the effects of NE concentration and feed intake on PD and plasma IGF-I are additive. In contrast to PD, the interactive effects of NE concentration and feed intake on EB lipid content, LD and LD/PD ratio indicates that increasing energy concentration is not desirable for optimal lean growth in weaned pigs.

Key Words: Weaned Pigs, Net Energy, Nutrient Deposition

184 Genetic background impacts growth performance and endocrine parameters during dietary phosphorus deficiency in young gilts. S. Cutler*, L. Grapes, M. Rothschild, and C. Stahl, *Iowa State University*, *Ames*.

Costs associated with inorganic phosphorus (P) levels in animal diets have driven research to more accurately define requirements in order to minimize P excretion while maintaining growth rate. We examined the influence of two sire lines, selected primarily for either meat quality (MQ) or growth performance (GP), on P utilization by 36 gilts (21 d of age, 6.63 ± 0.78 kg) from six litters (three pigs/litter) for each sire line. Pigs were allotted into three dietary treatment groups: P adequate (+P, 0.41% available P), P repletion (RP, 0.14% available P for wk 1, 0.41% available P for wk 2), or P deficient (-P, 0.14% available P) for 2 wk. MQ sired -P pigs had lower ($P < 0.05$) ADG compared to either RP or +P pigs, whereas this effect was not seen in GP sired pigs. Both MQ and GP sired -P pigs had lower ($P < 0.05$) G:F than their siblings in either the +P or RP groups. Plasma levels of inorganic P and plasma alkaline phosphatase activities were altered by -P diet but not genetic background. The RP group returned to normal levels after 1 wk on a +P diet. Pigs in the -P group had lower ($P < 0.05$) plasma IGF-1 concentrations than +P pigs. This difference in circulating IGF-1 levels was greater ($P < 0.05$) among the MQ sired animals than the GP sired animals. Gilts in the RP MQ group showed greatly increased plasma IGF-1 levels after being returned to the +P diet. This coincided with a sixfold increase in pituitary GH expression. The relative expression of IGF-1, IGFBP-1 IGFBP-2, and IGFBP-3, and IGFBP-5 mRNA in liver tissue was; however, not different between any of the treatment groups. Differential expression of thyroid receptor interaction protein 6 (TRIP-6) mRNA in the liver suggests that energy metabolism may be differently regulated across these genetic backgrounds. These results suggest that genetic background dramatically influences inorganic P requirements and that genotype specific P supplementation could reduce the environmental impact of swine production without detriment to performance.

Acknowledgements: This research was funded in part by the IAHEES, the Office of Biotechnology at ISU, and Sygen International.

Key Words: Phosphorus, IGF-1, Pigs

185 Dietary and ontogenetic regulation of digestive enzyme mRNAs in the small intestine of weanling pigs. J. Zhao*, X. Xiao, E. A. Wong, K. E. Webb, Jr., A. F. Harper, E. Gilbert, and D. M. Denbow, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Dietary and ontogenetic regulation of digestive enzyme mRNAs were evaluated in weanling pigs (n = 54, 17 + 2 d of age, 6.2 + 0.3 kg BW) along the horizontal axis of the small intestine. Experimental diets included a control soy protein diet, a diet containing 6% spray-dried plasma protein or a 0.5% commercial hydrolyzed marine protein source (Peptiva®, VITECH BIOCHEM, San Fernando, CA). Pigs were housed in double-deck nursery pens with continuous lighting at 29°C. Pigs were killed at weaning or 3 or 10 d after weaning for harvest of mucosa from duodenum, jejunum and ileum. The mRNA level of digestive enzymes aminopeptidase A (APA), aminopeptidase N (APN), dipeptidyl peptidase IV (DPPIV), and maltase-glucoamylase (MGA) were measured by Northern blotting and expressed as relative abundance to the housekeeping gene GAPDH. Significant diet × intestinal region interactions ($P < 0.05$) were found for APA and APN. Aminopeptidase A was evenly distributed along the small intestine in the Peptiva® group, but decreased dramatically in the ileum in other groups. Aminopeptidase N increased from proximal to distal intestine in the soy protein and plasma groups, whereas in the Peptiva® group, expression was highest in the jejunum and lowest in the duodenum. The profiles of mRNA levels showed that MGA was expressed at higher level in the jejunum compared to duodenum and ileum ($P < 0.01$). Aminopeptidase A expression decreased from duodenum to ileum ($P < 0.01$), whereas APN and DPPIV showed the opposite expression pattern ($P < 0.01$). The mRNA levels of MGA increased with age, compared to APA and DPPIV which decreased ($P < 0.05$). The APN level was constant during the entire experimental period. In this study, protein source altered the expression pattern of APA and APN. Expression of APA, APN, DPPIV and MGA was differentially regulated along the length of the small intestine and varied as a function of age.

Key Words: mRNA, Digestive Enzyme, Weanling Pigs

186 Effect of oral N-carbamylglutamate (NCG) supplementation on growth and tissue protein synthesis in piglets. J. Frank*[1], J. Escobar[1], A. Suryawan[1], C. Liu[1], H. Nguyen[1], T. Davis[1], and G. Wu[2], [1]*USDA/ARS CNRC, Baylor College of Medicine*, *Houston, TX*, [2]*Texas A&M University*, *College Station*.

Recent research indicates that oral supplementation of NCG, an analogue of N-acetylglutamate, increases plasma arginine concentrations and growth rate in sow-reared piglets. To investigate the mechanism involved in this response, nursing piglets (n = 14; BW = 2.75 kg) were orally administered 50 mg/kg BW of NCG or saline twice daily from 7 to 14 d of age. After an overnight (12-h) fast, 14-d old piglets were administered saline or NCG at time 0 and 60 min, then received a flooding dose of [3H]phenylalanine in order to measure protein synthesis. At 90 min, the piglets were euthanized and tissue samples were collected. NCG-treated pigs gained more weight during the 7-d trial than control pigs (1.63 ± 0.07 vs. 1.43 ± 0.06 kg, respectively; $P < 0.001$). Plasma arginine concentrations were 44% higher in NCG-treated pigs compared to control pigs ($P < 0.01$). NCG-treated pigs tended to have higher plasma insulin concentrations compared to control pigs ($P < 0.06$). Plasma glucose concentrations were not different between the treatments ($P > 0.73$). Fractional protein synthesis rate in longissimus dorsi muscle was 17% higher in NCG-treated pigs compared to controls (6.9 ± 0.5 vs. 5.9 ± 0.6 %/d, respectively), although this did not reach significance ($P < 0.24$). Fractional rates of protein synthesis in liver, kidney, and duodenum were not different between treatments ($P > 0.49$). We postulate that the sensitivity of muscle protein synthesis to NCG treatment in piglets may be reduced in the fasted state. Oral NCG administration increases growth rate of nursing piglets likely by increasing plasma arginine concentrations.

Acknowledgements: NIAMS AR 44474, USDA 58-6250-6-001, and USDA/NRI grant.

Key Words: Pigs, N-Carbamylglutamate, Protein Synthesis

187 Evaluation of culture independent quantitative real-time PCR of *S. bovis* in weaning pig. H. B. Lee*, C. S. Kong, M. S. Yun, L. G. Piao, and Y. Y. Kim, *Seoul National University*, *Seoul, South Korea*.

A culture independent quantitative real-time PCR method was evaluated for enumeration of the bacteria species *Streptococcus bovis* from intestinal samples of weaning pigs. Many of the earlier molecular techniques including real-time PCR were culture dependent or conducted with cultured samples, resulted in unaccurate analysis due to the fact that culture independent sequencing from intestinal samples showed less than 95% of similarity with culture dependent sequencing results. The intestinal microbiota of the pig is consisted mostly of anaerobic bacteria with little knowledge of its nutritional requirement, and consequently, it is hard to culture in the aerobic condition for further analysis. A total of 36 weaning pigs were sacrificed and samples from jejunum, cecum, colon and rectum were collected and immediately stored in liquid nitrogen, conserving the exact microbiota of the pig. Total DNA was extracted by bead-beating method using the UltraClean™ DRY Soil kit (MoBio). Primer set *S. bovis*_RT1, with CTAATACCGCATAACAGCAT (foward) and AGAAACTTCCTATCTCTAGG (reverse) was designed and tested for species specificity. The standard for RT-PCR was established according to DNA concentration from pure cultured *S. bovis*. The quantification of DNA (as DNA copy/g samples) by RT-PCR was performed with ICycler® Optical Module (Bio-Rad) using the iQ™ SYBR® Green Supermix (Bio-Rad). The result showed 95.3% of PCR efficiency, providing reliable data on *S. bovis* quantity in samples from different regions of the intestine, collected by culture independent method. This experiment indicated the possibility of a culture independent quantification of the intestinal microbes with known DNA sequence.

Key Words: Weaning Pig, Quantitative Real-Time PCR, *Streptococcus bovis*

188 Validation of an in vitro analysis to determine energy digestibility of barley for grower pigs. R. T. Zijlstra*[1], W. C. Sauer[1], J. H. Helm[2], D. N. Overend[3], and R. W. Newkirk[4], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Field Crop Development Centre*, *Lacombe, AB, Canada*, [3]*Ridley Inc.*, *Mankato, MN, Canada*, [4]*Canadian International Grains Institute*, *Winnipeg, MB, Canada*.

In vitro analyses will be beneficial to characterize the existing variation in energy digestibility within specific feed ingredients such as grains and to develop procedures predicting nutritional value of grains for swine. Analytical procedures have been developed to determine in vitro energy digestibility and DE content for barley, but have not been validated for their suitability to predict in vivo values. First, 21 barley samples with a range in fiber content (5.7 to 12.1% ADF) and total-tract energy digestibility (51.9 to 78.5%) and DE content in grower pigs were subjected to an existing in vitro analysis in duplicate. Briefly, the procedure involved subsequent digestions with pepsin (6 h), pancreatin (18 h), and cellulase (24 h), and DM and GE analyses of the barley sample and residue. The in vitro energy digestibility ranged from 63.7 to 82.2% for the 21 barley samples and relative errors for samples ranged from 0.2 to 4.8%. In vitro energy digestibility was strongly related to swine in vivo energy digestibility content ($R^2 = 0.81$). Second, a subset of seven barley samples was subjected to quadruplicate in vitro analyses. In vitro energy digestibility ranged from 63.5 to 82.8% for the seven samples and the relative error was 4.2% for the barley sample with a low energy digestibility (63.5%) and ranged from 0.6 to 1.4% for the other six barley samples. For the seven barley samples, in vitro energy digestibility was strongly related to in vivo energy digestibility content ($R^2 = 0.97$). In summary, with quadruplicate analyses, in vitro energy digestibility was an accurate predictor of in vivo energy digestibility. In vitro energy digestibility can be successful as the core analytical procedure to calibrate rapid analytical equipment to predict energy digestibility and therefore DE content of barley for grower pigs.

Key Words: Pig, Grain, Analysis

189 Dietary strategy to suppress ochratoxicosis in piglets. G. Schatzmayr*[1], S. Nitsch[1], D. Schatzmayr[1], M. Mezes[2], and E. Binder[1], [1]*Biomin GmbH*, *Herzogenburg, Austria*, [2]*Szent István University, Faculty of Agricultural and Environmental Sciences*, *Gödöllö, Hungary*, [3]*Erber AG*, *Herzogenburg, Austria*.

Ochratoxin A (OTA) is a mycotoxin occurring in many food- and feed commodities. In swine, OTA affects the kidneys (tubular necrosis). Economic losses attributed to the presence of this compound in feeds are not only related to impaired animal health and productivity, but are partly due to the discharge of pig carcasses after slaughter. OTA has a long biological half life and is frequently found as residue in porcine meat and meat products intended for human consumption. A yeast strain (*T. mycotoxinivorans* = MTV) with the capability to degrade OTA was isolated for the development of an OTA-deactivating feed additive. This feed additive was tested in a trial where piglets were challenged with OTA (500 µg/kg). Seventy-two pigs (Hungarian Large White x Hungarian Landrace F1 genotype; sex ratio, 1:1) with an age of 5 to 6 weeks and an initial average live weight of 10 kg were used in this experiment. Treatments included negative control (without OTA and MTV), addition of OTA alone (500 µg/kg), OTA combined with MTV at three different levels (10^4, 10^5 and 10^6 CFU/g of feed) and MTV alone (10^6 CFU/g of feed). Results revealed that OTA had a negative impact on live weight (LW), average daily weight gain (ADWG) and feed conversion ratio (FCR) of weaning piglets. Addition of 10^4 CFU of MTV did not show an improvement in live weight after 28 days but did show improved FCR (28 days) and live weight after 49 days. Higher concentrations of MTV already showed an improvement of live weight after 28 days. Compared to the toxin group the live weight after 49 days and FCR after 28 days were considerably improved. In all control and treated groups' losses of animals and cases of diarrhea were lower than in the toxin group. The ADWG in the toxin group was significantly lower than in all the other groups. From these results it can be concluded that *T. mycotoxinivorans* at a proposed concentration of 10^5 CFU/g of feed can be used to alleviate negative effects of OTA on swine.

Key Words: Ochratoxicosis, Deactivation, *T. mycotoxinivorans*

190 Effect of feeding reduced crude protein and phosphorus diets on pig compartmental and whole body mineral masses and accretion rates. R. Hinson*[1], B. Hill[1], M. Walsh[1], D. Sholly[1], S. Trapp[1], J. Radcliffe[1], A. Sutton[1], A. Schinckel[1], B. Richert[1], G. Hill[2], and J. Link[2], [1]*Purdue University*, *West Lafayette, IN*, [2]*Michigan State University*, *East Lansing*.

Pigs (Exp. 1 = 98 and Exp. 2 = 148) were allotted by sex and BW to determine the effects of feeding a control (CTRL), corn-SBM based diet or a low nutrient excretion (LNE) diet, with reduced CP + synthetic amino acids, low phytic acid corn, and phytase, on carcass, visceral, and blood mineral contents and masses. Pigs were split-sex phase fed, three nursery diets for a 5-wk nursery period (Exp. 2) and two grower and two finisher diets for a 16-wk grow-finish (G-F) period (Exp. 1 and 2). Pigs were housed two-five pigs/pen and five pens/sex/treatment (trt) in G-F. Individual pig weights and pen feed consumption were recorded bi-weekly. Five or six pigs/sex were harvested at the start of each experiment to determine initial composition and six pigs/sex/trt were harvested at the end of the nursery period (Exp. 2) and 10 pigs/sex/trt were harvested at wk 8 and 16 of the G-F period (Exp. 1 and 2) for determination of tissue pool compositions. Tissues were assayed for: DM, Ash, N, P, Ca, Zn, Fe, Cu, Mg, and Mn. There were no differences in nursery, grower, or finisher whole body tissue mass between treatments. However, total mass and accretion rates of P, Ca, and Mg decreased and Zn and Mn increased when LNE diets were fed during the nursery period (Exp. 2 only; $P < 0.05$). Grower period ash, P, Ca, Mg, and N (Exp. 2) masses and accretion rates of ash, P, Ca, Mg, Fe (Exp. 1), Zn (Exp. 2), Cu (Exp. 2) decreased when pigs were fed LNE diets ($P < 0.05$). During the finisher period, whole body ash (Exp. 2), P, Ca, Mg, N (Exp. 2) decreased and accretion rate of Zn (Exp. 2) increased ($P < 0.05$) when pigs were fed LNE diets. Overall, total tissue accretion rate was not different between treatments, however whole body accretion rates of ash (Exp. 2), P, Ca, Mg, and N (Exp. 2) were decreased when pigs were fed LNE diets from weaning to market. There were differences in individual mineral accretion rates by the different tissue pools at different phases of the pigs growth cycle, however, the carcass is the largest pool and has the greatest influence on the whole body mineral accretion rates.

Key Words: Pigs, Phosphorus, Whole Body Mineral Accretion

191 Pigs housed under deep litter and conventional housing systems have different growth paths to a similar carcass composition. D. Suster[1], D. J. Henman[2], D. J. Cadogan[3], and F. R. Dunshea*[1,4], [1]*Primary Industries Research Victoria*, *Werribee, Victoria, Australia*, [2]*QAF Meat Industries*, *Corowa, NSW, Australia*, [3]*Feedworks*, *Hamilton, Qld, Australia*, [4]*University of Melbourne*, *Parkville, Victoria, Australia*.

Three replicates of 120 boars and gilts were weaned into deep litter (rice hulls and straw) pens with an additional 60 pigs of each sex weaned into groups of 20 housed under conventional systems (raised weaner cots and then concrete flooring). All pigs were located in the same airspace with a stocking density of 0.65 pigs/m^2. Randomly allocated focus pigs were used for dual energy X-ray absorptiometry analyses at various time points to determine body composition. In the immediate post weaning period, conventionally housed pigs ate more (199 vs. 170 g/d, $P < 0.01$) and grew faster than deep litter pigs (189 vs. 154 g/d, $P < 0.05$). However, feed intake was higher ($P < 0.05$) in pigs housed in the deep litter system between 8 and 85 days of age. Over the final growth phase from 114 until 149 days of age, feed intake (2,726 vs. 2,551 g/d, $P < 0.05$) and daily gain (897 vs. 808 g/d, $P < 0.05$) were higher in conventionally-housed pigs. Over the finisher phase, gilts consumed more feed (2,379 vs. 2,289 g/d, $P < 0.05$) than boars probably because of social interactions between boars housed in groups. Pigs raised in deep litter systems deposited more ($P < 0.05$) lean and fat tissue than conventionally housed pigs up until about 60 and 80 days of age, respectively after which time the conventionally housed pigs deposited more of each tissue. The rate of lean tissue gain decreased in gilts but remained elevated in boars over the latter stages of the study. Hot carcass weight and backfat were not affected by either housing system. These data suggest that under the same relatively high stocking density there is little difference in the final carcass composition and overall growth performance of pigs housed under either conventional conditions or in deep litter. However, there were quite clear differences in the pattern of growth and tissue deposition with the deep litter pigs initially eating more and growing faster before slowing down.

Acknowledgements: Supported in part by Australian Pork Limited

Key Words: Deep Litter, Pig, Body Composition

Physiology and Endocrinology II

192 Differential expression of superoxide dismutases (SODs) in bovine corpus luteum during estrous cycle and pregnancy. R. K. Putluru*, C. N . Lee, and Y. S. Kim, *University of Hawaii at Manoa*, *Honolulu*.

In the tropics, lower conception rates are common in dairy cattle. While many factors contribute to a successful pregnancy, an important ingredient is a healthy functional corpus luteum (CL) for the maintenance of pregnancy. Previous studies in rabbits have shown that the generation of reactive oxygen species (ROS) including superoxides may play a role in the regression of CL and subsequent luteolysis. Studies in pregnant rats also showed that the up-regulation of superoxide dismutase (SOD), a ROS scavenging enzyme, is involved in the rescue of the CL from luteolysis. The objective of this study was to investigate the presence and expression of different types of SODs in the bovine CLs at different stages of the estrus cycle (1st, 2nd, 3rd and 4th) and pregnancy. CL samples (n=155) were collected from a local slaughter house and classified into different stages based on morphological classification. CL samples (0.25 gms) were homogenized in 20 ml of PBS buffer. Protein concentration of each CL was measured by Lowry method, and equal amount of protein from each sample was subjected to SDS-PAGE. The fractionated proteins were transferred onto a nitrocellulose membrane and immunoblotted against commercially available anti-MnSOD and anti-Cu/ZnSOD antibodies. The Mn-SOD and Cu/Zn-SOD were quantified using densitometry analysis. Mn-SOD was highly expressed in the pregnant CLs and 3rd and 4th stage CLs of the estrus cycle. In contrast, Cu/Zn SOD was equally expressed throughout the estrus cycle and pregnancy. Present results suggest that the Mn-SOD is probably involved in the maintenance of bovine pregnant corpus luteum.

Acknowledgements: We would like to thank local slaughter house staff and the local Dairy industry for their support.

Key Words: Superoxide Dismutase, Bovine Corpus Luteum, Estrus Cycle

193 Effects of changes in systemic progesterone in the first few days after ovulation on uterine retinol binding protein and folate binding protein gene expression in cattle. R. McNeill[1,2], R. Fitzpatrick[1], J. Sreenan[1], and D. Morris*[1], [1]*Teagasc, Research Centre*, *Athenry, Co. Galway, Ireland*, [2]*National Diagnostics Centre, National University of Ireland Galway*, *Galway, Ireland*.

Low systemic progesterone in the first week after AI is associated with a low probability of embryo survival in dairy cows. Progesterone may affect embryo survival by altering uterine gene expression and ultimately uterine function. The objective of this study was to establish the relationship between systemic progesterone during the first week after AI and bovine uterine gene expression. Heifers (n=24) were blood sampled twice daily from the day of ovulation (day 0) and on the basis of their systemic progesterone concentrations were divided into high or low groups on day four. Half of each group was, in turn, supplemented with exogenous progesterone (CIDR) from day 4 to day 8, resulting in a total of four groups, low control (LC), high control (HC), low supplemented (LS) and high supplemented (HS). Uterine endometrial tissue was harvested post mortem on day 6 or day 8 and snap frozen in liquid nitrogen. The effects of changes in systemic progesterone on uterine gene expression was measured using candidate and global gene approaches. Data were analyzed as a 2 x 2 factorial using analysis of variance. High systemic progesterone concentration up to day 4 was associated with increased ($P<0.01$) uterine retinol binding protein (RBP) mRNA expression on day 6 but not on day 8. In contrast supplementation with exogenous progesterone between days 4 and 6 or days 4 and 8 did not alter RBP mRNA expression ($P>0.05$). There was a positive ($P<0.05$) linear relationship between progesterone and folate binding protein (FBP) mRNA expression on day 6 after ovulation but not on day 8. These results indicate that uterine gene expression is very sensitive to small changes in systemic progest-

erone in the first few days after AI. Suboptimal progesterone during the first few days after AI may therefore result in altered uterine gene and protein expression and increased embryo loss.

Key Words: Cattle, Uterus, Gene Expression

194 Withdrawn.

195 Hepatic gene expression profiling in cows with early postpartum ketosis using a bovine 13,000 oligonucleotide microarray. J. J. Loor*, R. E. Everts, H. M. Dann, D. E. Morin, S. L. Rodriguez-Zas, H. A. Lewin, and J. K. Drackley, *University of Illinois*, *Urbana*.

We used a simple model for induction of ketosis (K) in early postpartum Holstein cows to examine liver gene expression profiles using microarray technology. Cows had ad libitum (142% of NRC requirements) or restricted (85% of requirements) DMI during the dry period. All cows were fed a common lactation diet after parturition. At 4 DIM, 7 cows classified as healthy after a physical examination were fed at 50% of DMI at d 4 from d 5 to signs of K or until 14 DIM. Another group of 7 healthy cows served as controls (H). Liver was biopsied at 10-14 (K) or 14 DIM (H). A microarray consisting of 13,257 unique oligonucleotides (70-mers) was used for transcript profiling. Annotation was based on similarity searches using BLASTN and TBLASTX against human, mouse, and bovine UniGene databases, the human genome, and the cattle TIGR database. Cy3- and Cy5-labelled cDNA from liver and a reference standard were used for hybridizations (28 microarrays). Loess-normalized log-transformed ratios were used to detect differential expression. ANOVA using a False Discovery Rate of $P = 0.20$ identified 3,513 differentially expressed genes. Hierarchical clustering of those genes showed that relative expression between K and H differed by 37%. Ketosis resulted in 76 downregulated genes with expression levels 2-fold or higher. There were 37 upregulated genes with K showing expression levels 2-fold or higher. Genes with key functions in stress, inflammation, and signal transduction had <2-fold expression in cows with K. Ketosis resulted in >2-fold decrease in expression for 2 genes involved in fatty acid desaturation, 2 in acetyl-CoA metabolism, and 1 in intracellular triglyceride transport. Other downregulated genes (>1.5-fold) in K were associated with regulation of transcription, insulin signaling, cytokine-mediated signaling, urea cycle/metabolism, and gluconeogenesis. Our data show that altered hepatic function due to ketosis early postpartum is associated with complex changes in transcript expression patterns.

Key Words: Microarray, Dairy Cows, Ketosis

196 Mammary gene expression profiling in cows fed a milk fat-depressing diet using a bovine 13,000 oligonucleotide microarray. J. J. Loor*[1], L. Piperova[2], R. E. Everts[1], S. L. Rodriguez-Zas[1], J. K. Drackley[1], R. A. Erdman[2], and H. A. Lewin[1], [1]*University of Illinois*, *Urbana*, [2]*University of Maryland*, *College Park*.

We studied the effects of a milk fat-depressing diet (MFD) on mammary gene expression patterns using microarray technology. Six lactating Holstein cows were randomly assigned to control (CON) or MFD (HCO; 25% forage, 70% concentrate, 5% soybean oil) in a single reversal design for 3-wk periods. Mammary tissue was biopsied in wk 3 of each period. A microarray consisting of 13,257 unique oligonucleotides (70-mers) was used for transcript profiling. Annotation was based on similarity searches using BLASTN and TBLASTX against human, mouse, and bovine UniGene databases, the human genome, and the cattle TIGR database. Cy3- and Cy5-labelled cDNA from mammary and a reference standard were used for hybridizations (24 microarrays). Loess-normalized log-transformed ratios were used to detect differential expression. ANOVA using a False Discovery Rate of $P = 0.20$ identified 2,175 differentially expressed genes. Hierarchical clustering of those genes showed that relative expression between CON and HCO differed by 60%. A total of 241 genes were downregulated ≥2-fold and 150 were upregulated ≥2-fold with HCO. Among genes associated with fatty acid metabolism 18 were downregulated and 5 were upregulated ≥1.5-fold with HCO. Twenty-six transcription factors were differentially expressed with 8 being downregulated and 3 upregulated ≥1.5-fold with HCO. Expression for *SREBF1* did not differ. Results confirmed HCO downregulated (≥1.5-fold) *FASN* and *ACACA* but also *SCD*, *LPL*, *FABP3*, *ACAS2*, *SLC27AC*, and *ACSL1* among other lipogenic genes. Differentially expressed genes with HCO included 21 associated with insulin action, 24 with glucose metabolism, and 27 with cytokine action. Mammary from HCO had >3-fold downregulation for a gene encoding a novel nuclear protein responsible for normal triglyceride synthesis and induction of key lipogenic genes (e.g. *PPARs*, *CEBPs*) in mice. Our data show that milk fat depression is associated with complex changes in mammary transcript expression patterns.

Key Words: Microarray, Dairy Cow, Milk Fat Depression

197 Transcriptional regulation of mammary gland sensitivity to thyroid hormones during the transition from pregnancy to lactation. A. V. Capuco*, E. E. Connor, and D. L. Wood, *USDA-ARS, BARC, Bovine Functional Genomics Laboratory*, *Beltsville, MD*.

Thyroid hormones are galactopoietic and appear to assist in establishing the mammary gland's metabolic priority during lactation. Expression patterns for genes that can alter tissue sensitivity to thyroid hormones and thyroid hormone activity were evaluated in the mammary gland and liver of Holstein cows at dry-off, 7, 25, 40 and 53 days into the dry period, and 14 and 90 days into lactation. Transcripts for the three isoforms of iodothyronine deiodinase, type I (*DIO1*), type II (*DIO2*) and type III (*DIO3*) and transcripts for the thyroid hormone receptors alpha1 (THRa1), alpha2 (THRa2) and beta1 (THRb1) were evaluated. Tissues for this purpose were obtained at slaughter from 3 to 6 cows per physiological state. The *DIO3* is a 5-deiodinase that produces inactive iodothyronine metabolites, whereas *DIO1* and *DIO2* form the active thyroid hormone, triiodthyronine, from the relatively inactive precursor, thyroxine. Low copy numbers of *DIO3* transcripts were present in mammary gland and liver during all physiological conditions. *DIO2* was the predominant isoform expressed in mammary gland and *DIO1*, the predominant isoform expressed in liver. Quantity of *DIO1* mRNA in liver tissues did not differ (P>0.05) with physiological state, but tended to be lowest during lactation. Quantity of *DIO2* mRNA in mammary gland increased during lactation (P<0.05), with copy numbers at 90 d of lactation 6-fold greater than at days 25 and 40 of the dry period. When the ratios of *DIO2/DIO3* were evaluated, the increase was even more pronounced (>100-fold). Quantity of THRb1 mRNA increased during lactation, whereas THRa1 and THRa2 did not vary with physiological state (P>0.05). Data support a role for increased expression of mammary THRb1 and *DIO2* as means to increase thyroid hormone activity in the mammary gland during lactation.

Key Words: Mammary Gland, Iodothyronine Deiodinase, Thyroid Hormone Receptor

198 Influence of parity, seasonal acclimatization, and recombinant bovine somatotropin (rbST), on diurnal patterns of physiological responses to thermal stress in cattle. B. C. Pollard*, M. D. Estheimer, M. E. Dwyer, P. C. Gentry, E. L. Annen, D. A. Henderson, C. M. Stiening, and R. J. Collier, *University of Arizona*, *Tucson*.

Twelve mid-lactation, multiparous (M) Holstein cows and twelve late-gestation, nulliparous (N) Holstein heifers were assigned to one of two studies in January (W) or June (S) of 2004. Animals were balanced for parity and rbST treatment then were randomly assigned to one of two environmental rooms and were exposed to thermoneutral (TN) or two heat stressing environments (heat stress [HS]; heat stress plus solar [HSS]) in three, fourteen day periods arranged in an incomplete crossover design. Physiological data (sweating rate [SR], respiration rate [RR], rectal temperature [RT] and surface temperature [ST]) were

collected on d 6 of each period at bihourly intervals for analysis over a 24 h day. Data was analyzed using a repeated measures mixed model that included main effects, time fitted as a heterogenous first order variance-covariance structure, and appropriate two-way and time interactions. Overall, rbST increased SR (P=0.09), but had no effect on ST (P=0.64), RT (P=0.31), or RR (P=0.95). There was an effect of rbST within season, as rbST produced greater RR in W than in the S (P<0.10). For seasonal comparisons, SR did not differ between S and W (P=0.94), but RT (P=0.07), ST (P<0.001) and RR (P<0.01) were higher in S than W. Also, ST, RT, and RR were increased in M compared to N (P<0.001) although M and N displayed no differences in SR (P=0.35). Highest SR and RR were measured in cows exposed to HSS. Environment by period interactions indicate that previous heat exposure within the trial diminishes the response to heat stress in later periods implicating acclimation to heat during the course of the study. Results indicate that sweating rate in cattle is influenced by rbST. These data indicate that rbST does not increase stress load in dairy cattle, and commercial use of rbST during period of heat stress is possible in well-managed herds.

Key Words: Bovine Somatotropin, Heat Stress, Dairy Cattle

199 The influence of parity, acclimatization to season, and recombinant bovine somatotropin (rbST) on diurnal patterns of prolactin and growth hormone in Holsteins exposed to heat stress. B. C. Pollard*[1], M. D. Estheimer[1], M. E. Dwyer[1], P. C. Gentry[1], W. J. Weber[2], E. Lemke[2], L. H. Baumgard[1], D. A. Henderson[1], B. A. Crooker[2], and R. J. Collier[1], [1]*University of Arizona*, *Tucson*, [2]*University of Minnesota*, *Saint Paul*.

Twelve mid-lactation, multiparous (M) cows and twelve late-gestation, nulliparous (N) heifers were assigned to one of two studies in January (W, 6M and 6N) or June (S, 6M and 6N) of 2004. Animals were balanced for parity and rbST treatment, randomly assigned to one of two environmental rooms and exposed to thermoneutral (TN) or two heat stressing environments (heat stress [HS]; heat stress plus solar [HSS]) in three, 14 day periods in an incomplete crossover design. Sweating rate, (SR), respiration rate (RR), rectal temperature (RT) and surface temperature (ST) were measured and blood samples were collected on d 6 of each period at either hourly or bihourly intervals for 24 h. Data was analyzed using a repeated measures mixed model which included main effects, time fitted as a heterogenous first order variance-covariance structure, and appropriate two-way and time interactions. Means were declared different when P<0.05. Serum growth hormone (GH) was elevated by rbST, and was greater in W and M than in S and N. Serum GH was less in HS and HSS than TN. There were no interactions of GH and time and no observed diurnal change in GH. Parity had no effect on serum prolactin (PRL), but PRL was increased in HS and HSS compared to TN and the rise in PRL was greater in W than S. Spearman rank correlations indicated positive relationships between PRL and several variables (SR; r=0.42; RT, r=0.307; RR r=0.480, and ST, r=0.476) but GH was only correlated with RT (r=0.117). Results suggest GH and PRL have important roles in the regulation of physiological parameters related to heat stress.

Key Words: Prolactin, Growth Hormone, Heat Stress

200 Leaking cows: Physiological and anatomical reasons. M. Rovai*, M. Kollmann, and R. M. Bruckmaier, *Techn. Univ. Munich*, *Germany*.

Milk leakage (*I. lactis*) is considered as an important factor of infection risk. The aim of this study was to identify the main possible causes of leaking in two dairy farms differing in breed but with similar production level: Herd A: Red Holstein cows (n=30); 28kg/d and Herd B: BraunviehxBrown Swiss cows (n=15); 26kg/d. Herd A was classified into *I. lactis* and Control group, whereas Herd B was only a Control group. For statistical analysis, the Proc Mixed procedure of SAS was used. Effects of parity number, degree of udder filling and udder diseases were also analyzed. Milk samples (foremilk and main milk fraction) were collected twice, as well as the milk leakage (*I. lactis* group) at different intervals from 0-5 h prior to milking. Teat traits (external and internal), milk flow, milk fractions, intramammary pressure (IMP), and oxytocin (OT) blood pattern were also obtained. Fat content did not present differences between milk leakage and foremilk. However, fat increased (P<0.001) during milking in response to milk ejection (+2.64% for main milk samples). *I. lactis* cows had about 9% shorter sphincters than Control groups while all other teat traits did not present any differences. Milk flow curves showed higher (P<0.001) milk yield, peak and average flow rate for *I. lactis* contrasting with both Control groups. Quarter cisternal yield of *I. lactis* tended to be superior (P=0.064; 0.49 vs. 0.30 and 0.22kg for *I. lactis* and Control group from Herd A and Herd B, respectively), while percentage of cisternal and alveolar milk was similar between groups. The higher IMP (P<0.001) for *I. lactis* group both before and after udder preparation (*I. lactis*: 4.0 and 6.4kPa, Control: 2.0 and 5.0kPa; respectively) could explain this phenomenon. The OT blood concentration was low until the start of udder preparation, and increased in response to the milking stimulus reaffirming the hypothesis of absence of milk ejection in leaking cows. Overall, leaking causes were not related to milk production, incidence of mastitis, age or stage of lactation. Milk losses are likely due to the large amount of cisternal milk, which creates pressure and leaking, and consequently does not represent milk ejection.

Key Words: Leaking Cows, Dairy Cows, Milk Losses

201 Effect of extended lactation on fertility of divergent Holstein-Friesian genotypes within a seasonal pasture-based dairy system. C. Burke*, J. Roche, and E. Kolver, *Dexcel Limited*, *Hamilton, New Zealand*.

Holstein-Friesian dairy cows with a predominance of North American (NA) ancestry exhibit excessive depletion of body condition score (BCS) and reduced pregnancy rates when constrained by managerial decision rules within a seasonal pasture-based system. However, the NA genotype does have potential for superior lactation persistency as compared with New Zealand bred (NZ) Holstein-Friesians. Reproductive characteristics are reported from a study that aimed to exploit this feature by relaxing the constraints of season and diet. The design was a 2 x 3 factorial with main effects of genotype (NA or NZ) and grain supplement (0, 3 or 6 kg DM/cow/d grain). Cows (n = 56) calved on 28 July 2003 (±3.5 d SEM) and were mated in October-November (Year 1). Pregnancy diagnosis was performed and pregnancies terminated in December 2003 with the intention of extending lactations to 670 d. All cows were mated again in October-November 2004 (Year 2). Cows were managed as a single group fed generously on pasture with high-energy grain supplements offered daily on an individual basis during each of the twice-daily milkings. Cows calved in similar BCS (5.8±0.2; 1 to 10 scale) but NA had a lower (P<0.05) BCS than NZ cows at PSM in Year 1 (4.0±0.3 vs. 4.5±0.2) and Year 2 (6.9±0.3 vs. 5.1±0.3). The net energy (NE_L) of milk production (MJ/d) per 100 kgBW was similar (P>0.1) among strains at PSM in Year 1 (16.9±0.4 MJd), but greater (P<0.01) in NA (11.1±0.7 MJ/d) as compared with NZ cows (7.8±0.7 MJ/d) at PSM in Year 2. Pregnancy rate by 42 d mating (PR42) in Year 1 was greater (P<0.01) in NZ (62%) as compared with NA cows (26%). Ultrasound examinations of the reproductive tracts 2 to 4 wks before PSM in Year 2 found mostly normal ovaries and uteri, consistent with cycling cows. The PR42 at Year 2 improved (P<0.05) for NA (52%) as compared with earlier in lactation but remained less (P<0.05) than NZ cows (76%). The NA-type cow was better suited to an extnded lactation system, but the reduced fertility of NA cows was only partially mitigated by removing the constraint of having to re-establish pregancy at 12 wks in lactation.

Key Words: Fertility, Genotype, Lactation

202 Localization of Interleukin-18 and its receptor in somatotrophs of bovine anterior pituitary gland. Y. Nagai*, T. Nochi, K. Watanabe, K. Watanabe, and T. Yamaguchi, *Tohoku University*, *Sendai, Japan*.

A pro-inflammatory cytokine, interleukin 18 (IL-18), induces intracellular expression of IL-1 and release of IL-6. IL-1 and IL-6 have been detected in anterior pituitary cells, suggesting that IL-18 is produced in anterior pituitary cells and serve as a mediator of immuno-endocrine regulation in anterior pituitary

gland. In the present study, we addressed this hypothesis by investigating intracellular localization of IL-18 and its receptor in the bovine anterior pituitary gland. Twelve cattle of Japanese Black and Holstein were used. The anterior pituitary gland were freshly removed and subjected to RT-PCR, western bloltting, in situ hybridization and immunohistochemical analysis. Immuno-laser microdissection was performed to confirm mRNA expression in IL-18-immunnoreactive cells. IL-18 mRNA and protein was detected in the anterior pituitary tissue by RT-PCR and Western blotting. In situ hybridization showed that IL-18 mRNA were constantly localized in the anterior pituitary cells. Immunohistochemistry of IL-18 and specific hormones revealed the presence of IL-18 in bovine somatotrophs. Furthermore, the expression of GH mRNA in IL-18 immunoreactive cells was confirmed by immuno-laser microdissection. These results first demonstrated that somatotrophs produced IL-18. Subsequently, the distribution of IL-18 receptor alpha (IL-18R α) was investigated in the anterior pituitary gland to understand IL-18 signal among anterior pituitary cells. Bovine IL-18R α cDNA was partially sequenced and detected in the anterior pituitary gland by RT-PCR. Immunohistochemistry of IL-18R α, IL-18 and GH showed that IL-18R α was expressed in IL-18 immunoreactive cells and somatotrophs. In conclusion, we found that IL-18 and IL-18R colocalized in somatotrophs of bovine anterior pituitary gland. Our results suggest that IL-18 acts on somatotrophs as an immuno-endocrine mediator through autocrine pathway.

Acknowledgements: Grant-in-Aid for Scientific Research (B) (No.13460122) from the Ministry of Education, Science and Culture of Japan.

Key Words: IL-18, Somatotroph, Immuno-Endocrine

Production, Management and the Environment: Impact of Culling Rate on Dairy Profitability

203 Historical examination of culling of dairy cows from herds in the United States. H. D. Norman* and E. Hare, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*.

Dairy producers need cows that reproduce, stay alive, and produce well, but information on culling rate and herd life has not always been readily available so that producers can minimize cow losses. A recent examination of cow survival in Dairy Herd Improvement herds provided information on culling rate since 1980. Cows were excluded if the herd discontinued testing during their productive period or they were sold for dairy purposes. Survival rates for individual parities were the fraction of cows with an opportunity to calve that did calve. Number of parities by breed and year of first calving was determined to provide an indicator of herd life before culling. Survival rates for second through eighth parities were 73, 50, 32, 19, 10, 5, and 2%, respectively, for Holsteins. Survival to second parity was 72% for Ayrshires, 69% for Brown Swiss, 66% for Guernseys, and 75% for Jerseys; corresponding survival to fifth parity was 22, 23, 15, and 26%. Although survival to second parity declined only slightly after 1980, survival to later parities dropped substantially. Survival rates for Holsteins were 77, 57, 39, 24, 14, 8, and 4% in 1980 for second to eighth parities but declined to 74, 49, 28, 16, 8, 4, and 1% in recent years. Mean number of parities declined from 3.2 for Ayrshires, 3.2 for Brown Swiss, 2.8 for Guernseys, 3.2 for Holsteins, and 3.4 for Jerseys that first calved in 1980 to 2.9, 2.9, 2.4, 2.8, and 3.2 for cows that first calved in 1992. Across calving years, about 36, 26, and 17% of Holsteins were first-, second-, and third-parity cows, respectively. Mean calving age ranged from 44 mo for Guernseys to 49 mo for Brown Swiss, a decline from earlier estimates, and recent years show a continuing decline. The increase in culling rate and subsequent reduction in mean calving age must be driven by dairy management choices rather than a decline in genetic merit of the population as genetic estimates indicate that substantial genetic improvement is being made in productive life.

Key Words: Culling, Herd Life, Survival

204 The impact of timing of the culling event on profitability in dairy herds. R. Cady*, *Monsanto*, *St. Louis, MO*.

Every cow is eventually culled. Thus, it is not a question of if a cow will be culled, but rather when she will be culled. Culling is primarily an economic risk management practice, influenced by existing economic conditions, risk tolerance of the dairy management team, and dairy cattle management skills. The only exceptions to this would be loss due to death, theft, or cows that are simply too difficult to manage (eg. kickers).

Knowledge of three factors is necessary to successfully manage culling: 1) how often does the event occur (turnover), 2) when does the event occur (timing), and 3) why the event occurred at that time (reason). The cow's life is a continuum from birth to death, divided into a growth and maturation process followed by a series of parturition/lactation events. Thus, the risk of cull is more than a simple function of increasing risk with increasing time because the initiation of each new lactation increases the risk of cull every time it occurs. Subsequent pregnancy reduces the likelihood of being culled.

Internal and external, controllable and uncontrollable factors influence culling. An example of an uncontrollable risk is increased culling associated with age. An external uncontrollable factor is beef price. Many factors however are within management purview, such as mitigating disease incidence, changing risk tolerance, production level, reproductive performance, transition cow care, and herd long-term growth goals.

Culling management is more complex than simply reducing herd turnover rate. There is an optimum time to cull a cow based on her productive, reproductive and health status and probability for future economic success. Culling too early limits profitability through the loss of the ability to recover costs of investment. Culling too late limits profitability because of lost opportunity to gain higher profits with a more profitable cow. Opportunity exists to better manage the timing of cull events.

Acknowledgements: Dr. Sandra Godden, University of Minnesota, Dr. Steve Stewart, University of Minnesota

Key Words: Culling, Risk Managment, Profitability

205 Culling: nomenclature, definitions and some observations. J. Fetrow*[1], K. Nordlund[2], and D. Norman[3], [1]*Univeristy of Minnesota*, *St. Paul*, [2]*University of Wisconsin*, *Madison*, [3]*USDA AIPL*, *Beltsville, MD*.

In advance of the Discover Conference on Culling in Dairy Herds in October, 2004, a subcommittee was formed for the purpose of laying out a proposed set of definitions of terms relating to culling on dairy farms. This paper is the product of that effort. In addition to the specific charge, the committee has chosen to make some observations on the general topic of culling in dairy cattle and on appropriate ways to examine the underlying factors surrounding the exit of cows from a dairy.

Key Words: Dairy, Culling

206 The effect of animal removal on herd internal growth rate. A. Skidmore*, *Blue Seal Feeds, Inc.*, *Londonderry, NH*.

The decision making process and reasons for removing an animal from a herd has been extensively studied. This study was designed to evaluate the effect of animal removal on herd size and herd internal growth rate. An inventory control model was adapted to develop a simple model for evaluation. Herd size is very dynamic and dependent on many factors. The factors that influence the dynam-

ics of herd size were indentified as: calving interval, percent of calvings that result in a heifer calf, initial size of cow herd, initial size of the replacement herd, percent heifer calves stillborn, culled or died, age at first calving, average age of cows, and percent cows culled or died. The model was initialized with the following values: calving interval = 390 days; percent of calvings resulting in a heifer calf = 49; age at first calving = 24; percent calves stillborn, died, or culled = 20; and initial herd size = 100 cows. In table 1 are the results of animal removal on future cow herd size and average annual herd internal growth rate after ten years.

Growth in herd size is not a linear function under steady state conditions. The length of the planning horizon will affect the results. Herd size increases at an exponential rate while average annual herd internal growth rate increases at a diminishing rate. Herd size increases to 111, 137, 186, 229, 386, and 648 cows for years 3, 5, 8, 10, 15, and 20 repectively when animal removal rate is 25% and the initial herd size is 100 cows. The average annual herd internal growth rate was 3.54, 6.50, 8.07, 8.64, 9.42, and 9.79 percent for years 3, 5, 8, 10, 15, and 20 respectively.

Animal removal rates have a significant effect on the rate at which a herd can grow from internal increase.

Table 1. The effect of animal removal on future cow herd size and average annual internal growth rate after ten years.

Animal Removal Rate (%)	Future cow herd size	Average annual herd internal growth rate (%)
15	458	16.44
25	229	8.64
35	108	.77
45	47	-7.27
55	18	-15.76

Key Words: Culling, Internal Herd Growth

207 A bankers view on culling. G. Sipiorski*, *Citizens State Bank of Loyal, Loyal, WI*.

A banker's main interest regarding the cull rate on a dairy is the potential loss of collateral. The loan officer has a fiduciary responsibility to the financial institution to maintain a loan to value ratio that is in compliance with the lending policy. There will generally be a loan covalent singed by the dairy producer that will outline the number of dairy animals that need to be maintained on the premise at all times.

The banker is also interested in the number of animals maintained in a milking herd for production and gross income purposes. The cash flow proforma that was completed to help secure the loan is directly dependent on the production per cow and on the number of cows held in the milking herd. If there is a current slip in the herd size for the short term the long term affect will be a shortage in gross milk and income. When the cash flow does not meet expectations the entire loan or loans will become jeopardized. This could lead to loans being placed on the bankers "watch list" or worst yet ending up in the "nonperforming" or "work out" files. Loans that end up in these areas reflect badly on the loan officer, the lending entity as well as the dairy producer.

These are the internal concerns of a lender that get them exited about culling rates. There will be even more lender interest in the issue in the west or dairy areas where collateralized assets are mostly livestock and few other assets such as machinery or land. Unfortunately this will lead to some producers holding on to poorer production cows just to satisfy the nose count for a lender inspection. This generally will occur when replacement cost are running at historically high dollar levels.

Thus far we have addressed the bankers concerns for maintaining lower cull rates and holding milking herd numbers. A good lender's main desire is for the success of the dairy producer. When the dairy is profitable all parties involved benefit.

The attached cash flows reflect the results of a 25%, 35% and 45% cull rates on three similar operation examples. The results on pages 3-5 demonstrates the Accrual Earning on line 55 and the Capital Repayment Margin on line 76. The figures show the huge economic impact of higher culling rates. The narrative summary on page 7 addresses 23 bench marking areas of performance. Note worthy are the Return on Assets (ROA), Return on Net Worth or Equity (ROE) and the Cost of Producing One Hundred Pounds of Milk.

The short term survivability, long term success and financial progress are clearly demonstrated in the financial papers. Producers that can maintain lower cull rates under 35% will find greater long term financial progress.

208 Genetics of longevity and productive life. K. Weigel*, *University of Wisconsin, Madison*.

Dairy cow longevity is influenced by many management factors, yet surprising genetic variation exists between families. Breeders once attempted to improve longevity by selecting for udders, feet and legs, and other conformation traits, but it became apparent that daughters of many high type sires still succumbed to early culling. In 1994, the USDA Animal Improvement Programs Laboratory introduced national genetic evaluations for length of productive life (PL). This trait is measured as time from first calving until culling or 84 mo of age, with a limit of 10 mo per lactation (to penalize cows with poor reproductive performance). The range in PL PTA among Holstein sires is huge - more than 8 mo between the best and worst bulls and roughly 4.5 mo between the top and bottom deciles. Selection for PL and its incorporation into economic indices (at 10-15% of the weight) has led to greater propagation of sire families in which cows resist culling more effectively. However, culling data that serve as the basis for evaluation of PL arrive late in life, often after important selection decisions have been made. Therefore, attention has shifted to components of PL that are measured earlier in life, such as female fertility, maternal calving ease, and resistance to mastitis, lameness, and metabolic disorders. The introduction of daughter pregnancy rate and daughter calving ease in 2003 was a major step in improving fertility and calving performance. Considerable effort is now being invested in the measurement and analysis of data regarding specific health disorders, such as mastitis, ketosis, displaced abomasum, lameness, and metritis. These traits are routinely recorded in the on-farm management software programs of many commercial dairies, and heritability estimates (0.04 to 0.14) are within the range observed in more tightly controlled veterinary recording schemes in Scandinavia. In addition, the range in lactation incidence rates between sire families is more than two-fold. In summary, programs for genetic improvement of dairy cow longevity are continually evolving in an effort to obtain early, accurate, and comprehensive information about all aspects of this complex trait.

Key Words: Genetics, Llongevity, Productive Life

209 Culling from a dairyman's perspective: a function of goals and management. J. Nocek*, *Spruce Haven Farm and Research Ctr, Auburn, NY*.

Spruce Haven is a 1600 cow commercial and research dairy. Growth has been accomplished by herd aquisition and purchased heifers. Culling rate is a moving target depending upon when the latest expansion occurred and how it occurred. Usually the incorporation of cows from whole-herd buyouts has resulted in an increased first year culling rate of purchased cows ranging from 35 to 50% for multiparous cows. Incorporation of heifers usually does not affect first year culling compared to the static herd. In both scenarios, it is important to understand that unless complementary replacements are also purchased, cow numbers will drop in the two subsequent years. When evaluating culling rate during expansion, we usually identify purchased animals versus our static herd for the first year after purchase. Culling is a result of management: using culling to manage signifies being several steps behind. Category culling rate (i.e.

repro, health, etc.) is a tool we use to evaluate management within a given period of time. In an expansion mode, usually voluntary culling takes a lower priority compared to involuntary issues. Culling rate for any given category can become camouflaged by ?real? management reasons for culling (i.e., cow comfort can be the rea-son for many culling categories including low production, lameness, and injury). Beef prices also play a critical role in some culling activities, especially for cows targeted to cull for reproductive reasons. Death loss is a culling category that most farmers choose to avoid but is a real number that oftentimes exceeds 8%. Culling is a reflection of many events that transpire in a static and expanding herd. Culling reflects management; therefore, our philosophy is culling is a tool with which our management can be measured.

Key Words: Culling, Management, Dairy

Ruminant Nutrition: Exploring the Boundaries of Efficiency in Lactation

210 Metabolic relationships in supply of nutrients in lactating cows. H. Tyrrell*[1] and K. Cummins[2], [1]*USDA/CSREES*, *Washington, DC*, [2]*Auburn University*, *Auburn, AL*.

The work reported in this symposium represents the current activities of members of the NC-1009 Multi-State Research Committee, an activity which has continued for nearly thirtyfive years and several project numbers and revisions. Members of this series of projects have been the core of National Academy of Science Subcommittees responsible for the revision of the Nutrient Requirements of Dairy Cattle published by the National Research Council. It was recognized a number of years ago that the conventional additive methods for the determination of nutrient requirements and the nutritive value of a ration fed to lactating cows was too simplistic a model to permit significant improvements in our ability to develop improved feeding systems for high producing dairy cows. This is particularly true for meeting energy and protein requirements of the high producing cow. The other presentations in this symposium will focus on current concepts of nutrient supply for lactation. It is critical, however, to not lose sight of established boundaries of efficiency in lactation. It was demonstrated clearly in the development of the Net Energy for Lactation System that the majority of the variation in the Net Energy Value of a ration is associated with pre-absorptive metabolism (85%) compared to variation in post-absorptive processes. The modern high producing dairy cow is significantly more efficient in the conversion of dietary energy to energy in milk produced. However, metabolizable energy required for maintenance and for each calorie in milk is remarkably similar to the cow a century ago. Improvement in gross efficiency of milk production is the result of dilution of maintenance.

Key Words: Lactation, Efficiency, Nutrients

211 Integration of ruminal metabolism in dairy cattle. J. L. Firkins*[1], A. N. Hristov[2], M. B. Hall[3], and G. A. Varga[4], [1]*Ohio State University*, *Columbus*, [2]*University of Idaho*, *Moscow*, [3]*USDA*, *Madison, WI*, [4]*Pennsylvania State University*, *University Park*.

Objective 1 of the NC1009 Cooperative Regional Research Project is to integrate various aspects of ruminal metabolism that affect the secretion of milk protein. Our overall aim is to quantify properties of feeds that determine the availability of nutrients critical to milk production. Specific goals are to integrate carbohydrate and nitrogen metabolism to provide fuel and precursors for metabolism by the digestive tract, mammary gland, and peripheral tissues to improve the efficiency of milk production while minimizing the loss of dietary nutrients to the environment. Thus, the current objectives of this paper are to review past research and highlight need for future research related to aspects of microbial population changes, feed degradability, microbial metabolism of dietary nutrients, VFA production, and flow of microbial protein (and AA) to the duodenum. Improved procedures for analysis of carbohydrate fractions are needed to better predict ruminal degradation of structural and non-structural carbohydrates and efficiency of microbial protein synthesis. Differences in concentrate and forage composition and particle size among studies are variables that influence these results. New procedures and data will be discussed to assess manipulation of bacterial and protozoal populations in vivo, with future goals being to better explain differences among animals fed similar diets and to integrate data to predict how production of milk components will vary among different dietary conditions. Whenever possible, current perspectives will be addressed to improve the integration of ruminal metabolism in dairy cattle for improved parameterization or better evaluation of computer models such as Molly, CPM, or NRC.

Key Words: Ruminal Metabolism, Microbial Protein Synthesis, Models

212 Regulation of key metabolic processes in lactation. S. Donkin*[1], J. Knapp[2], M. VandeHaar[3], and B. Bequette[4], [1]*Purdue University*, *West Lafayette, IN*, [2]*University of Vermont*, *Burlington*, [3]*Michigan State University*, *East Lansing*, [4]*University of Maryland*, *College Park*.

Research conducted under the NC-1009 multi-state project focuses on quantifying the properties of feeds that determine nutrient availability for milk production and on identifying the metabolic interactions among nutrients and tissues. Knowledge from these complementary research areas is integrated to challenge and refine nutrition systems for dairy cattle in a multi-faceted, quantitative manner using mechanistic models. The overall objective for this work is to provide information for the dairy industry that will improve the accuracy of feeding systems to predict the metabolic, production, and health responses of dairy cows in an environmentally responsive, profitable, and sustainable manner. An understanding of glucose and amino acid metabolism is central to this mission as they are critical metabolic commodities for milk synthesis. Often the metabolism of these nutrients within tissues and exchange among tissues dictates their availability for milk synthesis. Liver and portal drained viscera collaboratively dictate the availability of nutrients for use by muscle, storage in adipose tissue, and use in mammary metabolism and milk synthesis. Metabolism of these nutrients is sensitive to the rate of their appearance in blood, changes in hormone profiles, and responsiveness of tissues to hormonal changes. The net metabolism of absorbed nutrients in tissues is the combination of fluxes through individual reactions which comprise classical metabolic processes and pathways. These processes and their integration are described and the limiting elements identified with respect to nutrient use for milk production. Information pertaining to molecular events and key metabolic reactions is highlighted with regards to glucose and amino acid metabolism. Limitations for input and output relationships and the application of current biochemical and molecular knowledge to predictive models of nutrient metabolism in dairy cattle are identified.

Key Words: Lactation, Metabolism, Modeling

213 Nutrient supply for milk production by splanchnic tissues in dairy cows. C. Reynolds*[1], B. Bequette[2], and J. Knapp[3], [1]*The Ohio State University*, *Wooster*, [2]*University of Maryland*, *College Park*, [3]*J.D. Heiskell & Co.*, *Tulare, CA*.

A major focus of the NC-1009 regional project is the quantification of nutrient supply and utilization for production in lactating dairy cows. These data are integrated with measurements of fermentative and digestive processes through mathematical representations, with the overreaching goal of improving the nutritional management of dairy cows, thereby improving the efficiency and profitability of the dairy enterprise, and the health and longevity of the dairy cow. Together, the tissues of the portal-drained viscera (PDV; the gastrointestinal tract, pancreas, spleen and associated adipose) and liver determine the quantity and pattern of the nutrients available for production through their central roles

in diet digestion, nutrient absorption and assimilation, and the integration of nutrient supply with requirements for milk synthesis, maintenance and reproduction. The exogenous supply of most carbon-based nutrients in arterial blood is determined by amounts absorbed from the lumen of the gut, as well as the extent to which those nutrients are metabolized during their passage through absorptive cells and the liver. On a net basis, nutrient metabolism by the PDV and liver includes a substantial utilization of nutrients from arterial blood, as the splanchnic bed receives as much as 40% of cardiac output. A clearer picture of this metabolism is emerging through the strategic integration of measurements of net nutrient flux across the splanchnic tissues, in vitro measurements of metabolic processes, and their regulation, and isotopic labelling to assess tissue utilization and intermediary metabolism. Ultimately, the efficiency of nutrient utilization in the lactating dairy cow is determined by nutrient supply relative to the requirements of the mammary gland and other body tissues, and their propensity for productive nutrient utilization. Integration of research in these areas highlights progress in our understanding of intermediary metabolism of dairy cattle, and limitations to our ability to predict nutrient utilization.

Key Words: Nutrient Supply, Portal-Drained Viscera, Liver Metabolism

214 Metabolic models of ruminant metabolism: Recent improvements and current status. M. D. Hanigan*, H. G. Bateman, J. G. Fadel, and J. P. McNamara, *Land O' Lakes, Inc.*, *St. Paul, MN*.

The NC-1009 regional research project has two broad goals of quantifying the properties of feeds and the metabolic interactions among nutrients that influence nutrient availability for milk production and that alter synthesis of milk; and, to use those quantitative relationships to challenge and refine computer-based nutrition systems for dairy cattle. The objective of this paper is to review progress in modeling. Significant progress has been made in model refinements over the past 10 years as exemplified by the most recent NRC (2001) model and work on the model of Baldwin et al. (1987). These models have different objectives yet share many properties. The level of aggregation of the NRC model (2001) does not allow detailed analyses of specific metabolic reactions that affect nutritional efficiency. The Baldwin model is aggregated at the pathway level and is therefore amenable to assessment with a broad range of biological measurements. Recent improvements to that model include the addition of an ingredient based input scheme, use of in situ data to set ruminal protein degradation rates, and refinement of the representation of mammary cells numbers and activity. Although the Baldwin model appears to be appropriate structurally, several parameters are known to be inadequate. Predictions of ruminal nitrogen metabolism and total-tract starch digestions have similar accuracy as the NRC model. However the NRC more accurately predicts total-tract fiber digestion and both models significantly over-predict total-tract lipid digestion. These errors contribute to over-predictions of weight retention when simulating full-lactations with the Baldwin model and may result in performance prediction errors with the NRC model. Additional improvements in accuracy occur if a non-integral value for ATP production is adopted. Limitations remain in the descriptions of metabolism and metabolic regulation of the splanchnic viscera, adipose tissue, body muscle, and mammary tissue. Integration of genetic control mechanisms can expand these efforts to assist genetic selection as well as feeding management decisions.

Ruminant Nutrition: Beef—Feedstuffs and Predicting Feed Intake

215 Feedlot performance of a new distillers byproduct (Dakota Bran) for finishing cattle. V. Bremer*[1], G. Erickson[1], T. Klopfenstein[1], M. Gibson[2], K. Vander Pol[1], and M. Greenquist[1], [1]*University of Nebraska*, *Lincoln*, [2]*Dakota Gold Research Association*, *Sioux Falls, SD*.

Three hundred crossbred yearling steers (BW = 384 ± 20 kg) were utilized in a randomized complete block design to evaluate the effect of level of Dakota Bran (DB) on feedlot performance and carcass characteristics. Dakota Bran is a new distillers byproduct feed produced as primarily corn bran plus distillers solubles (53% DM) containing 14.9% CP (DM basis). Dietary treatments consisted of 0, 15, 30, and 45 % DB and 30% dried distillers grains plus solubles (DDGS), replacing corn (DM basis). Basal ingredients consisted of high-moisture corn and dry-rolled corn, fed at a constant 1:1 ratio (DM basis), plus ground alfalfa hay and dry supplement each fed at 5% of diet (DM basis). Steers were blocked by weight, stratified by weight within block, and assigned randomly to pen. Pens were assigned randomly to treatment within block with five/treatment and 12 steers/pen. Steers were fed for 116 d and slaughtered on d 117 at a commercial abattoir. There was a significant linear increase ($P < 0.01$) in final BW, ADG, and G:F, as level of DB in the diet increased and a significant quadratic response ($P < 0.01$) for DMI as level of DB in the diet increased. With the exception of HCW, there were no significant differences ($P > 0.05$) for carcass characteristics. These results indicate the new DB byproduct has feeding performance similar to DDGS at the same inclusion level. Feeding Dakota Bran in this trial, up to 45% of the diet, resulted in improved performance compared to feeding high-moisture/dry-rolled corn, suggesting energy value equal to or greater than corn.

Treatment[a]:	0 DB	15 DB	30 DB	40 DB	30 DDGS	SE
Final BW, kg[b]	583	596	601	609	595	4
DMI, kg/d	11.5	12.3	12.4	12.4	12.0	0.1
ADG, kg	1.71	1.83	1.86	1.94	1.82	0.03
G:F	0.149	0.149	0.150	0.157	0.152	0.002

[a]DB = Dakota Bran, DDGS = dried distillers grains plus solubles [b]Calculated from HCW divided by a common dress of 63%

Key Words: Byproduct Feed, Corn, Distillers Grains

216 Optimal level of corn distillers dried grains in no roughage diet for pre-conditioned calves. J. Williams*, F. Farias, and M. Kerley, *University of Missouri*, *Columbia*.

A study was conducted to determine the optimal level of dried corn distillers grains with solubles (DDGS) in a corn-soyhull-wheat midd diet for weaning calves. Seventy-two Angus Simmental crossbred calves (38 steers and 34 heifers; BW 249 ± 13.5 kg) were used in a 42 d growth and feed efficiency experiment. The first seven d after weaning calves were group fed ad libitum smooth brome hay and 2 kg per hd basal supplement. Calves were allotted by weight to eight pens and randomly assigned to one of five treatment diets. Diets were a control (C) containing the basal ingredients of all diets (38% corn, 40% soyhulls, 20% wheat midds, and 2%minerals/vitamins premix), a diet containing soybean oil (PC) added to lipid equivalency of the high DDGS diet, and three diets with increasing levels of DDGS (D1, D2, and D3). The D2 diet was formulated to optimize the amino acid to energy ratio. Individual intakes were measured using the GrowSafe Feed Intake System and weights were taken on consecutive days at initiation and termination of the experiment. Dry matter intake (avg 8.1

± 0.2 kg) was similar among treatment diets. Calves fed the D2 diet had the greatest (P < 0.05) ADG (1.5 kg/d) and the calves fed the PC diet had the lowest (P < 0.05) ADG (1.1 kg/d). Likewise, the calves fed the D2 diet had the best feed conversion ratio (6.0) and the calves fed the PC diet had the poorest (P < 0.05) feed conversion ratio (7.9). Plasma nonesterified fatty acids levels in plasma were similar among treatments at the initiation of the experiment and lowest (P < 0.05) for calves fed the D1 diet at the termination of the experiment. This experiment demonstrates that maximizing the potential of DDGS in beef diets is dependent upon optimizing the level of DDGS and amino acid supply in the diet.

Key Words: Corn Distillers, Steer Performance, Pre-Condition

217 Grazed forage supplementation with dried distillers grains, corn oil, or corn gluten meal. J. MacDonald*, T. Klopfenstein, and G. Erickson, *University of Nebraska*, *Lincoln*.

One hundred twenty heifers (368 kg, SD=39 kg) grazing smooth bromegrass (IVDMD=65.8%, CP=20.8%, undegradable intake protein (UIP)=2.0%) were blocked by previous ADG and allotted to control or one of nine treatments in a three by three factorial design to determine effects of DDG supplementation on ADG and forage intake (FI), and determine effects of UIP and ether extract (EE) in DDG on ADG. Factors were supplement source and level. Supplements were: 1) dried distillers grains (DDG, UIP=15.8%, EE=9.67%), 2) 54.4% corn gluten meal, 34.6% corn bran, and 8.0% molasses (CGM, UIP=31.6%, EE=0.83%), 3) 18.4% corn oil, 73.6% corn bran, and 8.0% molasses (OIL, UIP=0.74%, EE=19.3%). Levels of DDG were 0.750, 1.50, or 2.25 kg while levels of CGM and OIL were 0.375, 0.750, or 1.125 kg. Control animals were fed 0.250 kg of 92% corn bran and 8% molasses. Heifers were individually supplemented daily via Calan gates. Treatments were separated by regressing response variables on g nutrient (DM, UIP, or EE) intake per kg body weight using GLM in SAS because several animals did not consume their allotment of supplement. Net energy equations from NRC (1996) were used to estimate FI. Supplemental DDG DM resulted in a linear increase in ADG (P<0.01) with slope 0.039 ± 0.011 kg and intercept 0.759 ± 0.085 kg (r^2=0.50), and a linear decrease in FI (P<0.01) with slope -1.62 ± 0.176 and intercept 24.2 ± 1.18 g FI per kg BW (r^2=0.727). When ADG response was expressed as g UIP intake per kg body weight, intercept was 0.810 ± 0.093 kg and slope for DDG was 0.257 ± 0.153 which was greater (P=0.10) than CGM slope 0.113 ± 0.048. Expressing ADG as g EE intake per kg body weight resulted in intercept 0.762 ± 0.102 kg and slope for DDG of 0.449 ± 0.259 which was greater (P=0.09) than OIL slope 0.256 ± 0.066. The CGM slope is 44.0% of DDG slope while the OIL slope is 57.0% of DDG slope. When summed, they equal 101% of DDG slope. Supplementation with DDG increases ADG and reduces FI. While increased ADG observed from DDG supplementation is not independently explained by UIP or EE contained in DDG, it is likely explained by their combination.

Key Words: ADG, Dried Distillers Grains, Forage Supplementation

218 Effect of dried distillers grains plus solubles or sunflower meal on performance and body condition score on beef cows consuming poor-quality forage. H. Doering-Resch*, C. Wright, K. Tjardes, and K. Bruns, *South Dakota State University*, *Brookings*.

Degradable intake protein (DIP) is essential when feeding poor-quality forages to cattle. Based on 1996 NRC recommendations, it would be necessary to feed in excess of 3.2 kg of dried distillers grains plus solubles (DDGS) per day to meet the DIP requirement of a gestating cow consuming poor-quality forage. However, since cattle recycle N, it may be possible to feed smaller amounts of DDGS, yet maintain rumen function. The objective of this experiment was to compare DDGS and sunflower meal as protein sources for cows consuming poor-quality forage. Ninety-six gestating beef cows (BW = 580.2 ± 22.2 kg; BCS = 4.7 ± 0.09) were stratified by BW and BCS and allotted to 15 pens (14.7 m × 34.7 m). The pens were then randomly assigned to one of three dietary treatments. Treatments consisted of ground cornstalks and mineral supplement provided *ad libitum*, plus one of three supplements: 1) 1.47 kg/d sunflower meal with soybean oil (SFM), 2) 0.79 kg/d sunflower meal with soybean oil and 0.73 kg/d DDGS (COMB), and 3) 1.43 kg/d DDGS (DG). The supplements were formulated to be iso-caloric and iso-nitrogenous but provide decreasing levels of DIP (304.2, 256.5, 206.8 g/d for SFM, COMB, and DG, respectively). Cows remained on the treatment diets for 70 d. Weights were taken on d -1, 0, 35, 69, and 70, and BCS and ultrasound measurements of rib and rump fat were determined on d 0 and 70. Dry matter intake of corn stalks and mineral supplement was not affected by treatment ($P < 0.05$). Weight changes (31.6, 21.3, and 21.8 kg for SFM, COMB, and DG, respectively) and BCS changes (0.15, 0.21, 0.20 BCS for SFM, COMB, and DG, respectively) were not affected by treatment ($P > 0.05$). Ultrasound rib fat change (0.00 cm for SFM, COMB, and DG) and rump fat change (0.03, 0.05, and 0.02 cm for SFM, COMB, and DG, respectively) were not affected by treatment ($P > 0.05$). These results suggest that DDGS can replace sunflower meal on a crude protein basis without sacrificing cow performance or BCS.

Key Words: Corn Stalks, Degradable Intake Protein

219 Predicting forage intake of steers supplemented dried distillers grains while grazing native summer sandhill's range. S. Morris*, T. Klopfenstein, and D. Adams, *University of Nebraska*, *Lincoln*.

Fifty six crossbred steers (BW= 311 ± 11 kg) were used in a completely randomized design experiment to predict forage intake, determine rate of replacement of forage, and determine effects on animal performance by increasing supplemental dried distillers grains plus solubles (DDGS) on steers grazing native summer Sandhill's range for 88 days. Supplement was fed at five levels, 0, 0.257, 0.514, 0.770, and 1.027 % BW six d/week. Levels of DDGS were adjusted throughout the trial to correct for weight gain. Initial and final BW were based on three consecutive day weights following a five d limit-fed period. Steers were stratified by weight and randomly assigned to a level of DDGS. Steers continuously grazed, except during the morning when they were gathered and supplemented their respective amounts of DDGS in individual feeding crates. Amount of DDGS offered and refused were weighed daily to determine DDGS intake. Three esophageally fistulated cows were used to collect diet samples monthly to determine TDN of the pasture. To predict forage intake, total TDN intake was based on ADG and BW, using an equation developed by Winchester and Hendricks (1953 U.S.D.A. Tech. Bul. No. 1071). In a previous growing trial, with known TDN intake, BW, and ADG, Winchester's equation was adjusted by the following equation, where adjusted TDN intake = 1.110(known TDN intake)-1.389 (R^2 = 0.781). Adjusted TDN intake establishes the total TDN consumed by the animal. The DDGS TDN was subtracted from the total TDN. The remaining TDN was divided by the diet TDN (66.85% TDN), resulting in forage DMI. Forage intake linearly decreased (P < 0.001) as level of DDGS increased, while ADG linearly increased (P < 0.01) as level of DDGS increased. Average daily gain and forage DMI were regressed on DDGS intake and regression equations were determined as follows: ADG = 0.049(DDGS) + 0.732 (R^2 = 0.773), and forage DMI = -0.942(DDGS) + 8.968 (R^2 = 0.969). Supplementing DDGS to steers in grazing situations appears to replace forage and increase ADG.

Key Words: Distillers Grains, Predicting Forage Intake

220 A new equation to predict feed intake by *Bos indicus* cattle. R. Almeida*[1,2], C. Boin[2], P. R. Leme[3], R. F. Nardon[4], G. F. Alleoni[4], G. M. Cruz[5], M. M. Alencar[5], and D. P. D. Lanna[2], [1]*UFPR & PUCPR*, *Brazil*, [2]*ESALQ/USP*, *Brazil*, [3]*FZEA/USP*, *Brazil*, [4]*IZ Nova Odessa*, *Brazil*, [5]*Embrapa São Carlos*, *Brazil*.

The NRC (1984 and 1996 Editions) developed predictive equations for DMI by growing and finishing beef cattle. The data was obtained mainly from *Bos taurus* cattle, implanted and fed low forage diets with ionophores. Previous data has shown that NRC equations overpredicted DMI for *Bos indicus*. The objective of this study was to develop and validate a predictive equation for DMI by Zebu

cattle. Meta-analyses methods were applied to 15 experiments with Nellore cattle. All trials recorded daily DMI from Nellore bulls and steers fed in individual pens, group pens or electronic Calan gate feeders. Only trials conducted in research centers were used to ensure an adaptation period that would minimize compensatory growth effects. Among the 176 experimental units, feeding periods varied from 62 to 277 d and NE_m concentration ranged from 1.01-1.77 Mcal/kg (51.2-74.5% TDN). NE_m intake per unit of shrunk $BW^{0.75}$ was analyzed using mixed model procedure from SAS. Random experiment effect, fixed sex effect (castrated and intact), and continuous variables (dietary NE_m concentration, NE_m^2, and days on feed) were included in the model. The suggested new equation is:

$$DMI\ (kg/d) = (SBW^{0.75} * (0.2068 * NE_m - 0.03958 * NE_m^2 - 0.07553)) / NE_m$$

The sex effect was not significant (P>0.05), maybe because steers tended to be older than bulls. DMI predicted from the Zebu data and the NRC equations showed that at low dietary NE_m concentrations (1.0-1.4 Mcal/kg), *B. indicus* have higher intakes than *B. taurus*. Conversely, *B. taurus* cattle showed increasingly greater DMI than *B. indicus* when NE_m was above 1.4 Mcal/kg. Using an independent data set from Nellore young bulls to validate the new equation, we obtained less overprediction bias than the NRC 1984 and 1996 equations (1.3% vs. 6.1 and 3.2%). Also, actual intakes and the predicted estimates did not differ using *t* test (P>0.10). We conclude that our equation predicted DMI from *B. indicus* more accurately than NRC equations.

Key Words: Beef Cattle, Dry Matter Intake, Nellore

221 Use of chromic oxide and alkane controlled release capsules to estimate intake and digestibility by beef steers. I. Lopez-Guerrero*, J. Fontenot, and G. Scaglia, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Two digestion trials were conducted to evaluate chromic oxide and alkane controlled release capsule (CRC) technique to estimate DM fecal output (DMFO), intake (DMI), and digestibility (DMD) by steers. For the first trial, six Angus crossbred steers (BW = 328 ± 31 kg) were allotted at ramdom to individual pens and fed tall fescue hay at a level of 1.5% BW. Seven days before the collection period, the steers were dosed with two intraruminal CRC, one containing Cr_2O_3 and another containing a mixture of C_{32} and C_{36} alkanes. During the 7 d collection period, hay samples and feces were collected, mixed, and sampled twice per day. Statistical analyses were conducted using the mixed procedure of SAS. The results show that, actual DMI, DMFO, and DMD were 4.74 kg/d, 1.85 kg/d, and 61%, respectively. No differences were found among days in the recovery rate (RR) of alkanes (P ≥ 1.106) or Cr_2O_3 (P = 0.341). There was no difference between the actual and the estimated values of DMFO (P ≥ 0.315), DMI (P ≥ 0.381), and DMD (P ≥ 0.161), provided the RR of the respective marker was used as correction factor for the estimated values. However, estimates using Cr_2O_3 were more reliable than those obtained with alkanes. The second trial was conducted under grazing conditions. The procedures were basically similar to those used in the first trial. The main differences were that the steers (n = 5) were heavier (BW = 382 ± 16 kg) and grazed low-endophyte fescue pasture, and only Cr_2O_3 CRC was used to estimate DMFO and DMI. Forage allowance was between 12.48 and 14.81 kg of forage DM/100 kg BW. The RR of Cr_2O_3 was not different among days during the collection period, but the mean was unusually high (189%). Nevertheless, actual and estimated DMFO and DMI were not different (P ≥ 0.846) when the RR was used to correct the calculations. Under the conditions of these trials, DMFO, DMI, and DMD can be reliably estimated using Cr_2O_3 CRC if an accurate RR can be obtained.

Key Words: Beef Steers, Markers, Dry Matter Intake

222 The effect of silage microbial inoculant with and without additional preservatives on the aerobic stability of maize silage. S. Hall[1], P. Moscardo Morales[1], J. K. Margerison*[1], D. Wilde[2], P. Light[2], M. Smith[2], and N. Adams[2], [1]*University of Plymouth*, *Plymouth, Devon, UK*, [2]*Alltech (UK) Ltd*, *Stamford, Lincs, UK*.

The effect of inoculating maize silage with Maize-all GS (inoculant) and Sil-all Fireguard (inoculant and preservative) on silage aerobic stability was measured. Forage maize (DM 29 (±1.29)) was divided into sub-samples (300 kg FM) and treated with; No additive (0), Sil-All fireguard (0.5g/100kg FM (SAFS), Maize All GS 1g/100kg FM (MAS). Nine experimental silos lined with polythene had 75 kg/m2 applied and were stored (17 to 20 ° C) for 30 days. On opening 20 holes were made (0.5 cm d), samples were wrapped in polystyrene. Lactic acid (g/kg) at 48 to 168 h 0 -37.2 b,SAFS -78 a, MAS -52.5 a (11.9) and 0 to 168 h -0 53.2 b,SAFS -72.4 a, MAS -64.2 a (5.56) reduced significantly more (P<0.05) with SAFS and MAS, while acetic acid (AA) (g/kg DM) at 0 to 48 h) declined more in 0 -8.2 c, least in SAFS 0.6 a, and -2.2 b in MAS (2.6) (P<0.05), but between 0 to 168 h AA were lowest in SAFS, 0 -14.6 b, SAFS -23.8 a, MAS -18.4 b (2.67) (P<0.05). Maximum pH was lowest in MAS, and not sigificatly different between SAFS and 0 (0 7.3 a, SAFS 6.7 b, MAS 7.4 a (0.22) and pH change 48 to 168 h was greatest in MAS, 0 3.3 b, SAFS 3.0 c, MAS 3.6 a (0.17) (P<0.05). Time to max. temp. (h) was greatest in SAFS (0 83.1 a b, SAFS 109.1 a, MAS 74.5 b (10.4) (P<0.05). Silage additives increased lactic acid and silage aerobic stability.

Sheep Species: Management of Gastrointestinal Nematodes in Sheep

223 Epidemiology of sheep gastrointestinal nematodes in the U.S. R. Kaplan*, *University of Georgia*, *Athens*.

There are many important diseases of sheep, but none are as ubiquitous or present as direct a threat to the health and productivity of sheep as gastrointestinal nematode (GIN) parasites. Control of GIN is therefore of primary concern in any sheep health management program. Well designed worm control programs must take into account many factors, the most important of which is the epidemiology and transmission dynamics of GIN in the particular locale of the farm. Because epidemiology differs greatly between regions, it is not possible to formulate broad-scale recommendations that are valid in all regions of the United States. In order to develop rational control plans for GIN, it is important to appreciate that there are numerous worm species that can cause disease in sheep, and optimal control strategies will differ among species. Fortunately, only a few species are highly pathogenic and of primary concern. Major pathogens include *Haemonchus contortus*, *Trichostrongylus colubriformis*, and *Teladorsagia (Ostertagia) circumcincta*. Other less common and usually less important species/genera include *Trichostrongylus axei*, *Nematodirus*, *Cooperia*, *Oesophagostomum*, *Trichuris* and *Bunostomum*. In virtually all instances infections will be mixed, with climate and season being the major factors influencing the relative percentages of the different species. In the warmer regions of the country, *H. contortus* is by far the predominant species with *T. colubriformis* the next most important. In cooler regions, *T. circumcincta* will be more of a problem, and there is a greater potential to have a mixture of all 3 primary pathogenic species. The less common species usually are not present in numbers sufficient to cause disease on their own; however, in certain situations conditions may allow large infection levels to develop which can produce serious outbreaks of disease. In the cooler regions of the country, GIN transmission is highly seasonal, whereas in the warmer regions, transmission of GIN may occur year-round. In this presentation, epidemiology of the major GIN pathogens will be discussed in relation to how this impacts the development of worm control programs.

Key Words: Gastrointestinal Nematodes, Epidemiology

224 Immunological aspects of nematode parasite control. J. Miller*[1] and D. Horohov[2], [1]*Louisiana State University*, *Baton Rouge*, [2]*University of Kentucky*, *Lexington*.

Gastrointestinal nematode parasitism is arguably the most serious constraint affecting sheep production world-wide. Economic losses are caused by decreased production, cost of prophylaxis, cost of treatment, and the death of infected animals. The nematode of particular concern is *Haemonchus contortus*. Severe blood loss can occur, resulting in anemia, anorexia, depression, loss of condition, and eventual death. The control of nematode parasites traditionally relies on anthelmintic treatment. The evolution of anthelmintic resistance in nematode populations threatens the success of drug treatment programs. Alternative strategies for control of nematode infections are being developed and one approach is to take advantage of the host's natural and/or acquired immune response. The host's innate natural immunity can be used in selection programs to increase the level of resistance in the population. Vaccination can also be used to stimulate/boost the host's acquired immunity. The induction of protective resistance is dependent on the pattern of cytokine gene expression induced during infection by two defined CD4+ T-helper cell subsets which have been designated either Th1 or Th2. Intracellular parasites most often invoke a Th1 type response and helminth parasites a Th2 type response. Breeds of sheep resistant to infection have developed resistance over a much longer host-parasite relationship term than short-term genetically selected resistant lines within breed. The immune components involved in these (similar/different) will be reviewed. The potential for using vaccines has been investigated, with variable results, for several decades. The few successes and potential new antigen candidates will also be reviewed.

Key Words: Sheep, Nematode, Immunology

225 Use of QTL to determine parasite resistance in sheep. N. Cockett*[1], S. Bishop[2], G. Davies[2], T. Hadfield[1], S. Eng[1], and J. Miller[3], [1]*Utah State University*, *Logan, UT*, [2]*Roslin Institute*, *Midlothian, UK*, [3]*Louisiana State University*, *Baton Rouge*.

Gastrointestinal parasites have a profound effect on sheep production. The identification of genetic markers for parasite resistance in sheep will be useful for establishing breeding schemes that select for parasite-resistant animals. A genome-wide QTL scan was implemented as part of a collaborative project with Louisiana State University, Utah State University and Roslin Institute, in order to identify chromosomal regions in the ovine genome that play a role in resistance to gastrointestinal parasites. A sheep population segregating for parasite burden (measured by fecal egg count or FEC for *Haemonchus contortus*) was constructed and included F2 offspring of F1 parents produced from Gulf Coast Native (resistant) and Suffolk (susceptible) crosses. Using selective genotyping of 50 microsatellite markers on the upper and lower 20% of the lambs, suggestive QTLs were identified on ovine chromosomes 1, 3 and 19. Additional markers in these regions were then genotyped across the full population. The most significant results were detected on chromosomes 1 and 19. A study conducted by Roslin Institute and Glasgow University using Scottish Blackface lambs identified several QTL associated with parasitic infection across four ovine chromosomes (2, 3, 14 and 20). These QTL were within chromosomal regions previously associated with immune function and cell growth and specialization. A study by AgResearch, New Zealand using a Romney sheep line selected for parasite resistance identified a QTL near the *IFN* locus. Using a population of feral, naturally infected Soays, a significant association was found between FEC for *Teladorsagia circumcincta* and alleles of the *IFN* microsatellite but not with alleles of flanking markers. These results provide additional support that a QTL for reduced FEC is segregating near *IFN*. QTLs associated with *Trichostrongylus colubriformis* resistance were reported by CSIRO, Australia on ovine chromosomes 1, 3, 6, 22, and 23, and QTLs associated with resistance to *H. contortus* were identified on chromosomes 1, 3, 6, 14 and 23.

Key Words: Sheep, Parasite Resistance, QTL

226 The effects of forages/plants on *Haemonchus contortus* infection. T. Terrill*, *Fort Valley State University*, *Fort Valley, GA*.

Parasitic nematode diseases of domestic livestock are economically important throughout the world. The use of medicinal plants to control parasitic infections in animals is a common practice with resource-poor farmers in Africa, India, Asia, and other regions. In areas where chemical anthelmintics are readily available, there has been a world-wide increase in anthelmintic resistance in sheep and goats, and this is fueling increased interest in use of medicinal plants to control parasites. Haemonchosis, caused by the blood-sucking activity of *Haemonchus contortus*, is widespread in the tropics and subtropics and is the primary contraint to profitable small ruminant production in these regions. Despite a large amount of anecdotal information on plants with anti-parasitic activity, there are relatively few scientific reports on efficacy of plants or plant compounds against *H. contortus*. There is growing evidence that some condensed tannin-containing forages in fresh and dried forms have activity against eggs, larvae, or adult forms of this parasite, but the mechanism of action is still uncertain. Incorporating medicinal plants into grazing/feeding systems to effectively control parasitic nematodes in sheep and goats is an elusive challenge, but positive strides in this direction are being made.

Key Words: Sheep, Goats, Gastrointestinal Nematodes

227 Biological control of nematode parasites in sheep. M. Larsen*, *Danish Center for Experimental Parasitology, The Royal Veterinary and Agricultural University*, *Frederiksberg C, Denmark*.

This short review will present data from the last 10-15 years on biological control of nematode parasites in sheep. These nematodes cause serious infections and production losses in sheep production worldwide. Together with other, sustainable tools (e.g. FAMACHA, grazing management strategies, smart use of drugs) to combat the parasitic nematodes, biological control (BC) by means of the fungus, *Duddingtonia flagrans*, has been investigated. The fungus produces a large number of spores (chlamydospores) that can survive through the gastrointestinal tract of ruminants. The principle behind BC is to manage the level of infective larval stages of the nematodes (e.g. *Haemonchus contortus*) on pasture to an extent that the impact on the animals is minimized. The effect of daily supplementation of fungal spores to grazing young sheep has successfully been investigated world-wide (Australia, USA, Europe, Asia) and in different climatic zones (temperate to tropical). Researchers have found significantly lower levels of larval development in fecal cultures, as well as larvae found on pasture in field trials where animals received spores from start of grazing and onwards for 2-3 months in temperate climate, and even up to three quarters of a year under tropical conditions. Besides the reduction in number of larvae, worm burden of tracer lambs has been significantly reduced, and not least, the productivity of lambs receiving fungus was significantly higher than the controls. Some parasites (lungworm and *Nematodirus* spp.) seem to be refractory to control by this fungus. Although daily supplementation would be possible for dairy producers, it is imperative for a more advanced formulation of the fungal spores to become available. One such solution could be a slow release device, by which one would overcome the potential difficulties in securing daily uptake by individual animals over an extended period. Also, such a technology would be user friendly and very flexible with respect to implementation in different management systems and climates.

Key Words: Biological Control, Sheep, Nematophagous Fungi

228 Tres Al Dia. J. Bechtel*, *Penn State University*, *University Park*.

According to the U.S. Census Bureau, the Hispanic population grew 61% from 1990-2003. Hispanics are now the fastest growing demographic group in the United States. Due to this rapid increase, the dairy industry has taken several steps to address this changing population. Key changes in marketing plans include producing Hispanic style cheeses, introducing bilingual labels on top-selling brands of milk, and targeting Spanish speaking audiences through advertisements. A report by the National Agricultural Statistic Service in 2001 revealed the production of Hispanic-style cheeses increased 52% in volume sales over the previous five years, with Queso Blanco being the most popular. In September 2004, Swiss Dairy announced that it will begin selling milk with bilingual labels. While Hispanics account for 13% of the U.S. population, leading advertisers have spent less than 3% of their resources targeting this audience. The Association of Hispanic Advertising Agencies (AHAA) recommends that at least 8% of a company's marketing budget should target Hispanics. In areas such as New York, Los Angeles or Miami, the AHAA advocates even higher percentages of the advertising dollar. Because the Hispanic population is comprised of Cubans, Mexicans, Central Americans, Puerto Ricans, Caribbeans and South Americans, marketing plans must be culturally sensitive. As the United States demographic profile shifts, the dairy industry will work to continually meet the expectations of these changing audiences.

Key Words: Hispanic Cheese, Milk Promotion

229 Consuming three to four servings of dairy products a day may help end the plague of obesity. D. Cotterill*, *University of Kentucky*, *Lexington*.

Obesity is plaguing the United States of America. Forty million American adults suffer from obesity and out of those three million are morbidly obese. In a recent 24-week study adults who consumed three to four servings of dairy foods and were on a low-calorie diet lost more weight than other adults who were only on a low-calorie diet. The study has also proven that adults who consume 3-4 servings of dairy products a day loose more truncal fat than the adults who took calcium supplements or just cut calories. The consumption of dairy products, which contain calcium and protein, while on a low-calorie diet, will speed up an individualâ•™s metabolism causing them to burn fat. Another study divided adults into three groups: low calcium and dairy diet, high calcium supplements and low dairy diet, and a high dairy diet in which 3-4 servings of dairy products are consumed daily. After 24 weeks the high dairy group lost 11% of their total body weight. The high calcium supplements and low dairy group lost 9% and the low calcium and dairy group only lost 6% of its total body weight. Most of the weight was lost in the truncal area. A recent review of 90 studies showed that the consumption of 3-4 servings of dairy products daily along with a low calorie diet could lead to the reduction of obesity, diabetes and hypertension.

Key Words: Obesity, Dairy Products

230 The power of fortification. B. Lyons* and C. Boeneke, *Louisiana State University*, *Baton Rouge*.

In today's economy consumers are constantly dealing with many issues in their quest to fulfill dietary requirements set forth by the United States Department of Agriculture's Food Guide Pyramid. Today's consumer is constantly struggling to find food products that can provide a balanced diet and possibly offer additional health benefits. In special cases, this could mean continuing to eat the foods they already enjoy. An area that is rapidly gaining interest is the field of functional foods. A food may be considered naturally "functional" if it contains a food component that affects one or more targeted functions in a beneficial way. Dairy products are a good example of this because of their calcium content. Dairy foods naturally contain many health-promoting characteristics such as calcium and proteins that can be considered as part of a healthy diet. Foods may also become functional by adding certain functional components or replacing components with more desirable ones. Fortifying dairy products such as yogurt, milk, and cheese with additional vitamins, minerals, antioxidants, or probiotics will enhance their health promoting properties. Research is continually being conducted to prove that dairy products have the potential to have a major impact on the future of fortification to increase the functionality of foods. Advances in science, readily accessible nutritional information, rising health care costs, increase of aging population, government regulations, and an expanding self-care movement are all factors used to describe why functional foods is one of the fastest growing categories of foods. Our understanding of functional foods and their market potential is still in the early stages of development. As time progresses, functional foods will become increasingly important for the fast-paced on-the-go consumer of today. It's time for the dairy industry to become more functional. Continual education of consumers will be required and will be challenging. The bigger risk is to sit idle and miss this opportunity.

Key Words: Functional Foods, Dairy Products, Health

231 Food pyramid's dairy group minimum level rises to three servings: Two doesn't cut it. B. House*, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

After analyzing two national surveys the National Dairy Council recommended that the Food Guide Pyramid change the daily recommendation of the dairy group from two-four servings to three-four servings. Two national surveys showed that two servings from the dairy group were not sufficient in providing the daily recommended intake (DRI) of both calcium and magnesium, except for those under age nine. The majority of the population above age nine needs three or more dairy servings to reach the DRI of calcium and magnesium, especially when the recommended levels of grains, fruits and vegetables are not consumed as a source of calcium. To determine the number of servings needed to reach the DRI, the people surveyed were split into six groups according to the number of servings eaten per day. In order for an average person 9-18 years old to receive Adequate Intake (AI) of calcium they must consume on average four servings from the dairy group. Likewise, in that same age group, 90% consuming 3.5-4.5 dairy products per day met the Estimated Average Requirement (EAR) for magnesium. However 70% of those consuming 2.5-3.5 per day did not meet the EAR for magnesium. Similar results were found in the other age groups. For human health reasons the National Dairy Council recommended changes to the Food Guide Pyramid. The benefits of dairy products are substantial because over 70% of calcium in the human diet comes from dairy products; therefore, raising the minimum daily recommendation from two to three servings helps consumers better meet their DRI of calcium and magnesium.

Key Words: Food Guide Pyramid

Tuesday, July 26, 2005

POSTER PRESENTATIONS

Animal Behavior and Well-being: Behavior, Health and Nutrition

T1 Ingestive behavior of Holstein steers fed with differents particle sizes of Tifton 85 hay. E. S. Pereira*[1], A. M. V. Arruda[1], and I. Y. Mizubuti[2], [1]*Universidade Estadual do Oeste do Parana*, *Marechal Candido Rondon, Parana, Brasil*, [2]*Universidade Estadual de Londrina*, *Universidade Estadual de Londrina,Parana, Brasil*.

The objective of this work was evaluate the ingestive behavior of Holstein steers feeding with different particles sizes of Tifton 85 hay (5, 7, 10 millimeters and whole). Four steers with the average weight of 300 kilograms and 20 months of age, maintained in individual stalls and ad libitum feeding during the experimental period of 64 days. The animals were allotted in 4 by 4 latin square experimental design, with four steers and four experimental periods. The ingestive behavior of each steer was visually determined at 16 days, in intervals of 10 minutes, during 24 hours. The statistical analyses performed including general variation analyses and comparative means by tukey test in five percent probability. The feeding time (hour or minutes for day) of the animals was significant ($P<0.05$) for Tifton 85 whole hay and with particle size of 5 millimeters. The longer feeding time was observed with the Tifton 85 whole hay (6.85 hours for day) and shorter feeding time was observed with particle size of 5 millimeters (5.42 hours for day). No differences ($P>0.05$) were observed for feeding time when steers received Tifton 85 hay with particles sizes of 7 and 10 millimeters (5.81 and 6.29 hours for day, respectively). Average rumination time in minute for kilogram of dry matter and neutral detergent fiber were higher for the animals fed with Tifton 85 whole hay (50.97 and 86.11 minute for day, respectively). Ingestive behavior of steers was influenced by different dietetic particle sizes.

Key Words: Ingestive Behavior, Nutrition, Particle sizes

T2 Relationship between feeding behavior, morbidity and vaccination in feedlot cattle. K. S. Schwartzkopf-Genswein*[1], M. A.. Shah[1], T. A. McAllister[1], B. M. A. Genswein[1], M. Streeter[2], M. Branine[3], and S. Swingle[3], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [2]*Alpharma Inc.*, *Delaware*, [3]*Cactus Research Ltd.*, *Amarillo, TX*.

Three-hundred and eighty, non-preconditioned, multi-sourced, heifers (503±49 kg) were used to access the relationship between feeding behavior, morbidity and vaccination over 227 d. On entry to the feedlot calves were administered tilmycosin and vaccinated against IBR and BVD. Half of the calves were also vaccinated (V) against BRD while the other half were not (C). Calves were blocked by source and randomly allotted to V or C treatments within one of 4 pens. Calves were fed receiving and finishing rations containing (DM basis) steam-flaked corn (53 and 57 %), high-moisture corn (0 and 20 %), alfalfa hay (35 and 7 %), corn silage (5 and 5%), fat (0 and 3 %) and supplement (7 and 8 %), twice daily. Animals were weighed on entry to the feedlot, mid-way through, and at trial completion. Variables measured included number of medical treatments, incidence of lung lesions (LL), feeding behavior and ADG. Feeding behavior was collected using the GrowSafe System® to quantify daily bunk attendance duration, inter-meal interval and attendance frequency. Heifers were defined as sick (S) based on drug treatment and hospital diagnosis; healthy (H) cattle were never treated. Health status was compared by matching individuals by day of pull and pen. Overall and 4 d period prior to being pulled, S heifers spent less time at the bunk (81 vs 104 and 94 vs 141 min/d), made fewer daily visits (5 vs 7 and 7 vs 9) and had longer mean inter-meal intervals (513 vs 273 and 317 vs 204 min/d) respectively, then H heifers ($P<0.001$). S heifers treated 3 times or more also spent less time at the bunk (97 vs 67 and min/d) and made fewer daily visits than those treated once (5 vs 4) ($P<0.0001$). Cattle with LL spent less time (99 vs 102 min/d), made fewer visits (6 vs 7) and had longer mean inter-meal intervals (302 vs 291 min/d) than heifers without LL ($P<0.0001$). V heifers required fewer medical treatments (2.2 vs 2.9), had higher ADG (2.6 vs 2.5 kg/d) and fewer LL (0.08 vs 0.18) than C ($P<0.0001$). Use of feeding behavior as an early predictor of illness and indicator of vaccine efficacy could offer considerable benefit to the fed cattle industry.

Key Words: Beef Cattle Feeding Behavior, Health, Disease Detection

T3 Do changes in conductivity measures reflect variation in somatic cell count in bovine milk? A. M. Hurt*, F. C. Gwazdauskas, R. E. Pearson, A Becvar, C. O. Wilkes, K. J. Pence, S. C. Wilson, and L Harris, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to determine if milk conductivity measures can indicate changes in somatic cell counts (SCC), percent fat (PF) and percent protein (PP). Milk samples were obtained weekly from mid-July, 2004 for 12 wk on 95 cows (71 Holstein, 22 Jersey) in various stages of lactation; SCC, PF and PP were determined by DHI. Conductivity and milk yield (MY) were obtained twice daily using the Afimeteric® system. Conductivity measures were converted to integers (8 to 16 mS/cm) for categorization. Conductivity significantly affected SCC. Least squares means for SCC increased from 76.5 ± 253.8 $x10^3$ cells/mL at 8 mS/cm to $1125.1 \pm 277.9x10^3$ cells/mL at 14mS/cm and then declined. Conductivity and MY significantly affected SCC in Holsteins. SCC increased from $183.6 \pm 299.0x10^3$ to a peak at $1367.5 \pm 335.5x10^3$ cells/mL at conductivity measures of 8 to 14 mS/cm. As MY increased, SCC declined significantly. Conductivity and days in milk (DIM) significantly affected the SCC in Jerseys. SCC increased from $3.5 \pm 445.9x10^3$ to $1465.57 \pm 463.9x10^3$ cells/mL from 8 to 14 mS/cm, respectively. As DIM increased, SCC increased ($p<0.01$). PP was significantly affected by breed, conductivity, DIM and MY. Conductivity had a negative affect on PP. PP increased throughout lactation, but decreased with increases in MY. PF was significantly affected by breed, conductivity, DIM and MY. PF for Holsteins was 3.6 ± 0.1 vs. 4.31 ± 0.15% for Jerseys. As conductivity measures increased from 8 to 15 mS/cm, PF decreased from 5.0 ± 0.2 to 3.6 ± 0.5%, respectively. PF increased as lactation advanced. Overall our results indicated that breed, conductivity and MY significantly affected SCC, PP and PF. Our results show that milk conductivity can be an indication of changes in SCC, PF and PP in both Holsteins and Jerseys.

Key Words: SCC, Milk Conductivity, Percent Protein

T4 Stimulation of consumption in lambs trough variations in food flavor. J. Merino[1], R. Distel*[1,2], R. Rodriguez-Iglesias[1,2], and J. Arroquy[2,3], [1]*Universidad Nacional del Sur*, *Bahia Blanca, Buenos Aires, Argentina*, [2]*CONICET*, *Bahia Blanca, Buenos Aires, Argentina*, [3]*INTA*, *Santiago del Estero, Argentina*.

Because preferences for food flavors decline during and after a meal, consumption could be stimulated by offering a specific food in different flavors simultaneously. The objective of this study was to determine the effects of offering the same hay with different flavors on voluntary intake by lambs. Sixteen Corriedale female lambs 6-mo-old were randomly assigned to either a treatment (multiple flavors, MF) or a control (natural flavor, NF) group. For 15 d, individually penned lambs were given ad libitum access to either alfalfa hay (Trial 1) or alfalfa-grass hay (Trial 2). The alfalfa hay was lower in neutral detergent fiber (NDF) and acid detergent fiber (ADF) and higher in crude protein (CP) than the alfalfa-grass hay (49% vs. 57%, 34% vs. 39%, and 21% vs. 19%, respectively). In both trials, lambs in the MF treatment were fed natural, garlic, oregano, and basil flavored hay, whereas lambs in the NF treatment were fed natural hay. The hay was artificially flavored by mixing 20 g of either garlic, oregano or basil per kg of hay. Animals were switched in between treatments from Trial 1 to Trial 2. There was no difference ($P > 0.05$) between treatments in daily intake of alfalfa hay in Trial 1 (average daily intake was 1,620 g for MF and 1,583 g for NF), but in Trial 2 lambs in the MF treatment ingested 10% more ($P < 0.07$) alfalfa-hay grass than lambs in the NF treatment (average daily intake was 1,443 g for MF and 1,320 g for NF). In both trials, the average consumption of hay in the different flavors varied widely at the beginning of the trial, but it was much similar toward the end of the trial. Variety in flavor tended to stimulate consumption of alfalfa-grass hay (middle quality hay), but did not stimulated consumption of alfalfa hay (high quality hay).

Key Words: Flavor, Voluntary Intake, Ruminant

T5 Comparison of ethograms between penned and ranged young beef cattle. K. Uetake*[1], T. Ishiwata[1], R. J. Kilgour[2], Y. Eguchi[1], and T. Tanaka[1], [1]*Azabu University*, *Sagamihara, Kanagawa, Japan*, [2]*Agricultural Research Centre, NSW Agriculture*, *Trangie, NSW, Australia*.

To get some basic data to assess cattle welfare, ethograms of young cattle in pen and range conditions were compared. Behavioral observations of 122 steers in eight pens and 1136 steers in six ranges were performed using instantaneous recording during daylight over 3 days in each farm. The pens had Wagyu (W) and Wagyu × Holstein (WH) separately, and the ranges had assorted breeds of Angus, Murray Grey, Shorthorn, Santa Gertrudis and their crosses aged 5-15 months. The ranges varied in vegetation from native pasture to improved pasture. The proportion of behavioral repertoire was compared between rearing conditions by MANOVA, one-way ANOVA and the Tukey's post-hoc test in that order. Difference in daytime activities pattern (the interaction between rearing condition and time) was tested by repeated measures ANOVA. The proportion of walking was much lower in both pens (pen W: 1.4 ± 0.2%; pen WH: 1.0 ± 0.2%) compared to all ranges (at least 9.4 ± 4.0%; all $P < 0.05$), but grooming (pen W: 3.1 ± 0.8%; pen WH: 5.9 ± 1.2%), investigating (pen W: 1.1 ± 0.3%; pen WH: 2.5 ± 0.2%) and tongue playing (pen W: 0.1 ± 0.1%; pen WH: 1.1 ± 0.3%) made up the loss. However, the proportion of feeding in the pens (pen W: 21.3 ± 6.5%; pen WH: 32.4 ± 0.3%) was not different to that in one range (42.2 ± 12.6%), which had an improved pasture. The proportion of resting in this range (41.3 ± 9.1%) was also not different to that in pen WH (53.2 ± 1.7%). Especially the proportion of lying in this range (24.2 ± 2.3%) ranked between those in pen W (22.9 ± 8.5%) and pen WH (32.2 ± 1.1%). Fluctuation patterns of the proportions of feeding ($P < 0.001$) and resting ($P < 0.001$) were different between pen and range conditions, whereas the pattern of the proportion of walking was not different. These results suggest that we can learn a well-balanced ethogram for beef cattle by making comparisons of the proportion of behavioral repertoire and activities pattern between pen and various range conditions.

Key Words: Beef Cattle, Animal Welfare, Behavior

T6 Choice of attractive conditions by beef cattle in a Y-maze following release from restraint: effects of sheep. T. Ishiwata*[1], R. J. Kilgour[2], K. Uetake[1], Y. Eguchi[1], and T. Tanaka[1], [1]*Azabu University*, *Sagamihara, Kanagawa, Japan*, [2]*Agricultural Research Centre, NSW Agriculture*, *Trangie, NSW, Australia*.

We have previously reported that peers are attractive and a human is aversive to cattle by using choice test (J. Anim. Sci. 82 (Suppl. 1), 2004). In this study, we tested whether sheep grazing in the next pasture were as attractive as conpecific peers kept in the same group. Angus heifers (n=157) were individually allowed to enter a choice area after 2 min of restraint in a crush and to choose between 2 pens. After the animal had chosen a pen, she could freely access both test pens and the choice area for a further 5 min. The latency to choose, the pen first chosen, the time spent in each choice pen and choice area, and the number of times each pen entered were recorded. The behaviors during choice and after the first choice were recorded. In experiment 1, each heifer was given one of the following choices: pen with 3 familiar heifers (Peers) vs. pen with 6 sheep (Sheep) (n=30); Peers vs. the bare pen (Bare) (n=30); Sheep vs. Bare (n=30). More heifers chose Peers over Bare ($\chi^2 = 4.80$; $P<0.05$), whereas Peers and Sheep, and Sheep and Bare did not differ. The heifers given the choice of Sheep vs. Bare spent more time standing than the heifers given the choice of Peers vs. Bare ($P<0.05$). After the first choice, more heifers entered the Peers pen than the Bare pen ($P<0.05$) or the Sheep pen ($P<0.10$). When the choice was Peers vs. Sheep, heifers spent longer in the Peers pen than in the Sheep pen ($P<0.01$). In experiment 2, another 67 heifers were given one of the following choice: Peers vs. pen with a novel object (NO) (n=19); Sheep vs. NO (n=22); Bare vs. NO (n=26). The proportion of heifers choosing either pen was not different in any choice combination. However, after choosing, more heifers entered the Peers pen than the NO pen ($P<0.01$). When the choice was Sheep vs. NO, heifers spent more time in the choice area ($P<0.01$). We conclude that sheep were not as attractive as peers, but sheep were not fearful animals for cattle.

Key Words: Beef Cattle, Behavior, Preference Test

T7 Effect of tagging site in chicks on broiler performance, pecking behavior, and tag retention. J. E. Wohlt*[1], D. B. Imwalle[1], L. S. Katz[1], and E. W. Zirkle[2], [1]*Rutgers University*, *New Brunswick, NJ*, [2]*Zirkle Animal Health LLC*, *Fairton, NJ*.

Tagging as a means of identifying chicks was tested in a 6-wk study. Day-old male broiler chicks (Ross x Arbor) were received and maintained as a group for 24 h and introduced to feed and water. Chicks were weighed and assigned to serve as controls (n=36) or administered tags in the wing (n=36) or neck (n=36). Yellow-colored tags (1.9 cm x 4.9 cm) having a plastic T-bar fastener (2 cm) were administered using an Avery Dennison System 1000 II Swiftach® through the wing web or neck skin. Six chicks were assigned to individual pens (6 pens/treatment). All pens were equipped with an electric brooder, hanging feeder, and gravity-fed waterer and bedded with wood shavings. A commercial broiler grower (wk 1-4) and finisher (wk 5-6) were fed. Feed offered and refused was recorded and birds weighed weekly. Pens were randomly observed daily for 5 min, and pecks that any bird directed toward another bird recorded. Pecks were differentiated as to whether the peck was directed at the tag (or tag site) or anywhere else on the body. Data were analyzed using repeated measures with NCSS® software. During wk 1-6, feed intake was 102.9, 112.6, 108.9 g/d for control, wing-, and neck-tagged birds, respectively. During wk 1-6 ADG was 59.8 (control), 63.0 (wing tag), 59.1 (neck tag) g/d. For wk 1-6 efficiency (feed/gain) was 1.64 (control), 1.67 (wing tag), 1.79 (neck tag). Tagged birds ate more feed wk 4-6 compared to controls ($P < 0.05$), but only neck-tagged birds were less efficient during wk 4-6 ($P < 0.05$). Performance may be related to pecking behavior. Pecks to other parts of the body did not vary among treatments, but pecks to tag sites averaged 2, 9, and 10 per 5 min for control, wing-, and neck-tagged birds. Pecking at tags of tagged birds was greater wk 1-3 than in controls ($P < 0.05$) but still elevated wk 4-6. Birds tagged in the neck retained 100% of their tags, with tags easily visible at 6 wk. By 6 wk only 37% of wing tags were retained and visibility was impossible due to wing feathers. Tagging site was an important factor influencing tag retention, pecking behavior, and performance.

Key Words: Broiler, Tag Identification, Pecking Behavior

T8 Determination of piglets' preferences for drinker types at two weaning ages. S. Torrey* and T. Widowski, *University of Guelph*, *Guelph, ON, Canada*.

Piglets often experience a lag in growth at weaning during the transition from suckling to independent feeding and drinking. In a previous experiment, we found that through 48 h post-weaning, piglets weaned at 15 d of age given access to a push-lever bowl drinker consumed more feed while spending half as much time at the drinker and using a third of the water as piglets given access to a nipple drinker. Therefore, it appears that drinker style affects pigs initiation of feeding. In this experiment, we examined piglets' preferences for a drinker style. 32 Yorkshire pigs were used in two experiments to determine piglets' preferences for drinker types at two weaning ages. In experiment 1, 16 piglets were weaned at either 19 or 26 d of age and housed individually with two drinkers: a stainless steel push-lever bowl (P) and a stainless steel nipple drinker (N). Experiment 2 was identical to experiment 1 but pigs had access to a float bowl (F) instead of N. Growth, feed intake, water intake and wastage and ingestive behavior were examined through 10 d post-weaning. Preferences were analysed using T-tests and effects of age on preference and preference on other variables were tested with ANOVA. When pigs weaned at either 19 or 26 d were housed with P and N, they exhibited no preference for drinker type, as determined by their time spent at the drinkers (P=0.26 and P=0.39, respectively) and their total water intake (P=0.88 and P=0.83, respectively). Pigs weaned at 26 d also showed no preference between F and P, as determined by their time spent at the drinker (P=0.81), but had a tendency to consume more water from P (P=0.06). Pigs weaned at 19 d showed a significant preference for F. They consumed more water from F (P=0.03) and spent more time drinking from the F (P<0.001). However, this preference did not influence initial or overall feed intake (P=0.72 and P=0.37, respectively). More studies with larger numbers of pigs are necessary to determine why pigs weaned at different ages prefer one drinker style rather than another and whether these preferences reflect differences in the development of ingestive behavior systems.

Key Words: Behavior, Drinking, Weaning

T9 Effects of intermittent lighting on resting behavior by newly weaned piglets. S. T. Millman*, K. C. Sheppard, M. Madden, and A. E. Valliant, *University of Guelph*, *Guelph, ON, Canada*.

By initiating hourly nursing bouts, sow cue rest and activity of their piglets. The importance of rest by piglets is unknown, but has been shown to be an important prognosis of recovery from infections in other species. The objectives of this study were to determine if an intermittent lighting regimen facilitates rest by piglets post-weaning, and examined if high and low weaning weight piglets would be affected differently. Yorkshire piglets were weaned at 21 days of age and 16 pens of four piglets were formed so that each pen contained two high (H) and two low (L) weight pigs. Half of the pens received a standard (8L:16D) lighting regimen (S), and half received an intermittent lighting regimen (I) consisting of four periods of 2L:4D. Timelapse video recorded behavior over 24-hours, and piglets were individually marked for identification. Resting and activity data was recorded using 5-min scan sampling on post-natal days (PND) 22, 23, and 25. Data was analysed using an ANOVA and the Mixed Model or General Linear Model procedures as appropriate. Overall, resting was not affected by light treatment (P = 0.76), or piglet type (P = 0.41). However, time spent resting was significant affected by PND (P < 0.0001), with resting increasing from 0.80 on PND 22 to 0.87 on PND 25. There was also a light treatment by PND interaction (P = 0.0043). Neither lighting treatment (P = 0.69) nor piglet type (P = 0.44) had an effect on piglet weight gain, and there were no interactions (P = 0.97). Total time spent resting was not significantly correlated with weight gain for H piglets (P = 0.54), however there was a trend toward a negative correlation between resting and weight gain for L piglets (P = 0.0591). Transitions in light did not appear to cue resting or activity since behavior did not significantly change during 5, 10 or 20 minute time periods after lights switched on (P = 0.77, 0.63, and 0.51 respectively). In conclusion, lighting regimen has limited impact on resting behavior and weight gain of newly weaned piglets.

Acknowledgements: The authors thank Ms. Erin Reid and OMAF Swine and Isolation Units for technical assistance, as well as Ontario Pork, OMAF and NSERC for financial support.

Key Words: Swine, Rest, Behaviour

Animal Health II

T10 Continuous measurement of reticular and ruminal pH in dairy cows using a wireless pH system. K. M. Krause*[1], G. R. Oetzel[1], D. Kohn[2], D. Kuhn[2], and D. Frost[2], [1]*University of Wisconsin*, *Madison*, [2]*DK2Solutions, LLC*, *Cave Creek, AZ*.

The objectives of this study were to 1) compare ruminal pH measured using a wireless radio telemetry system with a hard-wired system and 2) to investigate the relationship between reticular and ruminal pH. Eight lactating, ruminally cannulated cows in tie stalls were equipped with hard-wired (hw) pH electrodes placed in the rumen and with wireless capsules (wc) anchored adjacent to the hard-wired electrode. Each cow also had a capsule placed in the reticulum. Cows were fed TMR once daily. Ruminal and reticular pH values were recorded every 10 sec for a 5 day period and were then collapsed by 1-min, 15-min and hourly intervals. Mean pH was evaluated using hours post feeding as repeated measurements in a mixed model. Hours after feeding significantly affected both reticular and ruminal pH (P<0.001), but post feeding drop in pH appeared less pronounced for reticular pH (P=0.11). Ruminal pH measured using hw and wc did not differ, whereas reticular pH was higher than ruminal pH regardless of method (hw or wc). Nadir pH (based on ±15 min rolling averages) was higher for reticular pH than for hw ruminal pH and wc ruminal pH. Nadirs occurred approximately 10.5 h post feeding. Hours spent below pH 6 was lower for reticular pH than for ruminal pH. Area below pH 6 was highest for hw ruminal pH and lowest for reticular wc pH. The wireless radio telemetry system reliably transmitted reticular and ruminal pH data. Ruminal pH from the capsules was very similar to hw ruminal pH. Reticular pH was consistently higher than ruminal pH.

Item	Hard-wired Ruminal	Wireless Ruminal	Wireless Reticular	SED
Number of daily readings (1-min)[1]	982	845	764	146
Mean pH (hourly)[1]	6.22[b]	6.29[b]	6.51[a]	0.06
Nadir pH (15-min)[1]	5.56[b]	5.76[b]	6.21[a]	0.09
Time of nadir post feeding, hh:mm (15-min)[1]	10:34	10:16	10:26	0.9 h
Hours<6.0, h/d (1-min)[1]	7.6[a]	5.3[a]	1.1[b]	1.4
Area<6.0, minxpH/d (1-min)[1]	128.5[a]	91.7[b]	3.0[c]	9.2

[1]Time interval into which readings were collapsed, [abc]Means within row with different superscripts differ, P < 0.05.

Key Words: Wireless pH system, Ruminal vs. reticular pH, Dairy cows

T11 Correlation among ruminal pH and short chain fatty acids in dairy cows affected by Subacute Ruminal Acidosis (SARA). M. Morgante*[1], C. Stelletta[1], M. Gianesella[1], B. Paolo[2], M. Badan[1], A. Lotto[3], and I. Andrighetto[2], [1]*Dipartimento di Scienze Cliniche Veterinarie*, *Legnaro (PD), Italy*, [2]*Dipartimento di Scienze Zootecniche*, *Legnaro (PD), Italy*, [3]*Cortal Extrasoy S.p.A.*, *Cittadella (PD), Italy*.

Subacute rumen acidosis (SARA) represents a major metabolic disorder in intensive dairy farms. This condition affects rumen fermentations, animal welfare, and farm both productivity and profitability. The aim of the present study was to determine short chain fatty acids (SCFA) concentration and pH in ruminal fluid of lactating dairy cows. Ten commercial dairy herds suspected of SARA were investigated because of high incidence of laminitis, metritis and culling rate for various pathological conditions. Twelve cows in each herd were selected randomly among symptom free healthy animals between 5 to 60 DIM to perform rumenocentesis to obtain rumen fluid. The pH of the ruminal fluid was determined immediately after sampling. Concentrations of SCFA in ruminal fluid were determined on the stored samples (-80°C). Results were subject to ANOVA and correlation analysis using (software SIGMA STAT 2.02). The results indicated the presence of SARA in 3 herds (more than 33% of the cows with rumen pH < 5.5), a critical situation in 5 (less than 33% of the cows with rumen pH < 5.5 and more than 33% of the cows with rumen pH between 5.6 - 5.8) and a normal rumen pH condition in 2 herds. Table 1 shows the mean values found in three classes of herds. Linear regressions for pH and total SCVFA, acetate, propionate, acetate/propionate ratio n-butyrate and n-valerate resulted different for each class. Pearson correlation coefficients indicated a strong relationship between ruminal pH and total SCFA (r= -0.827, -0.711, -0.732) in the three classes respectively.

Table 1. Mean ruminal parameters in the three classes of herds.

	Acidosis	Critical	Normal
pH	5.68A	5.86B	6.16C
SCFA mMol/ml	150.68A	140.68A	123.03B
Acetate mMol/ml	91.33A	87.93A	76.02B
Propionate mMol/ml	38.94A	32.32B	28.67B
C2/C3 ratio	2.53	2.2	2.74
n-Butyrate mMol/ml	15.35	15.56	13.58
n-Valerate mMol/ml	2.27a	2.09ab	1.92b

a,b = P < 0.05; A, B, C = P < 0.01

Key Words: Dairy cows, Subacute rumen acidosis, Short chain fatty acids

T12 Acid-base status, and the pH of feces, urine, muzzle and uterus in dairy cows affected by Subacute Rumen Acidosis (SARA). C. Stelletta[1], M. Badan[1], M. Morgante*[1], M. Gianesella[1], P. Berzaghi[2], L. Ravarotto[3], A. Lotto[4], and I. Andrighetto[2], [1]*Dipartimento di Scienze Cliniche Veterinarie*, *Legnaro (PD), Italy*, [2]*Dipartimento di Scienze Zootecniche*, *Legnaro (PD), Italy*, [3]*Istituto Zooprofilattico Sperimentale delle Venezie*, *Legnaro (PD), Italy*, [4]*Cortal Extrasoy S.p.A.*, *Cittadella (PD), Italy*.

The effects of subacute rumen acidosis (SARA) on health status of dairy cows are not well known. SARA represents one of the most important disorder in intensive dairy farms, and affects animal welfare, productivity and farm profitability. The aim of present study is to evaluate acid-base status and the pH of feces, urine, muzzle and uterus, to verify the effects of SARA on heath and reproductive status of dairy cows. Ten commercial dairy herds suspected of SARA were investigated because of high incidence of laminitis, metritis and culling rate for various conditions. Twelve cows in each herd were selected randomly among no pregnant animals without clinical signs of disease, good body condition, and between 5 to 60 DIM to perform rumenocentesis, venous blood, urine and feces sampling. The pH of ruminal fluid, urine and feces was determined immediately after sampling. Muzzle and uterine pH were recorded using special pH probes. Blood was stored at +4°C before laboratory analysis. Results were subject to ANOVA and correlation analysis using software SIGMA STAT 2.03. The results indicated the presence of SARA in 3 herds (more than 33% of the cows with rumen pH < 5.5), a critical situation in 5 (less than 33% of the cows with rumen pH < 5.5 and more than 33% of the cows with rumen pH between 5.6 - 5.8) and a normal rumen pH condition in 2 herds. Table 1 shows the mean values of the principal parameters among the three classes of herds. These data suggest a possible role of SARA in the acid-base status of the affected vs normal cows, with significantly higher venous pH, PCO2, HCO3 and TCO2. The correlation between SARA and the pH of feces, urine and muzzle must be further investigated. The uterine pH seems to be lower in the cows of affected herds.

Table 1. Mean blood parameters and pH of feces, urine, muzzle and uterus in tne three classes of herds

	Acidosis	Critical	Normal
pCO2	50.12a	45.97a	43.08b
HCO3	31.63a	31.27a	28.65b
tCO2	33.17a	32.68a	30.45b
Beb	6.54ab	6.91a	5.22b
Blood pH	7.42a	7.43a	7.40b
Feces pH	6.44a	6.68b	6.61ab
Urine pH	8.23	8.36	8.30
Muzzle pH	6.73a	7.13b	6.81a
Uterine pH	7.04a	7.09ab	7.12b

a,b = P < 0.05

Key Words: Dairy cows, Subacute rumen acidosis, Acid-base status

T13 Effects of Johne's disease status on production, reproduction, and health traits in US Holsteins. M. Gonda*, Y. Chang, G. Shook, M. Collins, and B. Kirkpatrick, *University of Wisconsin*, *Madison*.

Blood and fecal samples were collected from 5611 cows primarily in second or third lactation in 300 herds throughout the U.S. An enzyme-linked immunosorbent assay (ELISA) for *M. a. paratuberculosis* antibodies was performed on the serum samples and *M. a. paratuberculosis* was cultured on fecal samples using the radiometric (BACTEC) method. Because of low false positive and high false negative error rates, cows positive for either antibody (S/P ≥ 0.10) or culture test were classified as disease positive. Overall disease prevalences were 0.248 with the antibody test, 0.0324 with the culture test, and 0.256 with the combined tests. Yield deviations for milk, fat, and protein, standardized daughter pregnancy rates, adjusted lactation average somatic cell scores, and projected total months in milk were obtained from the Animal Improvement Programs Laboratory, USDA, for the lactation concurrent with the sample collection date. Yield deviations were twice daily milking 305 day mature equivalent yields adjusted for management group, permanent environment, and herd-sire interaction effects. Except for yield deviations, each phenotype was regressed on Johne's disease status (combined tests), lactation number, herd, sire, and days in milk on sample date. For yield deviations, only Johne's disease status and sire effects were included in the model. The remaining effects were already accounted for in the yield deviations. Only herd and sire were significantly associated with somatic cell score, so lactation number and days in milk were removed from this model. Some animals were not included in each model due to missing data. Disease positive cows had 79.3 kg milk (P = 0.0054; N = 4230), 2.52 kg fat (P=0.0177; N = 4230), 2.64 kg protein (P = 0.0004; N = 4154), and 0.756 projected months in milk (P = 0.0432; N = 3009) less than negative herdmates. Johne's disease status did not significantly alter somatic cell score (P = 0.3458; N = 4076) or pregnancy rate (P = 0.2117; N = 2865). Disease progression should result in progressively greater effects on performance traits.

Key Words: Production, Paratuberculosis, Dairy

T14 Prevalence of foot lesions observed in dairy herds in Sicily and North Italy. J. D. Ferguson*[1], G. Azzaro[2], C. Scollo[2], R. Petriglieri[2], A. Cappa[4], and G. Licitra[2,3], [1]*University of Pennsylvania*, *Kennett Square, PA*, [2]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [3]*D.A.C.P.A. University of Catania*, *Catania, Italy*, [4]*APA*, *Vicenza, Italy*.

Personnel from CoRFiLaC and Vicenza, Italy provide an extension program to dairy farms in foot trimming and hoof care. Description of foot lesions in Ragusa

and Vicenza are similar due to collaboration between the services. Records were compiled for cows examined from 1998 through 2004 and coded for date of examination, herd, cow, date of calving, lactation number, foot lesion(s), and/or hoof trimming. Data from 2317 cows from 54 herds comprised the data base of 3531 records in Ragusa whereas data from 4184 cows from 129 herds comprised the data base of 5798 records from Vicenza. The crude prevalence of foot lesions for all foot interventions in Ragusa and Vicenza, respectively, was as follows: abscess, 12.8%, 11.0%; deformity of claw, 23.2%, 13.9%; digital dermatitis, 28.6%, 22.5%; interdigital fibroma, 2.0%, .1%; infectious pododermatitis, 3.5%, 2.2%; laminitis lesions, 12.6%, 8.9%; sole ulceration, 21.0%, 8.8%; and tendon injury, .8%, 0%, trimming 35.3%, 32.5%. Mean days in lactation at time of foot intervention were 218.8 days (sd = 139.7) in Ragusa and 168.8 days (sd 143.4) in Vicenza. Age, season, and other foot lesions were examined as factors associated with the prevalence of a foot lesion. Data for reproduction and production from herd improvement association records were merged by herd, cow, and date of calving. Cows were coded as not seen for foot pathology, foot pathology more than 30 days prior to first insemination, foot pathology +/- 30 of first insemination, and foot pathology more than 30 days after first insemination. Reproduction was poorer in cows with foot pathology, but most foot pathology occurred well after first insemination suggesting other factors contributed to reduced reproductive performance in these cows. Production was higher in cows with foot pathology compared with herd mates, possibly reflecting a bias in producer selection of cows for intervention by off farm service providers.

Key Words: Foot lesions, Dairy cows

T15 The use of infrared and exercise to non-invasively determine lameness in dairy cattle. D. B. Haley*[1], C. J. Bench[2], A. M. de Passille[3,4], J. Rushen[3,4], P. Lepage[5], J. Coplyn[5], and A. L. Schaefer[5], [1]*Alberta Agriculture, Food & Rural Development*, *Red Deer, AB, Canada*, [2]*University of Sasakatchewan*, *Saskatoon, SK, Canada*, [3]*Agriculture & Agri-Food Canada*, *Lennoxville, QC, Canada*, [4]*Agriculture & Agri-Food Canada*, *Agassiz, BC, Canada*, [5]*Agriculture & Agri-Food Canada*, *Lacombe, AB, Canada*.

An induction model was used to test whether infrared thermographic images of the feet and legs could be used as a non-invasive means of differentiating lameness in dairy cows. Eight Holstein cows were chosen for this preliminary study based on detectable signs of lameness in their gait (eg. uneven stride length and reluctance to bear weight; n=4) or otherwise walking normally (n=4). All cows were exercised by allowing them to move at their own pace a distance of 466.2m. Infrared images were recorded immediately before and after exercise as well as 20 min after exercise. Four limb regions were imaged for analysis: (1) anterior aspect of the carpus on both front limbs, (2) lateral aspect of the tarsus (hock) of both hind limbs, (3) anterior aspect of the inter-digital cleft of both front and (4) hind feet. Data were analyzed as a GLM ANOVA for repeated measures. Thermographic images were not available for all cows in all regions. Significant interactions between lameness and time were found for regions 2 (n=6; $P \leq 0.05$) and 3 (n=8; $P \leq 0.05$). Limb temperature tended to increase between pre- and post-exercise time periods ($P=0.11$), however these effects were not consistent for all the limb regions measured. There was no significant difference between the temperature measurements for lame and non-lame cows ($P=0.14$). However, given the very low number of animals used here, the results suggest infrared thermography may be deserving of more attention as a potentially useful tool in the early, non-invasive detection of lameness in dairy cows.

Key Words: Lameness, Thermography, Dairy

T16 Highly sensitive and specific PCR assay for routine mastitis diagnostics: a comparative study of DNA and bacterial culture based methods. L. Salmikivi, P. Bredbacka, and M. Koskinen*, *Finnzymes Diagnostics*, *Espoo, Finland*.

Due to their high level of sensitivity and specificity, PCR based methods have become widely used in the field of pathogen diagnostics. However, difficulties relating to isolation of high quality bacterial DNA from raw milk and the need to identify a large number of causal pathogens have hindered the development of PCR assays for routine testing of bovine mastitis. Here, we outline a high throughput method for identification of the most relevant bacteria causing mastitis. The assay takes approximately five hours to perform and employs: i) a three-step DNA extraction from raw milk; ii) PCR amplification of bacterial and positive control DNA; iii) amplicon cleavage with restriction endonucleases; and iv) electrophoresis in precast agarose gels. Sensitivity and specificity of the PCR test was compared against bacterial culture methods. Quarter milk samples were collected from 338 dairy cows and tested for mastitis pathogens using both methods and a double-blinded experimental design. Bacterial culture and PCR revealed 239 and 293 positive results, respectively, suggesting markedly higher sensitivity of the PCR assay. A total of 221 samples were positive with both methods. Strikingly, in 39 cases the culture and PCR tests revealed discordant positive results. Sequencing of bacterial DNA from the discordant positive samples, and sequence alignment against known species sequences demonstrated full concordance, suggesting that the PCR method provided higher specificity than bacterial culture. Finally, performance of the PCR assay across potentially genetically differentiated bacterial strains was confirmed by analysing monocultures originating from geographically distant locations. Sequence mutations altering the PCR primer or restriction endonuclease recognition sites were not found.

Key Words: Mastitis testing, DNA diagnostics, PCR assay

T17 Modified Mannitol Salt Agar for Isolation and Enumeration of *Staphylococcus aureus* and Coagulase Negative Staphylococci from raw milk. A. Gurjar*, S. Larson, A. Sawant, B. Straley, N. Hegde, and B. Jayarao, *Pennsylvania State University*, *University Park*.

Two selective media including Baird Parker and modified Mannitol Salt Agar (mMSA) supplemented with egg yolk (50ml/L), esculin monohydrate (1gm/L) and ferric citrate (0.5gm/L) were evaluated for isolation and enumeration of staphylococcifrom raw milk. Five percent sheep blood agar was served as a positive control medium. Thirty two American Type Culture Collection reference strains (gram positive cocci and gram negative bacteria) were cultured on Blood Agar, Baird Parker Agar, and mMSA. Under experimental conditions mMSA showed significantly higher sensitivity and specificity as compared to Baird Parker Agar. mMSA allowed the growth of all Staphylococcal ATCC reference strains and two enterococcal species, while inhibited growth of all streptococci and gram negative reference strains. Baird Parker Agar allowed growth of some Staphylococcal ATCC reference strains (7 of 8 strains), enterococci (2 of 2 strains), Streptococci (1 of 8 strains) and gram negative bacteria (1 of 12 strains). mMSA allowed presumptive identification of *Staphylococcus aureus* at end of 24 h or incubation as compared as Baird Parker Agar which required at least 48 h of incubation before presumptive identification of *S. aureus* could be made. These results of the study indicate that mMSA can be used for isolation, and enumeration of Staphylococcal organism from raw milk.

Key Words: Bulk tank milk, Mastitis, Media

T18 Use of in-line milk sampling for monitoring milk quality and udder health on herds of large dairy operations. B. Straley*, A. Sawant, A. Gurjar, N. Hegde, D. Wolfgang, and B. Jayarao, *Pennsylvania State University*, *University Park*.

Milk samples were sequentially collected using in-line milk sampling device from a large dairy operation comprised of 12 different herds totaling about 2000 lactating cows. The dairy operation was visited six times, during each visit 12 bulk tank and12 in-line samples were collected over one milking session. Milk samples were analyzed for somatic cells, mastitis pathogens and bacterial counts for milk quality determination.

Bacterial and somatic cell counts for samples taken from the milk line system were averaged over time with respect to the volume of milk produced by each herd. Herd milk counts were compared to bulk tank counts as a function of milk

volume over time. A high correlation was observed between bulk tank and in-line counts for somatic cell counts (0.86), coliform counts (0.95), non-coliform counts (0.90), and lipolytic counts (0.81). Moderate to poor correlations were observed for standard plate count, laboratory pasteurization count, preliminary incubation counts, coagulase negative Staphylococcal counts, and Streptococci and Streptococci-like counts. The findings of the study revealed that in-line milk sampling permitted better interpretation of results not only in context to the whole operation but individual herds of lactating cows that contributed milk to the bulk tank. It can be concluded that in-line sampling is a valuable tool in monitoring somatic cells counts and number and type of mastitis pathogens and bacteria that influence milk quality in large dairy operations.

Key Words: Bulk tank milk, Udder health, Milk quality

T19 An approach to evaluate effects of gene expression of *Escherichia coli* associated with bovine mastitis. J. Bowman, M. Worku*, and P. L. Matterson, *North Carolina A&T State University*, *Greensboro*.

Infection with *Escherichia coli* and the resulting inflammation, in particular mastitis, is associated with changes in milk composition, loss of production and has consequences for animal health. The objective of this study was to evaluate the effect of host immune factors in whey on gene expression in *E. coli*. A mid-log culture of *E. coli* isolated from an acute case of clinical mastitis was grown . Whey samples were prepared from clinically healthy cows. The samples were heat inactivated (56°C, 30 min.). Six samples of *E. coli* (1 x10^9 cells) were incubated in RNase free Phosphate Buffered Saline (PBS) as negative controls. Six samples were incubated with a 1:1 dilution of the inactivated whey (10 min., 37°C). RNA from control and treated samples was isolated using Tri-Reagent® (Sigma) or RNeasy kits (Qiagen). The integrity and size distribution of total RNA purified with the RNeasy Kit was checked by 1 % denaturing agarose gel electrophoresis and ethidium bromide staining. RNA isolation using Tri-Reagent® was unsuccessful with all samples. However, the RNeasy method yielded sharp bands of the negative control on stained gels. The negative control gels revealed a smear of fluorescent material centered in the 1.3-2.6 kb range. For total RNA from *E. coli*, the major bands observed were 16S rRNA or 23S rRNA. In samples exposed to whey, ribosomal bands appeared as a smear of smaller sized RNA. These studies indicate that exposure to whey samples may have adversely affected the quality and integrity of RNA isolated from *E. coli* and may indicate a possible mode of action for immune components in bovine whey in combating *E. coli* infection that needs to be further investigated. Such studies are important for the understanding of mechanisms of host resistance against *E. coli* at the transcription level.

Key Words: Whey, Mastitis, E.coli

T20 Effects of acute experimental mastitis on clinical and productive variables in early-lactation dairy cows. M. R. Waldron*, A. E. Kulick, and T. R. Overton, *Cornell University*, *Ithaca, NY*.

Twenty Holstein cows in early lactation (7 days in milk) were administered 100 μg of *Escherichia coli* lipopolysaccharide (LPS) dissolved in 10 ml sterile 0.9% NaCl saline (TRT, n = 10) or 10 ml sterile saline absent LPS (CTL, n = 10) into both right mammary quarters. The hypothesis that acute experimental mastitis would result in altered measurements of clinical and productive variables similar to that seen during cases of natural periparturient bovine mastitis was tested. The CTL cows were pair-fed with the TRT cows for the 8 h after intramammary infusion, thus there were no treatment differences for dry matter intake (DMI) during this period. However, all animals were allowed ad libitum access to feed after the 8-h period and daily DMI for the TRT cows was decreased by 49% and 19% for the day of infusion and one d post-infusion, respectively (treatment by time effect, $P < 0.01$). Heart rate was increased by as much as 30 ± 3 beats/min (treatment by time effect, $P < 0.01$) and rectal temperature was increased by as much as and 2.9 ± 0.2 °C (treatment by time effect, $P < 0.01$) in TRT cows. Plasma cortisol concentration was increased by greater than ten-fold and remained elevated throughout the 480 min following TRT (treatment by time effect, $P < 0.01$). Milk somatic cell counts increased dramatically in LPS-infused quarters only (treatment by time effect, $P < 0.01$), and milk yield at each of four milkings after TRT was decreased by as much as 72% (treatment by time effect, $P < 0.01$). All milk components were significantly affected by TRT for at least 4 milkings (treatment by time effect, $P < 0.01$) and are reported according to maximal percent change relative to CTL in the table below. The TRT cows displayed clinical, physiological, and productive signs of moderate to severe inflammation, whereas CTL cows displayed no signs of immune activation. The data from this study will be useful for the future study of the metabolic responses to immune activation in periparturient dairy cows.

Maximal percent change of milk components during the four milkings following intramammary lipopolysaccharide infusion

Milk Variable	Percent Change
Fat %	+69%
Fat yield	-56%
Protein %	+27%
Protein yield	-62%
Lactose %	-21%
Lactose yield	-76%

Key Words: Mastitis, Clinical, Production

T21 Appearance of insulin resistance in dairy cows following a four-day fast to induce hepatic lipidosis. S. Oikawa*[1,2] and G. R. Oetzel[2], [1]*Rakuno Gakuen University*, *Ebetsu, Japan*, [2]*University of Wisconsin*, *Madison*.

Negative energy balance (NEB) around parturition has been implicated in the development of fatty liver, insulin resistance, and impaired health in early lactation dairy cows. A 4-day fasting model has been previously reported to increase liver triglyceride (TG) more than 2.5-fold and reduce hepatic extraction of bile acids. The purpose of the present study was to evaluate insulin resistance in this fasting model. Ten non-lactating, non-pregnant Holstein cows were fasted for 4 days (n=6) or fed continuously as controls (n=4). Samples were collected from 3 days before until 17 days after the 4-day fast. Fasted cows had higher ($P < 0.05$) liver TG content (49.4 vs. 16.2 mg/g, wet weight basis) at the end of the fasting period compared to controls. Fasted cows also had higher ($P < 0.01$) plasma nonesterified fatty acid (NEFA) concentrations (1.24 vs. 0.21 meq/l) and higher ($P < 0.01$) plasma beta-hydroxybutyrate (BHB) concentrations (439 vs. 220 μM) at the end of the fasting period. Liver TG, plasma NEFA, and plasma BHB in fasted cows returned to pre-fasting levels by the end of the experiment. Plasma glucose concentrations in fasted cows were not different than control cows throughout the study. Plasma insulin concentrations in fasted cows were lower ($P < 0.01$) than for control cows at the end of the fast (6.3 vs. 14.1 μU/ml). Insulin-stimulated glucose reduction (ISGR) was determined by calculating the percentage reduction in plasma glucose concentration 30 minutes after intravenous insulin administration. ISGR was lower ($P < 0.01$) in fasted cows at the end of the fast compared to controls (24.9 vs. 48.6%), suggesting that the fasting model induced insulin resistance. ISGR was negatively correlated with plasma NEFA and liver TG. Insulin resistance apparently increases in severity with increasing plasma NEFA and hepatic TG content, and may be an important complication of NEB and hepatic lipidosis in dairy cattle.

Key Words: Dairy cows, Fasting model, Insulin resistance

T22 Fine mapping of a bovine twinning rate QTL. E. S. Kim*[1], J. Cruickshank[1], M. Dentine[1], P. J. Berger[2], and B. W. Kirkpatrick[1], [1]*University of Wisconsin*, *Madison,*, [2]*Iowa State University*, *Ames*.

A twinning rate quantitative trait locus (QTL) has been previously detected on chromosome 5 in the North American Holstein dairy cattle population. The objective of the current study was to refine the map location of this QTL. In the previous work the strongest evidence for this QTL was obtained from analysis of an extended, four-generation sire family. In that work a total of 122 sires were genotyped with microsatellite markers for which sire families were informative in a linkage analysis. In the current study additional genotyping was performed to provide complete marker genotypes for all 14 markers used previously. The additional genotypes permitted deduction of paternally and maternally inherited marker haplotypes for all sons. The 14 markers used were located between 66 cM and 120 cM on the USDA linkage map for chromosome 5. The patriarch of this extended family was heterozygous *Q q* for the twinning rate QTL based on results of the previous linkage analysis where *Q* denotes the allele associated with increased twinning rate. Association between haplotype and twinning rate was evaluated with a model that included effects of sire, paternally inherited haplotype nested within sire and maternally inherited haplotype. Separate analyses considered either all possible haplotypes, or a dichotomous classification of allele *Q*-associated or non-*Q* associated haplotype, based on the haplotype associated with allele *Q* in the patriarch of the extended family. A significant ($P<0.005$) effect of maternally inherited haplotype was observed for the marker bracket flanking the 74-76 cM region of chromosome 5. This linkage disequilibrium analysis (effect of maternally inherited haplotype) provides additional evidence of the twinning rate QTL and suggests a narrowed region for potential QTL location.

Key Words: Twinning Rate, QTL Mapping, Linkage Disequilibrium

T23 Massive verification and mapping of SNP in cattle using the Illumina® BeadStation 500G genotyping system. C. Li*[1], B. Murdoch[1], Z. Wang[1], S. Mckay[1], J. Williams[2], R. Stone[3], S. Hennig[4], and S. Moore[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Roslin Institute*, *Roslin, United Kingdom*, [3]*USDA, ARS, US Meat Animal Research Center*, *Clay Center, NE*, [4]*Max Planck Institut fuer Molekulare Genetik*, *Ihnestr. Berlin, German*.

Single nucleotide polymorphisms (SNP) have been considered as the next generation of genetic markers for construction of denser linkage maps and detection of quantitative trait loci (QTL) of complex traits. SNPs also allow the identification of causative genes of interest by association-based studies. In cattle, however, the application of SNPs has been hindered by the lack of novel and sufficient markers. This study reports a massive verification and mapping of bovine SNPs reported in literature and public sequence databases using the Illumina® BeadStation 500G genotyping system. In total, 800 SNP sequences were compiled, of which 594 (74.25%) were found to be designable for an OPA (Oligo Pool Assay) based on the sequence quality and oligo sequence compatibility. In order to verify the SNPs, a panel of DNA samples from a hybrid beef cattle population of various breeds (*Bos taurus*) were genotyped using the OPA of 594 SNPs and a SAM (Sentrix Array Matrix) as implemented by the Illumina ® BeadStation 500G genotyping system. To date 474 sequences have been amplified and genotyped. In addition, an OPA containing a subset of 1536 putative SNPs compiled from the Bovine Genome Sequence Project has been designed and the putative SNPs are verified. Verified SNP will be mapped using a bovine mapping reference panel from USDA and using the Roslin Institute 3000 rad bovine whole genome radiation hybrid panel.

Key Words: Single Nucleotide Polymorphisms, Verification, Mapping

T24 Characterization of bovine functional genes from full-length cDNA libraries. M. Taniguchi*, L. L. Guan, Y. Meng, J. Yu, Z. Wang, and S. Moore, *University of Alberta*, *Edmonton, Alberta, Canada*.

Recent studies showed that the gathering of data pertinent to expressed genes (cDNA and full-length cDNA) will provide direct insight into the organization of bovine gene. As a part of Genome Canada's full-length cDNA sequencing project, the aim of this study is to generate full-length cDNA libraries for tissues of importance of beef production, quality and animal health and to characterize their related functional genes.

Animal tissues have been collected and used for mRNA extraction and synthesis of full-length of cDNA library using "cap-trapping" technology (Carninci 1999). The full-length cDNA was synthesized with reverse transcriptase, biotinylated and captured by magnetic beads system. The cDNA library was generated by using pCMV-SPORT 6 vector. Full-length of cDNAs was confirmed by the sequence analysis. Functional genes were identified by BLAST search.

Firstly we constructed full-length cDNA libraries from gastrointestinal (GI) tissues and analyzed the sequences of cDNA to investigate the relationships between their biological functions and the tissues. For example, libraries from Ileum and Peyer's Patch tissues have been analyzed due to association of those tissues with absorption of nutrients and with immune function. Based on the technology used, full-length cDNA sequences were successfully identified as functional genes and were deposited to GenBank. Our results will contribute to detect the genes which are associated with important traits for cattle industry such as disease resistance, meat quality, feed efficiency etc. Hence, the information from genes well-characterized can be used as genetic markers for animal estimation and selection.

Acknowledgements: This research is supported by AARI and Genome Canada

Key Words: Full-Length cDNA, Functional Gene, Bovine

T25 Precision of estimated QTL positions in half-sib designs using combined haplotype sharing TDT and linkage analysis. D. Kolbehdari*[1,2] and L. R. Schaeffer[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*University of Tehran*, *Tehran, Iran*.

The aim of this study was to develop the linear haplotype sharing transmission disequilibrium test (LHS-TDT) method and combine this method with the simple regression method to estimate the precision of QTL positions in half-sib designs. The precision of estimated QTL positions was determined by Monte Carlo simulation in granddaughter designs. A single bi-allelic QTL at the midpoint of a linkage group and 26 markers with 1 cM intervals and with two alleles each were simulated. The heritability of the quantitative trait was assumed to be 0.3 and the ratio of QTL variance to total genetic variance was 0.1. The base population was generated by random mating for 100 generations with an effective population size equal to 100. Three linear models, (i.e. the simple regression model, the linear haplotype sharing TDT method and the combination of these two models) were compared. The mean of absolute differences (A) between the estimated and true QTL position of each method was considered for six different scenarios consisting of combinations of a number of markers and the most frequent haplotypes. The mean of A, using the simple regression method, was 4.38 centimorgan (cM). The means of A using the LHS-TDT method were less than the simple regression method in all scenarios and ranged from 1.86 to 3.82 cM depending on the scenario. The mean of A using the combined method was more than the LHS-TDT method and less than the simple regression method. The means of A using the combined method ranged from 2.32 to 4.36 cM. Therefore, for populations similar to those population simulated in this study, the LHS-TDT was better than the simple regression method and the combined method for precision of estimated QTL position in half-sib designs.

Acknowledgements: The authors are very grateful to the Dairy Cattle Genetics Research Council (DairyGen) and the Matching Investment Initiative of Agriculture and Agri-food Canada and the University of Tehran, Islamic Republic of Iran.

Key Words: Quantitative Trait Loci, QTL Position, Haplotype Sharing TDT

T26 QTL mapping in complex pedigrees: Focusing on inbreeding and overlapping generations. G. Freyer*[1] and N. Vukasinovic[2], [1]*Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany*, [2]*Monsanto Animal AG, St. Louis, MO*.

Mapping QTL in animal pedigrees faces various challenges due to complicated family structure, overlapping generations, and inbreeding. Daughter design or granddaughter design have been used to overcome these difficulties. These designs ignore other relationships within a pedigree, thus simplifying computations but also losing power of QTL detection. Here, we explore abilities of different QTL mapping methods to deal with complicated pedigree structures. A four-generational pedigree, containing 850 individuals in nine related halfsib families, has been simulated assuming simple pedigree structure, without inbreeding and overlapping generations, and complicated pedigree structure, containing highly inbred individuals and overlapping generations. Phenotype and marker information was generated for all individuals. A single QTL explaining 15% of the phenotypic variance was simulated. QTL mapping was considered within a chromosomal segment covered by 11 polymorphic markers. The length of the segment was either 120cM with approximately equidistant markers, or 55cM with greater marker density around the QTL position. QTL mapping was conducted using: granddaughter design (GDD), where each sire family was considered independent; general pedigree design (GPD), including all relationships; and combined linkage disequilibrium and linkage analysis (LDLA), considering all pedigree relationships, also historical generations. All analyses were performed by maximum likelihood techniques. Within a 55cM segment, GPD method located QTL precisely. Within a 120cM segment, GDD method was superior regarding precision of QTL location; GPD method produced slightly biased results. Complicated family structure caused increased computational time, convergence problems, and less accurate estimates of QTL position and parameters. LDLA method precisely located the correct marker bracket in all situations. However, LDLA method only calculates likelihood for middle points between two markers and mapping resolution may be insufficient with sparse maps. The results indicate that LDLA method may be best for mapping QTL in complex pedigrees, provided dense marker maps.

Key Words: QTL Mapping, General Pedigree Analysis, Inbreeding

T27 The incidence of programmed cell death after in vitro fertilization (IVF) with morphologically abnormal bovine spermatozoa. A. Walters*, R. Saacke, R. Pearson, and F . Gwazdauskas, *Virginia Polytechnic Institute and State University, Blacksburg*.

Normal embryonic development depends on the maintenance of a population of healthy cells within each embryo. The aim of this study was to assess the incidence of programmed cell death (apoptosis) in embryos after IVF with morphologically abnormal spermatozoa. Three different semen samples from four Holstein bulls, collected before and after a 48 h scrotal insulation period, were used: 1) semen collected prior to insulation (Control); 2) semen collected 2 wk post-insult (2 wk-PI); and 3) semen collected 3 wk-PI. Post-thawed morphological evaluation revealed a decrease ($P < 0.01$) in the percentage normal spermatozoa for the 3 wk-PI samples in comparison with the Control samples for Bulls I (74 to 22%) and Bull III (68 to 1%). For Bull II the percentage vacuolated spermatozoa increased, with no changes in the sperm populations for Bull IV. On d 8 of culture the embryos were subjected to either the terminal transferase dUTP-nick end labeling (TUNEL) or caspase assay. An apoptotic index and caspase intensity were recorded. No differences were found between the embryos generated from the semen samples for Bull I, but for Bull II the index was higher ($P > 0.01$) for the Control (46%) and 3 wk-PI (41%) embryos compared to the 2 wk-PI (29%) embryos. The opposite was found for Bull III, the 3 wk-PI index (35%) was lower ($P > 0.01$) than the indexes for the Control (43%) and 2 wk-PI embryos (41%). For Bull IV the index was highest for the 3 wk-PI (45.2%) embryos compared to the Control (38%) and the 2 wk-PI (37%) embryos. On Day 8 caspase intensity increased significantly for both Bull I (217 ± 147) and Bull III (229 ± 98) for the 3 wk-PI embryo groups compared to the equivalent embryo groups for Bull II (98 ± 115) and Bull IV (90 ± 111). In conclusion, the inability to consistently measure apoptosis in early stage embryos complicates the assessment of differences in embryo quality. Despite the discrepancies, our results clearly indicated a difference in the embryo quality between embryos obtained after IVF with semen samples from bulls that had an intense response to scrotal insulation.

Key Words: Abnormal Spermatozoa, Scrotal Insult, Apoptosis

T28 X- and Y-chromosome bearing sperm ratio in individual bull ejaculates. J. Schenk, M. Meyers*, and E. Crichton, *XY, Inc., Fort Collins, CO*.

Small sample sizes often lead to erroneous conclusions about true sex ratios due to binomial statistical variation. DNA resort reanalysis, PCR and fluorescence in situ hybridization can be used to accurately determine sex ratios in a sample of semen. In this study we used a MoFlo^R SX sperm sorter to determine proportions of X- and Y-chromosome bearing sperm in individual bull ejaculates. First and second ejaculates were collected weekly from each of 6 Holstein bulls for 3 consecutive weeks. Ejaculates were diluted with Tris sheath fluid, sonicated to remove sperm tails and centrifuged to pellet nuclei. The concentration of nuclei was adjusted to 200 x 10^6 sperm/ml and nuclei were stained (1 h, 34°C) with 72-99 μM H33342 dye. After staining, nuclei were diluted 1:1 with sodium azide (3.8 mM) and frozen at -160°C. Thawed nuclei were analyzed by flow cytometry into sperm populations encompassing all of the nuclei: properly oriented at 0-30°, nonoriented at 30-45°, and nonoriented at 45-90°, relative to the 0° photomultiplier tube detector. All sperm from each population were collected and the percent of total histogram events were recorded for X- and Y-chromosome bearing sperm for each population. Sperm from all 3 populations then were subjected to DNA resort analysis, and the percentage of X- and Y-chromosome bearing sperm was calculated after data were conformed to a pair of Gaussian distributions. Data were analyzed using a split plot ANOVA. There were no differences ($P>0.05$) from 50:50 between bulls or ejaculates within bulls. The largest observed deviation in an individual ejaculate was 46:54. Additionally, statistically identical ($P>0.05$) proportions of X- and Y-chromosome bearing sperm, 49 and 51% respectively, were found in the oriented and nonoriented populations. From analyzing 36 individual ejaculates, we conclude that there were no significant deviations from 50% X- or Y- chromosome bearing sperm due to bulls, ejaculates within bulls, or ejaculation frequency.

Key Words: DNA, Flow Cytometry, Sperm

T29 Karyological profile of bovine clones. S. C. Gupta*[1], N. Gupta[1], C. X. Tian[2], and X. Yang[2], [1]*National Bureau of Animal Genetic Resources, Karnal, Haryana, India*, [2]*University of Connecticut, Storrs*.

The success rate of nuclear transfer (NT) is very low and the production of viable clone is a complex phenomenon which may depend on the type of cell used, karyotype stability, reprogramming of cleavage activity and interaction between various cell or DNA functions. The aim of this study was to know the karyological profile of cloned calves in comparison to their donor mother's own genome and its skin fibroblast cells that donated the karyoplast to the recipient oocyte in NT procedure. Chromosomal profile of donor Aspin, a Holstein Freisian (HF) elite cow was having normal karyotype of 60, XX diploid chromosomal count in 95 % of blood lymphocytes. Aneuploidy with 59, XX diploid count was 8 % in skin fibroblast cells at 5-6 passage and increased to 15 % at 10-12 passages. The proportion of aneuploid cells increased further in later passages. Chromosomal profile of Amy, the first cloned calf in US from skin fibroblast cell showed aneuploidy only in 1 per cent of blood cells on day of birth. However, it showed high frequency (15.67 %) of myxoploidy of tetraploidy (4 N) and octaploidy (8N) in cultured blood lymphocyte cells. The percentage of these polyploid cells was however only 8 percent on day 7 and at later, the blood cells showed no polyploid cells. The placental cells of the mother also showed 40.65 % frequency of polyploid cells. From this data, it can be inferred that the increased frequency of polyploidy cells in new born clone could have been due to transfer of polyploid cells from surrogate mother's placenta and later on filtered out in peripheral blood by normal cell division process in their stem cells in the homopoitic tissue. The chromosomal profile of other clones in blood lymphocytes from the same donor was also normal (60, XX). It can be concluded that the high proportion of prenatal and perinatal deaths in clone pregnancies could

be due chromosomal abnormalities carried by the donor karyoplast before nuclear transfer and their screening in multiple passaging is warranted.

Acknowledgements: We thank the Department of Biotechnoology, Govt. of India for the financial support for the study programme at Uconn, USA.

Key Words: Karyology, Bovine Clones, Skin Fibroblasts

T30 Within breed selection of boars for a gene bank. H. Blackburn*[1], C. Welsh[1], and T. Stewart[2], [1]*USDA-ARS-NAGP*, *Ft Collins, CO*, [2]*Purdue University*, *West Lafayette, IN*.

A primary component of genetic conservation of livestock species is the development of cryopreserved collections. Approaches to prioritizing breeds for conservation and entry into gene banks have been developed; but little attention has been given to determining how to select individuals within a breed. We addressed this issue by utilizing breed association pedigree records for Hampshire, Yorkshire and Duroc breeds. From these records genetic relationships were computed and utilized in a cluster analysis. The Ward Method of clustering, from SAS, was selected after testing several different approaches. For all breeds approximately 2,800 young boars were clustered, litter mates were excluded from the analysis. The pseudo t-test was used to determine where significant breaks in the clusters occurred. In addition, a pre-determined collection target of 100 boars per breed had been set. Significant divisions in the clusters occurred when approximately 20 clusters had been formed. Once the number of clusters were determined, average relationships within and between clusters were computed and evaluated. Using the Yorkshire as an example, several approaches were evaluated for individual selection and compared to randomly selected boars (control). These approaches were: weighting the number of animals selected by the cluster size, and selecting 5 boars per cluster. Simulating selection for these three approaches resulted in average genetic relationships for the selected boars of: 0.08, 0.08, and 0.07 for control, weighted by cluster size and 5 boars/cluster. These results indicate the two approaches would enable the selection of individual boars for a gene bank with an average relationship at or below the population average.

Key Words: Genetic Conservation, Swine

T31 Association of a single nucleotide polymorphism in the leptin receptor gene with carcass and meat quality traits in beef cattle. F. Schenkel*[1], S. Miller[1], S. Moore[2], C. Li[2], A. Fu[2], S. Lobo[2], I. Mandell[1], and J. Wilton[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*University of Alberta*, *Edmonton, Ontario, Canada*.

The leptin receptor gene (LEPR) produces a high affinity receptor that mediates the regulation of the leptin gene, which has been implicated in the control of feed intake and body composition of mammals. This study investigated the association of genotypes for a single nucleotide polymorphism (SNP) in exon 20 of LEPR (Liefers et al. 2004. Animal Genetics 35: 138-141) with carcass and meat quality traits in beef cattle. The LEPR SNP was genotyped on a total of 800 heifers, steers, and bulls from commercial herds (399) and from the University of Guelph breeding project (401). These same animals were also genotyped for 4 SNP in the leptin gene (S1, S2, E2JW and E2FB) whose effects were previously reported. Animals were crossbreds with breed composition mainly formed by Angus, Limousin, Charolais, and Simmental. The measured carcass traits included fat (Fatyl), lean (Leanyl) and bone yield (by 4-rib dissection), grade fat (Gfat), longissimus dorsi muscle (LM) area, and hot carcass weight (Hcw). Meat quality traits included quality grade, LM intramuscular fat, tenderness evaluation (Warner-Bratzler shear force) of LM at 2, 7, 14 and 21 days postmortem, and tenderness evaluation of semitendinosus muscle at 7 days postmortem. A univariate mixed inheritance animal model (SNP genotypes for LEPR and leptin gene + polygenic effects) was used to evaluate the association of the LEPR SNP genotypes with the traits. The model also included the effects of sex, slaughter group, and breed composition. Association of LEPR polymorphism with Fatyl (P=0.03) and Gfat (P=0.005) was found, as well as a trend for association with Leanyl (P=0.09) and Hcw (P=0.06). The heterozygote genotype CT decreased Fatyl and Gfat by 0.24 and 0.33 phenotypic SD and tended to increase Leanyl and Hcw by 0.21 and 0.20 phenotypic SD, respectively, compared to CC. The T allele, however, was quite rare in the population (4.1%). Only two TT genotypes were observed. Hence, the LEPR SNP was associated with fat yield and subcutaneous fat, but not with intramuscular fat, and tended to show association with lean yield and hot carcass weight.

Key Words: Beef Cattle, Carcass Traits, Leptin Receptor Gene

T32 Fat deposition in Angus cattle and its relation to animal age and body weight measures. A. Hassen*, D. E. Wilson, G. H. Rouse, R. G. Tait, Jr., and J. M. Reecy, *Iowa State University*, *Ames*.

The objective of the current study was to evaluate the relative influences of animal age and body weight measures on the rate of external and intramuscular fat deposition in young Angus bulls and heifers fed a medium energy diet. This study used data from 1,112 purebred Angus bulls and heifers born during 1998 and 2003 at the Rhodes beef research farm. Animals were ultrasonically scanned four to six times for 12-13th rib fat thickness (BKF), rump fat thickness (RMF), percentage of intramuscular fat (PFAT), and longissimus muscle area (LMA). Body weight (WT) and hip height (HT) measures were also recorded. Pooled data were analyzed using mixed linear models and allowing test of varying covariance structures for the between and within individual animal measures. There was a significant ($P < .05$) effect of sex on PFAT and BKF deposition. In addition, covariates of age and WT showed important ($P<.05$) influence on both traits. Plots of predicted PFAT trends showed that intramuscular fat deposition is more influenced by age than WT. At a constant mean WT of 382 kg, predicted PFAT values of bulls ranged from 2.68 % (age = 26 weeks) to 4.11 % (age = 64 weeks). Heifer PFAT values for the same range of ages increased by 3.55 % from the initial value of 3.00 % at 26 weeks. However, at a constant mean age of 46 weeks, the increase in PFAT values of bulls and heifers due to changes in WT (200 to 700 kg) was only 1.00%. External fat deposition was more associated with WT than age at measurement. At a constant mean age of 46 weeks, predicted BKF values of bulls increased from 0.18 cm (WT = 200 kg) to 1.27 cm (WT = 700 kg). The corresponding change for heifers was from 0.27 cm to 1.93 cm. At a constant weight of 382 kg, BKF measures of bulls and heifers showed no apparent change for ages ranging from 26 to 64 weeks. The present results confirm the suggestion that PFAT measures should be adjusted for age differences while yearling BKF measures need to be adjusted to a 365-day weight basis.

Key Words: Ultrasound, Beef Cattle, Body Composition

T33 Estimation of genetic parameters for image analysis traits on *M. longissimus dorsi* and *M. trapezius* of carcass cross section in Japanese Black steers. T. Osawa*[1], Y. Motohira[1], T. Sewaki[1], Y. Hirayama[1], K. Okamoto[1], K. Kuchida[1], and T. Kato[2], [1]*Obihiro University of Agriculture and Veterinary Medicine*, *Obihiro-shi, Hokkaido, Japan*, [2]*Tokachi Federation of Agricultural Cooperative*, *Obihiro-shi, Hokkaido, Japan*.

In Japan, *M. longissimus dorsi* (rib eye) has been evaluated in the beef meat grading process. However, size, shape and degree of marbling in other areas of muscle have also been important in determining the meat quality and carcass value. The purpose of this study was to estimate genetic parameters for the rib eye and *M. trapezius* of Japanese Black steers by computer image analysis. Digital images of the carcass cross section were taken between the 6-7th rib by photographing equipment. The numbers of records of Japanese Black steers and pedigree records were 2,418 and 9,293, respectively. Area, fat area ratio, overall coarseness of marbling and coarseness of the largest marbling particle in the rib eye and *M. trapezius* were calculated by image analysis. The ratio of minor and major axes for rib eye and the complexity of rib eye shape were also calculated. Genetic parameters for these traits were estimated with REMLF90 program using an animal model. Year-season and age at shipping as fixed effects and fattening farm and animal genetic effects as random effects were included in the model. For rib eye, heritability estimates were 0.42, 0.65, 0.49,

0.38 and 0.21 for area, fat area ratio, overall coarseness of marbling, minor and major axis ratio, and complexity of rib eye shape, respectively. For *M. trapezius*, heritability estimates were 0.41, 0.65 and 0.53 for area, fat area ratio and overall coarseness of marbling, respectively. Genetic correlation coefficients between subcutaneous fat thickness and fat area ratio for the rib eye and for *M. trapezius* were -0.18 and -0.16, respectively. Genetic correlation coefficients between rib eye and *M. trapezius* were 0.31, 0.58, 0.48 and 0.40 for area, fat area ratio, overall coarseness of marbling and coarseness of the largest marbling particle, respectively.

Key Words: Japanese Black, Image Analysis, Genetic Parameters

T34 Beef carcass characteristics and sex hormone levels in the longissimus dorsi and adipose tissue in Hanwoo. Y. H. Choy*[2], O. S. Han[1], S. K. Son[2], C. W. Lee[2], and M. G. Baik[1], [1]*Chonnam University*, *Kwangju, Republic of Korea*, [2]*National Livestock Research Institute*, *Suwon, Republic of Korea*.

Concentrations of sex hormones and their receptor gene expression levels in terms of mRNA's were analyzed to find out their relationship with carcass characteristics of Hanwoo especially the marbling scores (intra-muscular fat levels) and the effects of sexes on those characteristics. To take the loin eye samples for hormonal and gene expression analyses, carcasses of 10 steers, 10 bulls and 16 cows were taken from Namwon and Daekwanryung branches of National Livestock Research Institute, Korea. Correlation coefficients between marbling scores and crude fat contents in the rib eye were estimated to be around 0.7. Sex effect was a significant source of variation for estrogenic sex hormones in both muscle and adipose tissues while marbling was a significant source of variation for both estrogenic and androgenic sex hormone levels. Residual correlations showed that there were positive relationship between marbling scores and shear force or moisture content and negative relationship between marbling scores and cooking loss. Marbling scores were also positively correlated with pH or with water holding capacity. Significant positive relationships with estimated breeding values of body and carcass weights at slaughter or with rib eye area were found in the expression levels of androgen receptor genes. And estrogen receptor gene expression level in adipose tissues was positively and significantly related with marbling scores (r=0.61) in the loin eye area.

Acknowledgements: This research was funded by ARPC, Korea from Oct. 2002 to Oct. 2004.

Key Words: Hanwoo, Carcass, Sex Hormone

T35 Factors associated with ELISA likelihood s/p ratio scores for paratuberculosis in an Angus-Brahman multibreed herd of beef cattle. M. Elzo*, D. Rae, S. Lanhart, J. Wasdin, P. Dixon, and J. Jones, *University of Florida*, *Gainesville*.

Paratuberculosis is a chronic disease of ruminants that causes considerable economic losses in beef and dairy cattle due to diminished production and eventually death. The objective of this study was to identify factors that are associated with antibody response to the ELISA test in three year old and older cows from an Angus-Brahman multibreed herd. Blood samples were drawn from dams at the end of May each year. Outcomes of the ELISA test were represented by sample to standardized positive control (s/p) ratios. Data came from 245 dams and 359 calves born in the spring of 2003 and 2004. The mixed model included: 1) the fixed subclass effects of year and age of dam (3, 4, and 5 years and older), 2) the fixed regression effects of fraction of Angus (FA), dam heterosis (DH), birth weight of calf (BW), calf gain between birth and the date of the blood sample of their dams (CG), age of calf at date of dam blood sample (CA), dam change in weight between her last weight the previous year (late November) and her weight on the date of the blood sample (DG), dam condition score on the date of the blood sample (DS), and days pregnant at palpation (DP), and 3) the random effects of dam and residual. Dams were assumed to be unrelated. Procedure MIXED of SAS was used to carry out computations. Among subclass fixed effects, only year was important ($P < 0.001$). Assuming that the s/p ratio scores were a reflection of the impact of paratuberculosis on dams in this herd, estimates of fixed regression effects suggest that: 1) Brahman dams were more affected than Angus dams (FA = -0.610; $P < 0.013$), 2) sub-clinical paratuberculosis negatively affected calf birth weight (BW = -0.021; $P < 0.021$), pre-weaning calf gains (CG = -0.008; $P < 0.002$), and changes in dam weight between November and May of the following year (DG = -0.006; $P < 0.002$), and 3) dams that calved earlier in the season were more affected (CA = 0.005; $P < 0.043$). Variation due to dams yielded a repeatability estimate of 0.34 (SE = 0.01).

Key Words: Beef Cattle, ELISA, Paratuberculosis

T36 Differential effects of dietary phosphorus levels on gene expression in two lines of pigs. L. Grapes*, A. Qu, L. Hittmeier, M. Rothschild, and C. Stahl, *Iowa State University*, *Ames*.

Despite the cost of phosphorous (P) supplementation in porcine diets, as well as public concern about the environmental effects of P in excreta, little research has focused on the genetic mechanisms controlling P utilization in pigs. Microarray analysis was conducted to explore the effects of dietary P levels on gene expression in pigs from two sire lines primarily selected for either growth performance or meat quality. Thirty-six total gilts (initial body weight 6.63 ± 0.78 kg) were allotted to a P adequate, P deficient or P repletion dietary treatment for two weeks. At the completion of the trial, liver and muscle RNA samples were obtained for microarray analysis using oligonucleotide arrays containing over 13,000 unique genes. The microarray study involved a loop design with all pair-wise treatment comparisons performed within litter. Mixed-model analysis was performed on normalized signal intensity data and included the fixed effects of sire line, dietary treatment and sire line by dietary treatment interaction. Significant changes in gene expression ($P<0.01$) in liver and muscle were found between sire lines (103 and 339 genes, respectively), dietary treatments (122 and 18 genes, respectively), and for the interaction of sire line by dietary treatment (88 and 31 genes respectively). Few genes differentially expressed in liver were also found to be differentially expressed in muscle. The large number of genes differentially expressed between sire lines in muscle as compared to liver may be related to inherent differences due to the selection goal for each line. For all combinations of sire line by dietary treatment, genes shown to have differential expression by microarray analysis have been validated using real-time quantitative PCR. Many of these genes are involved in energy metabolism and signal transduction. These results are a first step towards enhancing our understanding of P metabolism and eventually identifying pigs, based upon their genetics, that tolerate low dietary P levels while maintaining growth.

Acknowledgements: This research was funded in part by Sygen International, the Office of Biotechnology at Iowa State University and the IAHEES.

Key Words: Phosphorous, Gene Expression, Microarray

T37 Estimation of genetic parameters in Korean swine populations. S.-H. Oh*[1], D. H. Lee[2], and M. T. See[1], [1]*North Carolina State University*, *Raleigh*, [2]*Hankyong National University*, *Ansung, Kyeonggi-Do, Korea*.

The objective of this study was to estimate genetic parameters among reproductive and post weaning traits in swine. Reproductive traits analyzed included total pigs born (TB), number of pigs born alive (NBA), number of pigs weaned (NW), and litter weaning weight (LWT) for first parity females. Post weaning traits included average daily gain (ADG), backfat depth (BF) and loin muscle area (LMA). Numbers of records were 385 for TB, NBA, NW, ADG, BF, and LMA and 333 for LWT. Genetic parameters were estimated using the MTDFREML software program. The statistical model for reproductive traits included fixed effects of year-season(17), breed of sow(3), mate breed(3), and age(5) and random effect of animal(2,368). For NW and LWT, age at weaning was also included as a covariate. For post weaning traits the statistical model included fixed effects of year-season, breed, sex, parity of dam, age off test and weight off test and random effect of animal. Heritability estimates for TB, NBA, NW, LWT, ADG, BF, and LMA were 0.12, 0.16, 0.14, 0.07, 0.33, 0.49, and 0.18, respectively. High to moderate genetic correlations were observed be-

tween traits for number of pigs from first parity females (TB-NBA, 0.97; TB-NW, 0.40; NBA-NW, 0.61). Litter weight at weaning for first parity females showed low genetic correlations with TB, NBA and NW of 0.03, 0.09 and 0.00, respectively. Genetic correlations between ADG and BF and LMA were -0.03 and 0.13, respectively. The genetic correlation between BF and LMA was 0.06.

Key Words: Pigs, Heritability, Genetic Correlation

T38 Selection intensity for yield traits, somatic cell score, and days open when culling dairy cows. H. D. Norman*, J. L. Hutchison, M. T. Kuhn, J. R. Wright, and E. Hare, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.*

Traits emphasized when culling cows from the herd should be similar to those considered when selecting bulls for matings. Emphasis given by dairy producers to different yield and fitness traits when culling cows was documented, and trends since 1980 were determined. Least-square estimates for survivor groups provided first-parity differences for milk, fat, and protein yields; somatic cell score (SCS); and days open (DO) between cows that calved for additional lactations and those that were culled. Trait differences also were expressed on a standardized basis by dividing the least-square estimate by the phenotypic standard deviation for the trait. Cows with 2, 3, or ≥4 parities had an advantage of 900 to 1100 kg of first-parity milk over those culled before second parity; only a small advantage was found for cows with ≥3 parities compared with those with 2. Superiority of cows kept in recent years to culled cows has declined considerably, not only for milk yield but for fat and protein yields, SCS, and DO. On a standardized basis, the most intense selection from 1980 to 1995 was for protein and milk yields (0.80 to 0.90); selection intensity was lower for fat yield (0.54 to 0.75), SCS (0.29 to 0.53), and DO (0.29 to 0.45). Cows that survived ≥2 parities had lower first-parity SCS than those with only 1 parity. Likewise, those with ≥3 parities had lower first-parity SCS than those with only 2 parities, and those with ≥4 had lower SCS than those with only 3. Cows with only 2 parities had the highest mean DO during first parity followed by those with only 3, those with ≥4, and those with only 1; those with only 1 parity had 20 to 27 fewer DO than those with ≥2 parities. Knowledge of which traits dairy producers emphasize in culling cows can assist artificial-insemination organizations in determining which traits should be emphasized when choosing young bulls and graduating progeny-test bulls.

Key Words: Culling, Selection, Yield

T39 Effects of complex vertebral malformation gene on production and reproduction. M. Kuhn*, J. Hutchison, and C. Van Tassell, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.*

Approximately 3 million records from about 1.7 million daughters of sires with known genotype for complex vertebral malformation (CVM) were used to estimate the effect of the CVM allele on lactational milk, fat, and protein yield, SCS, and days open (DO). The linear model for analysis included the fixed effects of herd-year-season, parity, age-at-calving, CVM status of sire, and the random effects of animal, permanent environment, and error. With random mating, the difference between carrier and homozygous normal bulls estimates the quantity (true effect)/[(q+1)*(q+2)] where q is the frequency of the CVM allele and true effect is the true difference between homozygous normal and carrier cows. Estimates of CVM gene frequency, based on random samples of the cow population, do not appear to be available. Thus, estimates from the linear model were doubled (corresponding to q = 0) which provides a lower limit for the estimate of the true effects. Using a gene frequency even as high as 0.1 had only a small effect on the estimates beyond doubling. For all traits, effects were minor. Lactational milk yield was 160 kg higher for carriers while lactational fat and protein were 4 and 5 kg higher, respectively, for cows from carrier sires. The difference in SCS between carriers and normals was only 0.03 and carriers averaged only 2 more DO than non-carriers. Given the lethal aspect of CVM, the small effect on DO may be a result of intentional avoidance of inbreeding which, to date, may have led to avoidance of most carrier x carrier matings. Also, most CVM calves may be carried to term in which case DO would not be affected by carrier x carrier matings. Elimination of the CVM allele from the population would have little direct detriment for performance traits. Exclusion of cows whose sires have unknown genotype, as done in this study, could lead to bias. Further research will ascertain the potential magnitude of such a bias and possible methods to correct for such a bias, if it exits.

Key Words: Complex Vertebral Malformation

T40 Allele effect for calf survival estimated for US Holstein Population. H. N. Schlesser*[1], R. D. Shanks[1], P. J. Berger[2], and M. H. Healey[2], [1]*University of Illinois, Urbana*, [2]*Iowa State University, Ames*.

A bimodal pattern of inheritance for calf survival was identified in sons of Holstein bulls. One explanation of this pattern of inheritance is an allele effect for bulls heterozygous for a quantitative trait loci affecting calf survival. Data on predicted transmitting ability for Perinatal Survival from the first parity daughter records of 8,678 sons of 599 sires were collected during 1984 through 1997 from The National Association of Animal Breeders calving ease database. Sixteen of the thirty-nine bulls with at least 50 sons were identified with a potential bimodal pattern of inheritance, using Proc KDE in SAS. Six of the sixteen bimodal bulls had a common sire. Three other pairs from the sixteen bimodal bulls were brothers. Truncation point to define two groups from the bimodal distribution of each bull was based on equating the coefficients of variation between the two groups. The average allele effect for each bull was half the difference between the low and high group. Allele effects ranged from .29 to .41 with average allele effect of .35 (standard error of .03). An average allele effect represented just over one-third of a percent change in calf survival. Allele frequencies were estimated based on a one locus model with two alleles corresponding to 16 AA, 16 Aa and 7 aa bulls. The frequency of A for greater survival was .62, and the allele frequency of a for less survival was .38. Variation is sufficient to allow selection to move the average percent calf survival. Unfortunately, the bimodal bulls are younger than most of the other bulls suggesting that calf survival may be declining.

Key Words: Perinatal Survival, Allele Effect, Dairy Bulls

T41 Applying restricted maximum likelihood and bayesian methods to estimate variance components for milk yield in Brazil. A. Falcão*[1], E. Martins[2], C. Costa[3], E. Sakaguti[2], and J. Mazucheli[2], [1]*Pontifical Catholic University, Toledo, PR, Brazil*, [2]*Maringá State University, Maringá, PR, Brazil*, [3]*Brazilian Agricultural Research Corporation, Dairy Cattle, Juiz de Fora, MG, Brazil*.

Variance components for milk yield were estimated by REML and bayesian via Gibbs sampling (GS), using 40727 lactations of Holsteins cows, calving from 1981 to 1993 in 322 herds of Paraná state in Brazil. An animal model was applied and included the effects of herd-year, parity (five), genetics groups (PO and 31/32), and effects additive and permanent enviroment. There was no evidence of lack of convergence of the GS. Estimates and standard deviations of heritability using REML and GS were 0.26±0.001 and 0.28 ±0.014. Gibbs sampler allowed calculation point estiamtes and confidence interval.

Variance components and heritability and standard errors to milk yield, estimated using bayesian and REML methods

Method/Variance	Additive	Permanent	Residual	Phenotipic	Heritability
Bayesiano	355.1±20.2	257.2±16.4	663.3±7.5	1276±11.0	0.28±0.014
REML	331.6	268.2	664.8	1265.0	0.26±0.001

1 figures divided per 1000

Key Words: Dairy Cattle, Markov Chain, Variance Components

T42 The survey of Sistani cows dairy characteristics in rural production conditions. M. R. Birjandi*, *Agricultural and Natural Research Resources Center of Khorasan*, *Mashhad, Khorasan, Iran*.

The Sistani cattle is one of the most popular humped (Bos indicus) Iranian cattle spread in the Southern-East regions of Iran. This breed, with a population of about 100,000, is well adapted to the extreme hot and dry environmental conditions of the region and plays a major role in the country›s animal production. Two hundred and seventeen Sistani cows from 209 rural farms with similar production conditions were studied for one lactation period. Traits measured included total lactation yield, milk yield to 180 days, daily milk yield, amount of milk consumed by the calf, fat percentage, protein percentage, lactose percentage, total solid non-fat (SNF) percentage, total solid (TS) percentage, lactation length, days dry, calving interval, age at first calving, days open, peak yield, days to peak and weaning age. The effect of parity, calf feeding type, sex of the calf, calving season, management and lactation length were tested on the traits using the model: Yijklmn = μ +Pi + Nj + Sk + Gl + Mm + Ln + NS(jk) + eijklmn in which Yijklmn is the observation, μ is mean, Pi is parity, Nj is calf feeding type, Sk is calving season, Gl is sex of the calf, Mm is management, Ln is lactation length, NS(jk) is feeding x calving season and eijklmn is the error.There were strong positive correlations ($p < 0.01$) between daily milk yield and lactation length (0.91), daily milk yield and calf milk consumption (0.77), Lactation yield and calf milk consumption (0.87), calving interval and days dry (0.70) and calving interval and days open (0.96). Lactation length and sex of the calf had significant effects on days to peak ($p< 0.05$). Lactation length also affected milk yield ($p < 0.01$), milk yield to 180 days ($p < 0.05$) and SNP % ($p < 0.01$). The interaction between calving season and feeding type was also significant ($p < 0.01$).The Relatively high coefficients of variations for many traits indicate potential for improvement by selective breeding within the population. This is important for the sustainable conservation-production of the Sistani population, given the danger of being crossed and (or) upgraded to exotic breeds for economical reasons.

Key Words: Sistani Cows, Dairy Characteristics, Rural Condition

T43 Crossbreed dairy cattle production in the tropical area in Bolivia. J. A. C. Pereira*[1], J. S. Romero[1], Z. B. Johnson[2], D. W. Kellogg[2], and A. H. Brown[2], [1]*Gabriel Rene Moreno University*, *Santa Cruz, Bolivia*, [2]*University of Arkansas*, *Fayetteville*.

The objective of this study was to determine the effects of birth (B), grade of crossing (G), calving season (S), parity (P) and its interactions on milk production, length of lactation, age at first calving and calving interval on different grades of Holstein (H), Zebu (Z) and Criollo (C) crosses in the tropical area of Bolivia. Records of 906 lactations of 356 cows collected from 1988 to 1999 were analyzed. The management of both systems of crossing (H x Z and H x C) was semi intensive: grazing with supplementation according to the level of production. The statistic analysis was performed independently for both crossing systems using the GLM procedure of SAS. The results determined that B, G, S and P have an influence ($P< 0.05$) for all the traits involved. The range of milk production (Standard Error in parenthesis) in 305 days of milking was 2870.1 (±121.1) to 3135.9 (±78.2) kg of milk yield for H x Z crosses and 3672.2 (±107.1) to 3920.8 (±64.3) kg of milk yield for H x C crosses. In the H x Z crosses significant differences ($P< 0.01$) were found for S and for the G X S interaction especially in the F1 animals. The study showed that the introduction of genes of specialized breeds increases significantly the milk yield production, and reproductive parameters were managed among acceptable ranges in tropical areas.

Key Words: Tropical, Crossbreeding Cattle

T44 Mature equivalent protein yield in daughters of Holstein sires selected for high and average fat plus protein yield. P. J. Berger, M. H. Healey, G. A. Gutierrez*, and A. E. Freeman, *Iowa State University*, *Ames*.

The objective of this analysis was to compare mature equivalent protein yield between two long-term selection lines. Sires were selected for high or average PTA fat plus protein (1988-2002). Data for cows (n = 978) were restricted to less than 7 parities. We analyzed the data using two models. Model 1: fixed model in SAS PROC GLM, fixed effects were generation of sire, lines, year-month, parity, and the interaction of parity by lines. Model 2: repeated-record sire model in SAS PROC MIXED, fixed effects were lines, year-month and parity; and random effects were sire, cow within sire. Random effects of cows within sire were modeled assuming compound symmetry (co)variance structure. Model 1 showed differences ($P<0.001$) among levels of year-month, and parities. Model 2 showed differences ($P<0.001$) between lines, and among levels of parity. Least square means were 303 ± 3.9 kg and 323 ± 3.7 kg for average and high lines, respectively. Implication of this research is that selection for fat plus protein yield increased protein yield in the high line.

Key Words: Selection, Protein Yield

T45 Estimation of genetic parameters and breeding values for persistency of lactation in Japanese Holsteins. Y. Masuda* and M. Suzuki, *Obihiro University of A & VM*, *Obihiro, Hokkaido, Japan*.

The objective of this study was to calculate genetic parameters and breeding values for persistency of milk and fat yield in the first three lactations using a random regression test day model for dairy cattle in Japan. Data included 11,562,034 (6,010,320 and 2,977,116) test day records from 1,149,474 (607,351 and 302,415) Holstein cows calving between 1975 and 2000 for 1st (2nd and 3rd) lactation. A single trait random regression model was employed for each lactation, and fourth order Legendre polynomial were fitted both animal genetic and permanent environmental effects. (Co)variance components were estimated with EM-REML using subsets sampled randomly from the whole data. Six different measures of persistency were investigated. Heritabilities and genetic correlations between persistency measures and 305-d yield were calculated as a function of (co)variances. Due to low genetic correlations of persistency with 305-d yield (-0.08 to 0.31) and due to high heritability (0.28 to 0.40) for both traits in all three lactations, the difference between test day yields at 60-d and 280-d was defined as persistency. Heritability estimates for persistency of milk (fat) in first lactation was 0.28 (0.24), lower than 0.36 and 0.40 (0.31 and 0.28) in two and three lactations. For bulls with more than 25 daughters, correlations between EBVs for persistency of milk and fat yields in the first three parities were 0.76, 0.86 and 0.87, respectively. Correlations between EBVs for those of milk (fat) in 1st-2nd, 1st-3rd and 2nd-3rd lactation were 0.59, 0.52 and 0.78 (0.54, 0.46 and 0.76), respectively. These results suggest that persistency of milk and fat yields can be improved genetically in Japan. Persistency in first parity may be a different trait from those in later lactations. Further studies should be conducted to investigate the genetic relationship by multiple trait analyses.

Key Words: Persistency, Genetic Evaluation, Test Day Model

T46 Rapid determination of Swiss cheese composition by infrared spectroscopy. N. Koca*[1,2], W. J. Harper[2], L. Rodriguez-Saona[2], and V. B. Alvarez[2], [1]*Ege University*, *Izmir, Turkey*, [2]*The Ohio State University*, *Columbus*.

Current methods for analyzing cheese composition are time consuming, expensive and use hazardous chemicals. Infrared spectroscopy is an attractive technology for the rapid, inexpensive, sensitive, and high-throughput analysis of food components without requiring special skills from the users. The objective of this research was to develop a simple and rapid screening tool for monitoring Swiss cheese composition by using FT-IR spectroscopy. Swiss cheese (16) samples from eight different manufacturers were evaluated. Direct measurements of Swiss cheese slices (about 0.5g) were made by using a MIRacle three reflection diamond attenuated total reflectance (ATR) accessory. Reference methods for moisture (vacuum oven), protein (Kjeldahl) and fat (Babcock) contents were used. Calibration models were developed based on a cross-validated (leave-one-out approach) Partial Least Squares (PLS) regression. The information-rich infrared spectral range for Swiss cheese samples was from 3000-2800 cm^{-1} and 1800-900 cm^{-1}. The range of 1800-900 cm^{-1} was used to develop calibration models for moisture and protein with performance statistics of 0.58% and 0.32% standard error of prediction (SEP), respectively and the correlation coefficients (R^2) were 0.96 and 0.92, respectively. Models for fat were generated by using all the information-rich spectral range and provided performance statistics of 0.35% SEP and R^2 of 0.97. FT-IR/ATR spectroscopy allowed for the rapid (about 3 min analysis time) and accurate analysis of composition of Swiss cheeses. This technique could contribute to the development of simple and rapid protocols for monitoring the complex chemical changes and predicting the final quality of the cheeses.

Key Words: Infrared Spectroscopy, Composition, Cheese

T47 Development of a combined sensor technology for monitoring coagulation and syneresis operations in cheese making. M. Castillo*, F. Payne, and A. Shea, *University of Kentucky*, *Lexington*.

The cheese making industry is a very important segment of the US agriculture and produces approximately 25% of world cheese production at an economic value of approximately $19 billion. Forming a gel, cutting that gel into cubes and stirring the mix of curd grains and whey to allow syneresis to occur are the first major unit operations in the cheese making process and exert a very significant impact on cheese quality. Indeed, it is well-known that milk composition and coagulation factors affect coagulation and gel properties, which ultimately have a decisive effect on curd firming and thus on syneresis properties of gels. There are several optical sensor technologies for monitoring milk coagulation based on either light backscatter or transmission, but unfortunately there are currently no technologies available for monitoring curd syneresis. The goal of this study is to develop an optical sensor technology for simultaneous monitoring of coagulation and syneresis operations to improve the control of curd moisture content during cheese making. We hypothesized that a light backscatter sensor having a large field of view relative to the curd size would accurately measure syneresis, and might hold the ability to monitor the coagulation too. A prototype sensor was fabricated and tested using a dual fiber optic spectrometer. The prototype signal increased by a 29% during coagulation and decreased by a 40% during syneresis. The proposed technology shows potential for monitoring changes in light backscatter during coagulation and syneresis. However, results suggest that the prototype must be redesigned to reduce the signal to noise ratio, especially during the first minutes of syneresis. Successful development of a sensor technology that is able to control curd moisture content will have a large impact on cheese manufacturing worldwide in terms of production efficiency and product quality and consistency.

Acknowledgements: This research was supported by the Kentucky Science and Engineering Foundation grant KSEF-407-RDE-004.

Key Words: Optical Sensor, Milk Coagulation, Syneresis

T48 Effect of the pH on the proteolysis of Prato cheese during ripening. V. S. Monteiro, R. T. A. N. Risse, and M. L. Gigante*, *State University of Campinas*, *Campinas, SP, Brazil*.

Although pH is an essential parameter characterizing the identity and quality of cheeses it is difficult to segregate its effect from the effect of pH-induced changes during cheese making. One way to overcome this difficulty is to change the pH after the cheese is manufactured. The objective of this study was to evaluate the effect of pH on the proteolysis of Prato cheese using a post-manufacture pH change method. Prato cheese was manufactured by the traditional method and one day after manufacture, the cheeses were shredded and mixed together so as to obtain a homogeneous sample, which was subsequently divided into 3 equal portions. The first portion was exposed to ammonium hydroxide for 5 minutes to raise the pH; the second portion was exposed to acetic acid lower the pH and the third portion was used as the control. Immediately after the pH alteration, portions of cheese were vacuum packed and stored at 12±1°C. To evaluate the effect of pH on proteolysis, randomly selected samples were analysed after 1, 8, 15, 22, 29, 44 and 58 days of storage for total nitrogen, soluble nitrogen at pH 4.6 and in 12% TCA and electrophoretic profile. The experimental design used was a split-plot arrangement of treatments in a randomised complete block of three replications. Pearson's correlation test was used to assess the correlation between pH and the other variables. The treatments had a significant impact on the pH of the cheese and generated three distinct pH groups: control (4.99±0.05), high pH (5.7±0.1) and low pH (4.79±0.08). The interaction between treatments and ripening time had a significant effect on proteolysis, increasing with time, but to a lesser extent in the low pH group of cheeses. Electrophoresis showed that the degradation of α_{s1} and β-caseins occurred at a slower rate and less extensively at the low pH. An analysis by Pearson's correlation showed that there was no significant association between pH and proteolysis. The effect of pH on proteolysis depends on storage time.

Key Words: Prato Cheese, pH, Proteolysis

T49 Effect of NaCl and pH on curd firmness, residual coagulant activity and chemical composition of soft white cheese. S. Awad*, *Alexandria University*, *Alexandria, Egypt*.

Domiati is the most popular soft white cheese produced in Egypt. This cheese is made from salted milk (8-15% NaCl). The high salinity level of whey obtained during Domiati cheese manufacture makes its disposal a problem. Characteristics of cheese made from unsalted milk has not been studied. The objectives of this work were a. to study the effect of sodium chloride concentration and pH of milk at renneting on the rennet clotting time (RCT) and curd firmness, and b. to study effect of milk salting on residual coagulant activity, expressible serum and chemical composition of cheese. The results showed that rennet clotting activity and curd firmness decreased with increasing NaCl concentration in milk. The RCT increased as the pH of the salted milk decreased. Milk containing 10 % NaCl did not coagulate at pH 5.0. The curd firmness increased with decreasing milk pH. However, the firmness decreased as the pH of milk at renneting dropped below 5.8. Cheese moisture and soluble proteins in expressible serum were lower in cheese made from unsalted milk than in that made from salted milk. Pre-acidification with citric acid increased the moisture content in cheese and reduced the amount of expressible serum. Cheese made from salted milk contained the lowest activity of residual coagulant, while cheese made from milk pre-acidified with citric acid contained the highest activity. In conclusion, Domiati cheese made from unsalted milk was much firmer than that produced from salted milk. Preacidification of unsalted milk reduced firmness and produced cheese with characteristics comparable to those of cheese made from salted milk.

Key Words: Soft White Cheese, Sodium Chloride, Residual Coagulant Activity

T50 The effect of calcium removal from milk on casein micelle stability and structure. H. Grimley*, A. Grandison, and M. Lewis, *The University of Reading*, *Reading, UK*.

Milk contains approximately 30 mM total calcium, but only about 5% of this is present as ionic calcium. Changing the amount of calcium in milk can influence its stability and structure. In this study calcium was removed from raw skimmed milk at levels of 10, 19, 29, 40 and 51% of total calcium using an ion exchange resin. During ion exchange, calcium must be removed from the micelle, before being converted to ionic calcium prior to its removal by the resin. After removal, ionic calcium, sodium and potassium were measured along with pH, ethanol stability, micelle size and zeta potential. Ionic calcium decreased with removal of calcium and pH increased. Calcium removal resulted in an increase in the ethanol stability from 88% to above 100%. Measurement of casein micelle size showed that the average micelle diameter increased as calcium was removed, from 198 nm to 213, 230, 254, 323 and 420 nm with 10, 19, 29, 40 and 51% total calcium removal, respectively. The zeta potential of the skimmed bulk milk was -24.4 mV, gradually becoming more negative with calcium removal to -30.6 mV for the sample with 51% calcium removal. The appearance of the milk became more translucent as calcium was removed.

To investigate the reversibility of this process, calcium was added back to each of the samples, as concentrated $CaCl_2$, to restore their original total calcium content. At 51% removal, restoration of the total calcium level resulted in formation of clots. At levels of 10 and 19% calcium removal the ethanol stability remained above 100%, but at higher levels of calcium removal the alcohol stability was reduced when the calcium was added back. Adding back calcium resulted in some restoration of the original casein micelle size. Where the micelle size was increased greatly, due to high removal of calcium, the addition of calcium reduced the micelle size but did not restore it to the original size. These results suggest that calcium plays a pivotal role in the stability of milk and reincorporating calcium into the micelle is not straightforward.

T51 A review of the models for the structure of the casein micelle. E. Ferrandini[1], M. Castillo*[2,1], M. B. López[1], and J. Laencina[1], [1]*University of Murcia*, *Murcia, Spain*, [2]*University of Kentucky*, *Lexington*.

Casein micelles have been defined by Dalgleish as the association colloid in fresh milk. They consist of four types of aggregated casein combined with significant amount of colloidal calcium phosphate (CCP). It is widely accepted that casein micelles are sterically stabilized by an external hairy layer of κ-casein. The fact that casein micelles constitute a very stable colloidal system, as compared to almost any other synthetic colloidal system, has significant implications especially with regard to casein gel formation and stability of dairy products during heating, concentration and storage. For that reason, the structure of the casein micelle has been intensively investigated during the last five decades. However, specific questions about micelle structure and stability are still arising as new instrumental methodologies become available. This work reviews the current state of knowledge of the casein micelle structure. Traditionally, casein micelle models have been classified in three different groups: coat-core models, internal structure models, and subunits models. The subunit models have become widely accepted, probably because the existence of submicelles has been supported by different techniques: casein dissociation, formation of submicelles from sodium caseinate and subsequent polymerization in presence of calcium, microscopic observation of submicelles, small-angle neutron scattering measurements and ultrasonic spectroscopy. However, several studies by Holt have made the existence of submicelles doubtful. This controversy is stimulating the apparition of alternative models such as the model based in CCP nanoclusters proposed by Holt, the dual-binding model proposed by Horne, and a modified submicellar model proposed by Walstra. New studies based on field emission scanning electron microscopy have shown no evidence of the presence of either micellar coating or spherical subunits, but have shown evidence for the organization of caseins into tubular structures within the micelles. The new models might improve our knowledge about the technological and functional properties of casein micelles, enhancing the development of novel structures and textures in foodstuffs.

Key Words: Casein, Micelle, Structure

T52 Porcine milk proteins throughout lactation and isolation of lactoferrin and immunoglobulin. J. Gunness*[1], M. Monaco[1], B. Lonnerdal[2], and S. Donovan[1], [1]*University of Illinois*, *Urbana*, [2]*University of California*, *Davis*.

The piglet is commonly used to assess the impact of milk-borne components on neonatal development. Whey proteins exert functional roles within the neonate, but have not been extensively studied in the pig. Our goals were to develop methods to isolate porcine whey proteins and to characterize the protein content and composition of porcine milk throughout lactation. Milk samples were collected from sows (n=3) at farrowing (0 h), 12 h and d 1-4, 7, 14, 18, 21 and 24 postpartum. To separate porcine whey and casein proteins, whole milk was pH-adjusted to 4.0, 4.3 or 4.6 or left unadjusted (6.5) and centrifuged at 40,000xg or 190,000xg. Whole milk, whey and casein pellets were compared by SDS-PAGE. The pH 4.3 and 40,000xg treatment produced the best separation of porcine whey and casein proteins. Proteins in whole porcine milk and whey were visualized throughout lactation by SDS-PAGE and compared to purified milk proteins. Bands of similar molecular weight as IgG, lactoferrin, α-lactalbumin, β-lactoglobulin and α, β and κ-casein were visualized in porcine milk. The density of IgG bands decreased with lactation, while casein increased from colostrum (0-24h) to mature milk (>24h). Whey protein and IgA and IgG were measured by Lowry protein and ELISA, respectively. Colostral protein (15.9 ± 0.8 g/dL) was 3-fold higher ($p<0.001$) than mature milk (5.1 ± 0.2 g/dL). IgG decreased 100-fold ($p<0.001$) from colostrum to mature milk and accounted for 80% and 2.3% of total whey protein, respectively. IgA was highest at farrowing (0.5 ± 0.02 g/dL), decreased 50% ($p<0.05$) within 12h, but rose again at d21 and d24 of lactation. Lastly, lactoferrin (Lf) was isolated from porcine whey by fast protein liquid chromatography using Heparin-Sepharose and IgG was isolated by affinity chromatography using Protein A. SDS-PAGE analysis of purified proteins and Lf- and IgG-depleted milk samples demonstrated quantitative isolation of high purity milk proteins. Thus, methods established for human and bovine milks were optimized for porcine milk, which will enable future studies directed towards assessing bioactivity of porcine milk proteins.

Key Words: Milk, Protein, Immunoglobulin

T53 Interactions of whey proteins during heat treatment of oil-in-water emulsions formed with whey protein isolate and hydroxylated lecithin. A. Ye[2], H. Singh[2], and R. Jimenez-Flores*[1], [1]*California Polytechnic State University, DPTC.*, *San Luis Obispo*, [2]*Riddet Crntre, Massey University.*, *Palmerston North, New Zealand*.

The interactions of proteins during the heat treatment of whey-protein-isolate (WPI)-based oil-in-water emulsions with and without added hydroxylated lecithin were studied by examining the changes in droplet size distribution and the quantity and type of adsorbed and unadsorbed proteins. Heat treatment at 90°C of WPI emulsions resulted in an increase in total adsorbed protein; unadsorbed β-lactoglobulin (β-LG) was the main protein interacting with the adsorbed proteins during the first 10 min of heating, but, after this time, unadsorbed α-lactalbumin (α-LA) also associated with the adsorbed protein. In emulsions containing hydroxylated lecithin, the increase in total adsorbed protein during heat treatment was much lower and the unadsorbed β-LG did not appear to interact with the adsorbed proteins during heating. However, the behavior of α-LA during heat treatment of these emulsions was similar to that observed in the emulsions containing no hydroxylated lecithin. In the presence of NaCl, the particle size of the emulsion droplets and the quantities of adsorbed protein increased markedly during heating. Emulsions containing hydroxylated lecithin were less sensitive to addition of NaCl. These results suggest that the binding of hydroxylated lecithin to unfolded monomers or intermediate products of β-LG reduces the extent of heat-induced aggregation of β-LG and consequently decreases the interactions between unadsorbed β-LG and adsorbed protein. This was confirmed by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) of heated whey protein and hydroxylated lecithin solutions.

Key Words: Emulsions, Whey Proteins, Lecithin

T54 A novel two-dimentional gel electrophoresis for studing the cress-linking between β-Lactoglobulin and milk proteins. W. L. Chen*, M. T. Huang, and S. J. T. Mao, *National Chiao Tung University*, *Hsinchu, Taiwan*.

β-Lactoglobulin (LG) is one of the major protein moiety in milk. It forms aggregates from the heating in milk processing. The aggregation, however, may attenuate some physiological function such as binding to fatty acids and retinols. In addition to self aggregation, LG also conjugates with other milk proteins mediated by disulfide bond linkage. There have been no specific methods in separating and identifying the proteins cross-linked to LG using gel electrophoresis. In this study, we developed a novel 2D-SDS-polyacrylamide gel electrophoresis (PAGE). In the first dimension, sample was run without reducing reagent, after which time the gel with separated proteins was immersed in reducing reagent. The gel was then placed horizontally and run the second dimension. Under this condition, the aggregated proteins were reduced and dissociated from the LG and could be identified by a Western blot. This 2D-SDS-PAGE assay allows us to analyze cross-linkings between LG and other milk proteins. The results show that LG interacted with casein, lactalbumin, and BSA by disulfide bond linkage during the heating process. We also mixed LG and casein, lactalbumin, with BSA, and heated respectively, followed by analyzing 2D-gel. It confirms that LG associated with casein, lactalbumin, and BSA by thiol group upon the heating. Finally, the LG conjugates in heated milk were isolated from LG antibody affinity-column, the conjugated proteins contained casein, lactalbumin, and BSA. Thus, we conclude that the 2D-gel assay can be used for analyzing protein-protein interaction.

Acknowledgements: This work was supported by a grant 90-2313-B-009-001, 91-2313-B-009-001, 92-2313-B-009-002 and 93-2313-B-009-002 from the National Science Council (NSC) Taiwan, ROC.

Key Words: β-Lactoglobulin, Two-Dimentional Gel Eelectrophoresis, Cross-Linkings

T55 Concentration of polar MFGM lipids from buttermilk using supercritical carbon dioxide. A. Spence*[1,2], J. Yee[1], M. Qian[2], and R. Jimenez-Flores[1], [1]*California Polytechnic State Universtiy*, *San Luis Obispo*, [2]*Oregon State University*, *Corvalis*.

Buttermilk is a unique source of milk fat globule membrane (MFGM), a material that contains many complex lipids that function as nutritionally valuable components. Milk derived phospholipids not only function as integral components of the membrane, but have been shown to be involved with other biological processes, including cell regulation and development, cell to cell interactions, immune recognition, transmembrane signaling, and as cell receptors. Previous work has shown that polar MFGM lipids can be concentrated using a two-step method by microfiltration and supercritical fluid extraction (SFE) using CO2. We have optimized the SFE concentration process for efficient non-polar lipid extraction from buttermilk powder without compromising the remaining components. First, we evaluated pressure and temperature parameters using a general full factorial design. Three pressure levels (150, 250 and 350 bar) were evaluated with three temperature levels (40, 50 and 60°C). SFE treatments at 60°C show an increased whey protein Mr (relative molecular mass) indicating likelihood of lactosylation at higher temperatures. Optimal extraction conditions were 350 bar and 50°C at a flow rate of 20 g/min and three consecutive runs of 75 min. Second, we assessed an alternative to adsorbent addition; removable Teflon® beads are a suitable substitute to the addition of biosilicate materials. Third, we assessed modified CO2. Using a co-solvent can further concentrate or fractionate polar lipids. Isopropanol, ethanol and methanol at three concentrations (10%, 20%, and 50% w/w) displayed different extraction affinities for buttermilk lipids. Methanol showed the highest level of total lipid extraction at higher concentrations whereas at 20% concentration, ethanol and methanol had the highest level of polar lipid extraction. Little to no polar lipids was extracted using isopropanol or a 10% co-solvent concentration.

Key Words: Buttermilk, Supercritical Fuid, MFGM

T56 Quantitative determination of thermally derived volatile compounds in milk using solid-phase microextraction and gas chromatography. P. Vazquez-Landaverde*[1], G. Velazquez[1,2], J. Torres[1], and M. Qian[1], [1]*Oregon State University*, *Corvallis.*, [2]*Universidad Autonoma de Tamaulipas*, *Reynosa, Tamaulipas, Mexico.*

Many volatile compounds are generated during the heat processing of milk and their association to the development of cooked, stale and sulfurous notes have been reported. A headspace solid phase microextraction/gas chromatographic (HS-SPME/GC) technique for their quantitative analysis was developed in this study. The extraction temperature, time and sample weight were optimized using a randomized 2^3 central composite rotatable design with two central replicates and two replicates in each factorial point along with response surface methodology. High correlation coefficient calibration curves were obtained for twenty volatile compounds in milk using the standard addition technique and then used to quantify their concentration in raw, pasteurized and UHT milk samples with various fat contents. Concentrations of dimethyl disulfide, 2-hexanone, 2-heptanone, 2-nonanone, and 2-undecanone, 2-methylpropanal, 3-methylbutanal, heptanal, and decanal were present at much higher concentrations in UHT milk as compared to raw and pasteurized samples.

The concentration of volatiles in raw and pasteurized milk samples was not significantly different, except for dimethyl disulfide in raw and one of the pasteurized milk brands analyzed. Fat content had an effect on the concentration of volatiles in heat-processed milk, generally increasing with fat content.

Key Words: Milk, SPME, Heat

T57 Quantification of volatile sulfur compounds in milk by solid-phase microextraction and gas chromatography coupled to pulsed-flame photometric detection. P. Vazquez-Landaverde*[1], G. Velazquez[1,2], J. Torres[1], and M. Qian[1], [1]*Oregon State University*, *Corvallis*, [2]*Universidad Autonoma de Tamaulipas*, *Reynosa, Tamaulipas. Mexico.*

The sulfurous off-flavor generated during thermal processing of fluid milk affects the consumer sensory perception of milk. A wide variety of sulfur compounds have been identified as the responsible of this off-flavor; however, no quantification of these sulfur containing compounds has been reported due to their high reactivity and volatility. A headspace solid phase microextraction/gas chromatographic (HS-SPME/GC) technique coupled to a pulsed-flame photometric detector for their quantitative analysis in milk was developed in this study. Calibration curves with highly significant correlation

coefficients were obtained for seven sulfur-containing milk volatiles using the standard addition technique and then used to quantify their concentration in raw, pasteurized and UHT milk samples with various fat contents. All calibrated compounds were stable in the milk matrix and no artifact formation was observed. UHT milk contained significantly higher concentrations of hydrogen sulfide, carbon disulfide, dimethyl trisulfide, methanethiol and dimethyl sulfoxide when compared to raw and pasteurized milk with the two latter ones being the most abundant. The concentration of dimethyl sulfone was lower for the UHT 3% sample when compared to the raw and one of the pasteurized brands analyzed. Pasteurized samples had the same concentration of sulfur volatile compounds when compared to raw milk, except for carbon disulfide found at a higher concentration in one pasteurized brand. In UHT milk, the concentrations of hydrogen sulfide, methanethiol, dimethyl trisulfide, and dimethyl sulfoxide increased with fat content level.

Key Words: Milk, Sulfur, SPME

T58 Novel reporter molecule for the development of rapid assay probes. I. Surjawan*, H. Karacelik, S. Neelakantan, P. A. Crooks, and C. L. Hicks, *University of Kentucky*, *Lexington*.

A novel rapid assay reporter molecule (4-{[6-aminohexyl]-ethyl-amino}-2,3-dihydro-phthalazine-1, 4 dione) was prepared using a 5 step syntheses process.

The novel synthesis procedure placed the 6 amino hexyl group in the 4 position rather than the 3 position of the traditional 9 step syntheses procedure. Overall yield was 8% for the novel procedure compared 2% for the traditional method. The limit of detection (LOD) for the traditional probe and novel probe were determined by comparing fluorescent readings of the serially diluted probes (0.1, 1, 10, & 100 ppm) against those obtained from blank samples and establishing the minimum detectable level of each reporter molecule. The stock of each probe (100 ppm) was initially dissolved in DMSO (2 drops) and then adjusted to volume (2.0 ml) with 0.01 N phosphate buffer (pH 6.6). Each dilution of probe (2.5 ml) was placed in cuvette for fluorescent readings with excitation and emission wavelengths set at 360 and 430 nm, respectively. The means (n=5) of the highest fluorescent intensity for each diluted probes were recorded. The noise level of each diluted probe was determined by dividing the mean of the highest intensity by the average peak- to-peak distance for 60 sec. or RMS (n=54 fluorescent readings). Results showed that the LOD for the traditional and novel probes fell between 1.006 to 1.09 ppm. Thus the LOD for either probe would be approximately 1.1 ppm. Since no difference in sensitivity existed between the reporter molecules, all new rapid assay probes could be prepared utilizing the novel synthesis procedure.

Key Words: Rapid Assay Probe, Fluorescent, Limit of Detection

T59 Spectrophotometry and DSC correlate with fatty acid differences in milk fat crystallization behavior. L. Lassonde*[1], E. DePeters[2], and R. Jimenez-Flores[1], [1]*California Polytechnic State University, DPTC*, *San Luis Obispo*, [2]*University of California*, *Davis*.

The purpose of this study is to test if common methods used in food thermodynamic analysis can detect differences between samples when a single fatty acid component is altered. Butter and buttermilk samples taken from individual cows on high and low palmitic acid (C16:0) diets were received from UC Davis. Genotypic information from herd records was provided for each cow for the following genes, k-CN, β-LG, α-LA, DST, and DGAT to correlate with individual variation between samples. Samples were shipped to Cal Poly, DPTC for analysis. Milk fat crystallization studies were performed on the anhydrous milk fat, which was separated from the serum fraction by melting the butter, then centrifuging. Isothermal turbidimetric absorbance was measured on melted (60°C) anhydrous milk fat (AMF) at 610nm. Measurements were taken in 30s intervals until nucleation occurred. Of the analysis conducted, between individual cows low-palmitic AMF resulted in slower rates of crystallization and longer induction times until catastrophic nucleation. Conversely, high palmitic AMF resulted in faster crystallization rates and shorter induction times until nucleation. This data was positively correlated with DSC (differential scanning calorimetry) melting profiles of heat flow from -40°C to 65°C, at 5.00°C/min. DSC melting profiles of anhydrous milk fat showed a lower melting temperature and lower crystallization temperature in low palmitic AMF, when compared to high palmitic AMF. Texture analysis on low palmitic AMF of hardness (force g) at refrigeration and ambient temperatures yielded a softer AMF. The high palmitic acid content resulted in a much harder AMF at both refrigeration and ambient temperatures. Subjectively, differences in the milk fats could be observed visually, as melted, equilibriated high palmitic AMF solidified at room temperature much quicker than low palmitic AMF. These net effects were seen on pooled data regardless of the genotype of the individual cows. However, between individuals, genotype either increased or decreased the net effect of the palmitic acid on AMF behavior.

Key Words: Palmitic Acid, DSC of Lipids, Milk Fat Crystallization

T60 Optimization of cholesterol removal in milk by crosslinked β-cyclodextrin. E. M Han, S. H. Kim, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was examined to find optimum conditions of crosslinked β-cyclodextrin (β-CD) concentration, mixing temperature, mixing time, and mixing speed for cholesterol removal in milk and to examine the recycling efficiency of the crosslinked β-CD. Crosslinked β-CD was made by adipic acid. When milk was treated with 1% crosslinked β-CD with 400 rpm mixing speed at 10°C for 5 min, 93.13% of cholesterol was removed. At the lower than 10°C mixing, the rate of cholesterol removal was significantly lower than that above 10°C mixing temperature ($p<0.05$). Mixing speed did not affect the rate of cholesterol removal . In recycling study, when crosslinked β-CD was repeatedly used five times, the rate of cholesterol removal was about 92.32% in the range of 92.13 to 92.51%. Therefore, the present study indicated that optimum conditions for cholesterol removal in milk using crosslinked β-CD were 1% β-CD, 10°C mixing temperature, 5 min mixing time, and 400 rpm mixing speed, which resulted in 92.39% of cholesterol removal. In conclusion, the crosslinked β-CD could be efficiently recyclable for cholesterol removal in milk.

Key Words: Crosslinked β-CD, Cholesterol Removal, Recycling

T61 Effect of crosslinked β-cyclodextrin on cholesterol removal in cream. E. M. Han, S. H. Kim, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was carried out to determine optimum conditions of four different factors (β-cyclodextrin (β-CD) concentration, mixing temperature, mixing time, and mixing speed) for cholesterol reduction in cream by crosslinked β-CD and to examine the recycling efficiency of the crosslinked β-CD. Crosslinked β-CD was manufactured with adipic acid. When cream was treated with 10% crosslinked β-CD at 40°C for 30 min with 1,400 rpm mixing speed, 90.72% of cholesterol was removed ($p < 0.05$). The rate of cholesterol removal was not significantly different among 10, 15 and 20% crosslinked β-CD addition, but those in 1 and 5% crosslinked β-CD addition resulted in a significantly lower rate ($p < 0.05$). There was no difference in the rate of cholesterol removal by mixing temperature (40 to 55°C), mixing time (30 to 50min), and mixing speed (1,200 to 1,600rpm). In subsequent study, the used crosslinked β-CD was applied into cream five times for recycling. The rates of cholesterol removal were in the range of 90.42 to 91.45% with no significant difference. Therefore, the present study indicated that optimum conditions for cholesterol removal of cream using the crosslinked β-CD were 10% β-CD concentration, 40°C mixing temperature, 30 min mixing time and 1,400 rpm mixing speed, and the average cholesterol removal reached 91.42%. In addition, the crosslinked β-CD could be efficiently recyclable for cholesterol removal in cream.

Key Words: Crosslinked β-CD, Cholesterol Removal, Cream

T62 The comparison of freeze drying and stirring processes for recycling of crosslinked β-cyclodextrin used for cholesterol removal in milk and cream. S. H. Kim, E. M. Han, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was performed to compare two different processes on the recycling of crosslinked β-cyclodextrin (β-CD). The mixture of acetic acid and isopropanol (3:1) was used as a solvent. Freeze Drying is known as an efficient method in recycling β-CD because it can preserve ingredients for a long time, stabilize and make ingredients to rehydrate fast and completely. Stirring is the reverse way of removing cholesterol from milk and cream with using β-CD. When organic agitation is applied, it gets back cholesterol which is attached to the β-CD. For freeze drying process; cholesterol - crosslinked β-CD complex was freeze-dried for 6 hr, and solvent was added, ultrasonicated for 30min, stirred for 2hr with 100rpm for 50°C, and centrifuged. For stirring process, the complex was mixed with solvent and mixture, stirred at 400 rpm in room temperature for 20 min, and centrifuged. Freeze drying process needed more reaction time, while stirring process was rapid and easy. However, the rate of average cholesterol removal was 97.3% in milk and 97.82% in cream when the crosslinked β-CD recycled by freeze drying process was applied ten times repeatedly. In comparison, when stirring process was applied, it was significantly lower as 90.18% and 91.63% in milk and cream, respectively. In conclusion, the present study indicated that crosslinked β-CD could be efficiently recyclable in milk and cream over 90%.

Key Words: Crosslinked β-CD, Cholesterol Removal, Recycle

T63 Microencapsulated isoflavone to apply into milk and hypocholesterolemic effect. B. J Jeon, N. C. Kim, E. M. Han, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was designed to develop the microencapsulation of water-soluble isoflavone to apply into milk and to examine the hypocholesterolemic effect in rats. Coating material was medium-chain triglyceride (MCT) and core material was water-soluble isoflavone. The microencapsulation efficiency was 70.2% when the ratio of coating material to core material was 15:1. The isoflavone released from microcapsules was 8% at 4°C for 3 day storage. In vitro study, water-soluble isoflavone from microcapsules was released 4.0-9.3% at the range of 2 to 5 pHs for 60 min incubation. In simulated intestinal fluid, 87.6% of isoflavone was released at pH 8 for 40 min incubation. In sensory analysis, the scores of bitterness, astringency, and off-taste in encapsulated isoflavone-added milk were slightly but not significantly different from those in uncapsulated isoflavone-added milk. In blood analysis, total cholesterol was significantly decreased in isoflavone-added group compared with in control for 6 week feeding, however, no difference was found in blood HDL-cholesterol. The present study suggested that as a coating material, MCT was suitable for the microencapsulation of water-soluble isoflavone, and isoflavone showed blood cholesterol lowering effect.

Key Words: Microencapsulation, Water-Soluble Isoflavone, Hypocholesterolemic Effect

T64 Hydrolysis of isoflavone glycoside by β-galactosidase and stability in the form of microcapsule. N. C. Kim, B. J. Jeon, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

The objectives of this study were to find conditions for conversion to aglycone form which showed a high biological activity using β-galactosidase and to examine the stability of microencapsulated β-galactosidase and isoflavone in the simulated gastric and intestinal conditions in vitro. Three different β-galactosidases were tested and the conversion of isoflavone glycoside by selected β-galactosidase was determined by different factors, such as pH, temperature and time in incubation, and enzyme activity. The rate of conversion was about 35% in optimum conditions. For stability study, isoflavone and β-galactosidase were microencapsulated to prevent beany flavor and sweetness in milk. When microencapsulated isoflavone was incubated in simulated gastric fluid with the pH range of 2 to 4, isoflavone was released 6.5 to 5.9mg(9.3 to 8.4%) and the release of β-galactosidase was 0.41 to 0.40 unit/ml (13.7 to 13.3%), respectively. However, 84.4% of isoflavone was released and 80.7% of β-galactosidase were in simulated intestinal fluid after 3 hr incubation(pH7). The contents of aglycone converted from isoflavone glycoside were 2.6mg in control and 18.8mg in β-galactosidase containing sample. Finally, this study showed that the converted high amount of aglycone was found by microencapsulated β-galactosidase when incubated in simulated intestinal fluid. In addition, the result may improve milk digestion.

Key Words: Isoflavone, β-Galactosidase, Microencapsulation

Forages and Pastures: Additives, Nutrient Content, and Quality

T65 Addition of enzyme or/and wheat bran on fermentation characteristics and in vitro gas production of rice straw silage. J.-M. Lv*, W.-L. Hu, and J.-X. Liu, *Zhejiang University*, *Hangzhou, China*.

A two- way factorial trial was designed to study the technique aspects of ensiling rice straw (RS) mixed with Strawzyme (an experimental preparation of cell-wall degrading enzymes containing cellulase and xylanase) and wheat bran (WB). The WB was added at levels of 0, 3, 6 or 9 % (fresh basis), respectively, and the RS was untreated (C-0, C-3, C-6 and C-9), or treated with Strawzyme at level of 1300g/t DM (T-0, T-3, T-6, and T-9). The fermentation characteristics of ensiled rice straw were evaluated for pH value, percentage of ammonia N in total N and organic acid (lactic acid, butyric acid, acetic acid and propionate acid) content. The in vitro gas production technique (Menke et al, 1988) was utilized to assess the nutritive value of silages.

Addition of WB improved the fermentation quality and nutritive value of RS silage. The pH value, percentage of ammonia N in total N and butyric acid content were decreased ($p<0.05$) and the lactic acid content and in vitro gas production (GP48) were increased with the increasing levels of WB ($p<0.01$). Compared to the silages added with WB alone, the RS silages added with WB along with Strawzyme treatment had a higher 48h GP and a faster rate of GP ($p<0.01$). The content of NDF was 3.3 and 5.3 percent unit lower in treatments T-6 and T-9 than in C-6 and C-9, respectively ($p<0.01$). Proportion of ammonia N of total N was decreased by 37.9 or 15.5% ($p<0.05$), and the lactic acid was increased by 67.8 or 5.7% respectively ($p<0.01$), when Strawzyme plus 6 or 9% WB was added. It can be concluded that combination of Strawzyme with WB was more effective in the improvement of RS silage quality than addition of WB alone.

Key Words: Rice Straw Silage, Enzyme, Wheat Bran

T66 Effect of adding enzyme on fermentation quality and nutritive value of corn stover silage. J.-M. Lv*, W.-L. Hu, and J.-X. Liu, *Zhejiang University*, *Hangzhou, China*.

This experiment was carried out to assess the effect of adding enzyme on fermentation quality and nutritive value of corn stover silage. About 120 kg corn stover was used as materials. The DM content of the corn stover was 22.1% The CP, NDF and WSC in corn stover (on DM basis) were 8.1, 74.2 and 3.5%, respectively. The enzyme containing cellulase (3500 IU/g) and xylanase (450 IU/g) was added to corn stover to ensile at four levels: 0(control, C), 800(1), 1300(2), 1800(3) g/kgDM.

Materials for each treatment were ensiled in triplicate in experimental silos with capacity of 50 L. After ensiled for 40 days, silages were taken for analysis in terms of chemical composition, pH value, ammonia nitrogen and organic acid. The in vitro gas production technique (Menke et al, 1988) was utilized to assess the nutritive value of silages.

The result showed that while all corn stover silages were of good quality with low pH, low ammonia nitrogen (NH3-N) and high lactic acid content, enzyme addition reduced the NDF content, pH value and the ratio of NH3-N to the total N, meanwhile increased the concentration of lactic acid as well as the total organic acid. Compared to control, the NDF content was 6.5% and 3.2% ($p<0.05$) lower, and lactic acid content was 32.6% and 29.1% ($p<0.01$) higher for the silages in group 2 and 3, respectively. PH value and the ratio of NH3-N to total N in group 3 were lower than those in group C ($p<0.01$). Enzyme addition improved the silages's nutritive value be increasing in vitro gas production (GP) parameters. The organic matter digestibility (OMD) estimated from the GP was higher ($P<0.01$) for the enzyme added silages than for group C. In conclusion, enzyme addition can improve both fermentation quality and nutritive value of corn stover silage, in this experiment, the best addition level of enzyme was 1800g/tDM.

Key Words: Corn Stover Silage, Enzyme, Nutritive Value

T67 Dietary cation-anion difference of forage grasses as affected by species and chlorine fertilization. G. F. Tremblay*[1], S. Pelletier[1,2], H. Brassard[1,2], G. Bélanger[1], P. Seguin[3], R. Drapeau[1], A. Brégard[2], R. Michaud[1], and G. Allard[2], [1]*Agriculture and Agri-Food Canada*, *Québec, QC, Canada*, [2]*Université Laval*, *Québec, QC, Canada*, [3]*McGill University*, *Montréal, QC, Canada*.

For milk fever prevention, a target Dietary Cation-Anion Difference [DCAD=(Na+K)-(Cl+S)] of -50 meq/kg DM is used in balancing rations for dry dairy cows. Low DCAD rations induce a mild compensated metabolic acidosis that stimulates bone resorption and improves Ca homeostasis. Dry cow rations contain a high proportion of forage and forages fed 4 weeks prepartum should have a low DCAD. We compared the DCAD of 5 grass species and we determined the effect of Cl fertilization on the DCAD of timothy. In a first experiment, 2 to 4 cultivars of orchardgrass, tall fescue, meadow bromegrass, smooth bromegrass, and timothy were harvested at 3 sites during spring growth and summer regrowth of 2 years; sites were considered as replicates for the species and cultivars were nested within species. In a second experiment, we applied increasing rates of Cl fertilization (0, 80, 160, and 240 kg Cl/ha) to timothy harvested during spring growth at 4 sites with contrasting soil K contents (311, 289, 197, and 123 kg K/ha) with sites as main plots and Cl rates as sub-plots. All harvests were taken at the early heading stage. For all harvests, the DCAD of orchardgrass was the highest (522 to 785 meq/kg DM) and that of timothy the lowest (272 to 420 meq/kg DM) ($P<0.05$); the DCAD of the other 3 species were intermediate. Cultivars within a species did not differ in DCAD. With no Cl fertilization, timothy DCAD was lower (199 meq/kg DM) at the low soil K content site than at the other 3 sites (365-459 meq/kg DM, SEM=28). Chlorine fertilization decreased timothy DCAD ($P<0.05$); with the highest rate of Cl fertilization, the DCAD ranged from 8 to 319 meq/kg DM at the 4 sites. Chlorine fertilization increased timothy Cl concentration ($P<0.05$) but had no effect on DM yield. Among the 5 cool-season grasses tested, timothy is best suited for the production of low DCAD forages for dry cows. Timothy forage with a DCAD close to 0 meq/kg DM can be produced using Cl fertilization on a soil with a low K content.

Acknowledgements: Financial support from "Action concertée FQRNT-NOVALAIT-MAPAQ en collaboration avec Agriculture et Agroalimentaire Canada" is gratefully acknowledged.

Key Words: Mineral Composition, Parturient Paresis

T68 Ruminal dry matter, crude protein, neutral detergent fiber and acid detergent fiber degradation parameter kinetics of *Vicia villosa*, *Festuca ovina*, and *Taeniatherum caput-medusaen*. P. Shawrang*[1], A. Nikkhah[1], and A. A. Sadeghi[2], [1]*Tehran University*, *Karaj, Iran*, [2]*Islamic Azad University*, *Tehran,Iran*.

An in situ experiment was conducted to determine rate and extent of DM, CP, NDF and ADF degradation parameter kinetics of *Vicia villosa* (VV), *Festuca ovina* (FO), and *Taeniatherum caput-medusaen* (TC). Four mature rumen cannulated Holstein steers were fed a total mixed ration containing 85% alfalfa hay and 15% concentrate. Duplicate in situ digestion bags containing five grams substrate were incubated for 72, 48, 24, 12, 6, 3 and 0 h. Immediately after submersion of the 0 h bags of substrate into the ruminal fluid, all bags were removed and rinsed with an automatic washing machine and rinsed using 4 to 6 gentle cycles of agitation until rinse water was clear. Bags were then freeze-dried and weighed. Data was fitted to non-linear degradation characteristics to calculate effective rumen degradation (ERD). Crude protein contents of VV, FO and TC were 197, 54, and 124 g/kg, NDF contents were 398, 626, and 512 g/kg and ADF contents were 287, 190 and 357 g/kg DM, respectively. There were significant ($P<0.05$) differences between effective DM, CP, NDF and ADF degradability of these pasture species. The ERD of DM, CP, NDF and ADF for VV at rumen outflow rate of 0.05/h were 541, 677, 310 and 292 g/kg, for FO were 307, 402, 295 and 486 g/kg, and for TC were 535, 732, 389 and 379 g/kg, respectively. Constant degradation rate of DM, CP, NDF and ADF for VV were 5.6, 9.6, 3.6 and 3.8 %/h, for FO were 7.3, 9.1, 3.5 and 6.2 %/h and for TC were 4.2, 9.2, 2.7 and 2.9 %/h, respectively. The differences between pasture species in the rate and extent of DM, CP and fiber degradation are likely to lead to major differences in forage intake, therefore these characteristics must be considered as main parameters in developing models and ration formulation of grazing ruminants.

Key Words: Pasture Species, Degradability, Nylon Bags

T69 Evaluation of yield and nutritive value of Hairy indigo (*Indigofera hirsuta* L.) in Venezuela. Omar Araujo-Febres*, *La Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*.

Tropical grassland has a high potential yield of dry matter, but the nutritive value of tropical grasses declines rapidly. The aim of this work was to evaluate the effect of cutting age on nutritive value of Hairy indigo (*Indigofera hirsuta*). *I. hirsuta* is a tropical annual legume and has relatively high dry matter yield and crude protein concentration, but intake under grazing is limited. The study was conducted at La Esperanza university farm of La Universidad del Zulia (Venezuela). Three cutting ages (28, 56 and 84 d) were established. Dry matter yield was 1,410, 4,068 and 8,947 kg/ha ($P<.05$; SE=83). Leaf CP content was 274, 244, and 231 g kg DM ($P<.05$; SE= .47). Leaf to stem ratio was 1.87, 1.48, and 1.16 ($P<.05$; SE= .08). Leaf ADF content was 198; 217 and 249 g/kg DM ($P<.05$; SE= .95). The NDF content in leaves was 224, 242, and 299 g/kg DM ($P<.05$; SE= .74). IVDMD was 69.3, 68.8, and 60.9% ($P<.05$; SE= 1.20) for each cutting age, respectively. Dry matter, CP yield, and ADF, NDF, and lignin concentrations increased when delaying harvest from 28 to 84 d. Crude protein percentage and leaf to stem ratio decreased with age of plant. Ensiling may be a useful alternative to grazing hairy indigo. Further research is being conducted to evaluate acceptability and silage quality.

Key Words: Indigofera Hirsuta, Dry Matter Yield, IVDMD

T70 The effect of *Lactobacillus buchneri* on aerobic stability, fungal growth, and mycotoxin concentrations of corn silages. C. Iglesias*[1], A. Bach[1,2], C. Adelantado[3], and M. A. Calvo[3], [1]*Unitat de Remugants, Institut de recerca i tecnologia agroalimentàries (IRTA)*, *Barcelona, Spain*, [2]*Institució catalana de recerca i estudis avançats (ICREA)*, *Barcelona, Spain*, [3]*Departament de Sanitat i Anatomia Animal, Universitat Autònoma de Barcelona (UAB)*, *Barcelona, Spain*.

A total of 24 different corn silages were used to evaluate the effects of *Lactobacillus buchneri* inoculation on aerobic stability, fungal growth, and mycotoxin concentrations. During the ensiling process, in each silage, two 7-kg samples of plant material were treated with 200 ml of water (Control) or with 200 ml of water containing 10 g of *L. buchneri* (strain NCIMB 40788) at 4.3×10^5 CFU/g (Treatment) and placed in two permeable nylon bags. These bags were then placed in the bunker silo at the same level and separated about 80 cm from each other in a location that ensured that bags would remain in the silo for at least 3 months. After this period, the materials from each bag were removed and placed in two separate pans and kept at room temperature for 1 wk. Temperature was monitored daily during this time. Also, after retrieving the bags from the silo, a grab sample was analyzed to determine volatile fatty acids, fungal counts, and mycotoxin concentrations. At 4-d after removal from the silo, another grab sample was taken from the pans to determine fungal counts and mycotoxin concentrations. Inoculation of *L. Buchneri* resulted on lower ($P < 0.001$) temperatures compared with the Control silages (17.22 vs 17.43 C, respectively). Acetic acid concentrations were greater ($P < 0.04$) in Treated than in Control silages (279.4 vs 248.7 mM, respectively). Fungal counts (CFU/g) were numerically lower in Treated than in Control silages on days one (5.38×10^2 vs 7.85×10^3, respectively) and four (2.13×10^3 vs 2.59×10^4, respectively) after opening the silages. Aflatoxin concentrations tended ($P < 0.09$) to be lower in Treated than in Control silages (0.28 vs 1.09 ppm), but concentrations of DON and zearalenone did not differ between treatments. Inoculation of *L. buchneri* increases acetic concentrations in corn silages, improves aerobic stability, and may reduce aflatoxin concentrations.

Key Words: Fungi, Silage, Mycotoxin

T71 Inoculum source effects on *in vitro* gas production of forages. E. Grings* and R. Waterman, *USDA-ARS, Miles City, MT*.

Buffer N concentration and forage protein fermentability can both influence *in vitro* gas production profiles. Therefore, we tested the impact of using inoculum from cattle fed grass or grass and alfalfa on *in vitro* gas production profiles of forages and ruminal extrusa. Four ruminally cannulated beef cows were used in a 2 x 2 Latin Square design experiment. Dietary treatments consisted of grass hay or grass hay plus 1.4 kg/cow of alfalfa pellets fed once daily. Ruminal fluid was used to inoculate an *in vitro* gas production system using 100 ml glass syringes. Twenty ml of media were placed in each syringe containing from 200 to 250 mg substrate. All substrates were run in media containing ruminal fluid at concentrations of 24, 29 or 34%. Substrates tested included two alfalfa hays, one grass hay, *Pascopyron smithii* harvested in either June or December, and lyophilized ruminal extrusa collected from cattle grazing native range in May, August, or December. Gas production was read manually at 0, 2, 4, 6, 8, 10, 12, 14, 24, 30, 34, 36, 48, 54, 72, and 96 h of incubation. Net gas production was calculated on an OM basis. Rate, maximal gas production, and lag time were evaluated using a Gompertz model. Gas production at each time point, the relative standard deviation of duplicate readings, rate, maximal gas production, and lag time were subjected to analysis of variance procedures using a model containing the terms diet, cow group, gas run, ruminal fluid concentration, and the ruminal fluid concentration by diet interaction. The residual error term was used to test effects. Relative standard deviations were less ($P < 0.05$) for many individual gas production measures when only grass was fed to inoculum donors. Grass inoculum resulted in increased ($P < 0.05$) gas production at all time points earlier than 48 h, faster ($P < 0.05$) rates of gas production, and decreased ($P < 0.05$) lag times compared to inoculum from cows fed grass plus alfalfa. Addition of alfalfa into the diet of inoculum donors to increase dietary protein did not improve the precision of *in vitro* gas measures.

Key Words: Gas Production, Forage, Digestion

T72 Predictability of Streptomyces griseus RUP, methionine and lysine content of randomly selected alfalfa silages. M. J. Stevenson*[1], W. Heimbeck[2], and R. A. Patton[3], [1]*Degussa Corporation, Kennesaw, GA*, [2]*Degussa AG, Hanau, Germany*, [3]*Nittany Dairy Nutrition, Mifflinburg, PA*.

Alfalfa silages vary widely in terms of protein, amino acids (AA) and RUP content with significant consequences for amino acid delivery post ruminally. Because RUP and AA composition are difficult and expensive to determine, we investigated the feasibility of predicting these values using more cost-effective analyses. Alfalfa silages (n=27) were obtained from 19 farms in central Wisconsin. Silages varied in sward purity and preservation quality typical of dairy farms. Samples were analyzed for nutrient fractions and RUP using a S. griseus assay at Cumberland Valley Analytical Services and AA at Degussa AG (AOAC method 994-12). Regression equations were developed using the MaxR option of SAS. Analyzed means and ranges for significant regressors are presented. RUP, MET and LYS content were predicted from the most efficient models and compared to observed values. RUP = 70.36 + (2.70 * NDICP) + (1.10 * starch) - (2.66 * titratable acidity) - (9.46 * pH) with $R^2 = 0.82$, mean predicted value (MPV) = 27.2 and mean residual (MR) = 1.23. MET = 0.1096 + (0.0109 * CP) - (0.0464 * ADICP) with $R^2 = 0.87$, MPV = 0.232 and MR = 0.013. LYS = 0.2683 + (0.0383 * CP) - (0.0508 * NDICP) - (0.0310 * NH_3) with $R^2 = 0.81$, MPV = 0.785 and MR = 0.043. We conclude there is potential to accurately predict RUP and AA in alfalfa silages using commonly performed analyses.

Analyzed Variable	Mean	Std Dev	Min	Max
DM%	43.6	10.4	27.1	66.7
CP%DM	19.3	3.5	13.2	26.9
RUP%CP	27.0	3.4	21.2	34.2
MET%DM	0.24	0.04	0.17	0.34
LYS%DM	0.79	0.14	0.58	1.18
Neutral Detergent Insoluable CP%DM (NDICP)	3.20	0.74	2.04	4.61
Acid Detergent Insoluable CP%DM (ADICP)	1.91	0.31	1.24	2.45
NH_3%CP Equivalent	2.29	1.42	0.57	5.81
Starch%DM	1.12	0.90	0.30	4.60
Titratable acidity	2.64	1.35	0.65	5.22
pH	4.98	0.52	4.30	6.85

Key Words: Alfalfa Silage, RUP, Methionine

T73 Nutrition implications of differences in amino acid composition between crude and true protein in randomly selected alfalfa silages. W. Heimbeck*[1], M. J. Stevenson[2], and R. A. Patton[3], [1]*Degussa AG, Hanau, Germany*, [2]*Degussa Corporation, Kennesaw, GA*, [3]*Nittany Dairy Nutrition, Mifflinburg, PA*.

Alfalfa undergoes considerable proteolysis during the ensiling process. This can lead to poor estimates of RUP amounts and amino acid (AA) contents. The purpose of this study was to separate the AA content of alfalfa silages into protein bound and free AA pools and to calculate the apparent degradability of the protein fractions using in vitro techniques. We used the same alfalfa silages and laboratories as in the companion abstract with the exception that free AA were determined in addition to total AA. Free AA were subtracted from total AA to calculate true protein (TP) AA. Using RUP and AA composition, potential RUP AA flow was calculated. AA differences and flows between CP and TP were assessed with GLM of SAS. Overall, 71.7% (13.85 ± 2.41% DM) of alfalfa silage CP (19.2 ± 3.49% DM) was present as AA. Of the total AA, 56.5% (7.83 ± 1.07 % DM) was in TP meaning that 41.1 ± 6.1% of total CP was TP. Assuming that all RUP had to arise from the TP fraction, RUP of true alfalfa silage protein was 66.7 ± 7.9%. Essential AA were a greater percent of TP (51.0 ± 0.04%) than of CP (31.5 ± 0.04%) ($P<0.001$). There was no difference in degradation of LYS, ARG or HIS compared to MET between CP and TP. Using the AA composition of CP resulted in less predicted flow of AA from RUP to the intestine than using TP. We conclude that there are more essential than non-essential AA in TP of alfalfa silages. Further, this has the potential to change the estimates of AA flow to the intestine.

	AA Content				AA flow g/kg DM (Calculated)			
Amino Acid	% in CP	% in TP	SE	P	CP	TP	SE	P
MET	1.23	2.47	0.02	<.001	0.63	1.29	0.02	<.001
LYS	4.08	6.62	0.02	<.001	2.11	3.46	0.07	<.001
ARG	2.25	4.98	0.07	<.001	1.16	2.59	0.10	<.001
HIS	1.58	2.83	0.03	<.001	0.80	1.50	0.03	<.001
LYS:MET	3.33	2.69	0.46	NS				
ARG:MET	1.83	2.03	0.22	NS				
HIS:MET	1.29	1.15	0.10	NS				

Key Words: Alfalfa Silage, Amino Acids

T74 Relationships between alfalfa silage nutrient content and in vitro NDF digestibility. R. A. Patton*[1], M. J. Stevenson[2], and R. L. Spitzer[3], [1]*Nittany Dairy Nutrition*, *Mifflinburg, PA*, [2]*Degussa Corporation*, *Kennesaw, GA*, [3]*Gladwin A. Read Company*, *Omaha, NE*.

Our objective was to assess the possibility of predicting in vitro NDF digestibility of alfalfa silage using nutrient analyses. Twenty-seven samples of alfalfa silage were obtained during July 2004 from 25 farms in central Wisconsin. Silages were stored in either bunkers (n=13) or silage bags (n=14). Samples were sent to a commercial laboratory (Cumberland Valley Analytical Service) for analyses including 30 and 48 hr NDF digestibilities. Factors affecting NDF digestion were identified using the regression procedures of SAS with the MaxR option. Effect of silo type on NDF digestibility was assessed with Proc Mixed of SAS.

Nutrient content of silages represented the normal range commonly encountered. In vitro NDF digestibility at 30 hours was highly correlated with 48 hours (38.8 vs. 45.1%; R^2=0.93). Acid detergent lignin was most highly correlated with digestibility (R^2=0.71 and 0.77 for 30 and 48 hr respectively). Means, ranges and regressions for 30 and 48 hr NDF digestibility are presented below.

$DNDF_{30}$ = 75.261 - (5.649 * lignin) - (0.973 * starch) - (0.770 * sugar) + (1.239 * ash) R^2 =0.78 $DNDF_{48}$ = 62.092 + (6.487 * ADICP) + (0.366 * NDF) - (7.853 * lignin) + (1.542 * ash) R^2 = 0.82

NDF digestibility was better in bunker silos (42.0 and 48.0%) compared to bags (36.1 and 42.7%) at 30 and 48 hr respectively (P<.05). Whether this represents a real difference will require more study. Reasons for negative starch and sugar correlations with NDF digestibility at 30 but not 48 hr are obscure. It does appear correlations are more biologically plausible for 48 hr digestion. This limited data set suggests that for alfalfa silage, prediction of in vitro NDF digestibility may be possible.

Variable	Mean	Std Dev	Min	Max
NDF dig 30 hr %	38.6	6.6	25.7	54.6
NDF dig 48 hr %	44.8	7.2	33.8	61.1
NDF % DM	47.2	5.7	37.1	58.1
Lignin % DM	7.8	1.0	6.5	10.6
Starch % DM	1.1	0.9	0.3	4.6
Sugar % DM	3.2	2.0	0.8	9.6
ADICP % DM	1.9	0.3	1.2	2.4
Ash % DM	9.5	1.7	6.6	13.7

Key Words: Alfalfa Silage, NDF Digestibility

T75 Vacuum-sealed polyethylene bags as mini-silos to assess differences in grasses. D. J. R. Cherney*[1], M. A. Alessi[2], and J. H. Cherney[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Universita Degli Studi Di Palermo*, *Palermo, Italy*.

Laboratory silos are considered a practical method of comparing a number of treatments, and are necessary when evaluating numerous experimental variables and their interactions involving different grass silages. Objectives of this study were to evaluate the suitability of grasses ensiled in vacuum-sealed polyethylene bags to assess treatment differences. Four field replicates of three grass species, orchardgrass (*Dactylis glomerata* L., OG), reed canarygrass (*Phalaris arundinacea* L., RC), and tall fescue (*Festuca arundinacea* L., TF), harvested at two dates were ensiled whole or chopped. Bacterially-inoculated grass samples (500 g) were ensiled for 0, 2, 4, 8, 16, 24, and 30 d. At 30 d post ensiling, lactic acid was the predominant volatile fatty acid, suggesting good fermentation. There were species differences in lactic acid, with RC silages having lower lactic acid (4.6% of DM) than OG (7.1%) or TF (6.0%) silages (SED=0.63), suggesting that the polyethylene bag is sensitive to treatment differences. Silages were not different in lactic acid (P > 0.05) between chops or harvest dates. Lactic:acetic acid ratios were higher in OG (4.9) than RC (2.7) or TF (3.4) (SED=0.52), but there were no differences due to chop or harvest date. There was little or no butyric or propionic acids in the silages, indicating that the silages did not undergo clostridial fermentation. Despite species and processing differences, pH of silages tended to be under 4.7, considered acceptable for grass silages. There was a species x chop interaction, with the chopped RC being lower in pH than whole material. The differences between chopped and whole TF were small and there was no difference between chopped and whole OG. The species x day interaction was mainly due to the rate of pH decline during the first 4 d. The RC declined in pH faster than the other two species, with whole RC and TF declining at slower rates than OG. Despite these differences, ensiled grasses dropped rapidly in pH and were stable beyond eight days. We conclude that it is possible to use vacuum-sealed plastic bags to ensile temperate grasses to assess treatment differences.

Key Words: Laboratory Silo, Grass-Silage, Fermentation

T76 Alfalfa yield and nutritive quality as influenced by air quality in west-central Alberta. J. Lin*[1], M. Nosal[2], R. Muntifering[1], and S. Krupa[3], [1]*Auburn University*, *Auburn, AL*, [2]*University of Calgary*, *Calgary, Alberta, Canada*, [3]*University of Minnesota*, *St. Paul*.

Phytotoxic effects of individual air pollutants on forage yield are well documented; however, little is known about their combined effects on yield, and even less is known about air pollution effects on forage quality. Alfalfa (*Medicago sativa* cv. Beaver) yield and nutritive quality responses to ambient concentrations of atmospheric ozone (O_3), sulfur dioxide and oxides of nitrogen were assessed at three sites in west-central Alberta, Canada over five growing seasons (1998 to 2002). At each site, primary-growth and regrowth harvests were taken from replicated plots, and air quality and meteorological parameters were monitored at appropriate time scales. Using median values across all study sites and years, yield data were separated into two different ($P < 0.05$) classes (low and high) and utilized in multiple regression analysis of alfalfa yield and nutritive quality responses. Across all harvests, air quality and meteorological factors accounted for two-thirds (adj. $r^2 = 0.67$, $P < 0.001$) of the variability in alfalfa yield; air quality influenced half of the accounted variation, with O_3 alone accounting for 25%. Ozone and precipitation (P) contributed 69 and 17%, respectively, to the variability in percentage CP of low-yielding alfalfa that was attributable (adj. $r^2 = 0.52$, $P = 0.003$) to air quality and meteorological parameters, and temperature (T) and humidity collectively influenced 98% of the accounted variation (adj. $r^2 = 0.52$, $P = 0.003$) in percentage CP of high-yielding alfalfa. Three-fourths of the accounted variation (adj. $r^2 = 0.58$, $P < 0.001$) in relative feed value (RFV, calculated from forage concentrations of ADF and NDF) of low-yielding alfalfa was attributable to meteorological parameters, whereas air quality contributed 25%. In contrast, air quality (primarily O_3) influenced 86% of the accounted variation (adj. $r^2 = 0.47$, $P = 0.199$) in RFV of high-yielding alfalfa, and T and P collectively contributed 14%. Elucidation of causal relationships between air quality, crop yield and nutritive quality represents a novel and potentially useful application of air pollution research to forage-based animal production systems.

Key Words: Alfalfa, Nutritive Quality, Air Quality

T77 In situ DM and N disappearance of ryegrass (*Lolium multiflorum*)-rye (*Secale cereale*) mixed swards fertilized with different N rates. J. M. B. Vendramini*[1], L. E. Sollenberger[1], J. D. Arthington[2], A. Adegbola[1], J. C. B. Dubeux, Jr.[1], S. M. Interrante[1], and R. L. Stewart, Jr.[3], [1]*Univeristy of Florida*, *Gainesville*, [2]*University of Florida*, *Ona*, [3]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Protein of fertilized cool-season grasses is often highly degradable and easily fermented to VFAs and NH_3-N in the rumen, however, the NH_3-N that is not captured in microbial protein is absorbed and excreted. The objective of this study was to characterize the DM and N fractions in rye-ryegrass herbage from swards harvested at two maturities and fertilized at three N rates. A plot study was conducted from January to April 2003 and 2004 in Gainesville, FL, and treatments were the factorial combinations of three N rates (0, 40, and 80 kg/

ha) and two ages of regrowth (3 and 6-wk). The plots were harvested at a 5-cm stubble height, and duplicate samples of each treatment were incubated in one cow for 0, 3, 6, 9, 12, 24, 48, and 72 h. The McDonald model, P=A+B (1-exp$^{-c(t-L)}$), was fitted to the DM and N disappearance with lag time excluded for N evaluation. The DM and N fractions were described as A, rapidly degradable; B, potentially degradable; and C, undegradable. There was a linear (P<0.01) increase in total CP (14 to 23%) with increased N fertilization rates from 0 to 80 kg N/ha. Total CP was lower (P<0.01) for 6-wk (16%) than 3-wk (20%) regrowth. There was no effect (P>0.05) of N fertilization or age of regrowth on DM A, B, and C fraction concentrations; however, there was a linear (P<0.01) increase in the concentration of the A fraction in total N (41 to 50%) with increased fertilization rates from 0 to 80 kg N/ha. A linear decrease (P<0.01) in the B fraction of total N (53 to 37%) was observed across the range of N fertilization rates. There were no treatment effects on concentration of the C fraction in DM or N. Nitrogen fertilization rate is a major factor affecting the N profile of rye-ryegrass mixed swards in North-Central Florida.

Key Words: Rye-Ryegrass, In Situ, N Fractions

T78 Effects of lactic acid bacteria and formic acid on the silage quality of whole crop rice. B. W. Kim*[1], G. S. Kim[1], K. A. Albrecht[2], and K. I. Sung[1], [1]*Kangwon National University*, *Chunchon, Kangwon-Do, South-Korea*, [2]*University of Wisconsin*, *Madison*.

Silage additives are often used for whole crop rice silage production in Korea, however, little is known about their impacts on the fermentation of this crop. This study was conducted to determine the optimum levels of silage additives by evaluating the effects of lactic acid bacteria (LAB) and formic acid concentrations on the silage quality of whole crop rice harvested at different maturity stages. Rice was established early in May and harvested through October 7th in a rice field at Yupori, Sinbuk-yeup, Chunchon, Kangwon-Do. *Ilpum* mutant rice (Japonica type) was harvested at six different maturity stages; boot (17 Aug), milk (27 Aug), dough (7 Sep), yellow ripe (17 Sep), dead ripe (27 Sep) and full ripe (7 Oct). Each sample was ensiled in laboratory silos in three different ways; with 1) LAB (10^6, 10^7 and 10^8 cfu/g), 2) formic acids (0.2, 0.3 and 0.4% of sample wt.) and 3) no additive. The additive levels did not affect dry matter content, crude protein, fiber or total digestible nutrient concentrations at any stage. Additives significantly decreased silage pH and butyric acid concentrations, which tended to be inversely related to additive level. Lactic acid concentrations were higher with the use of LAB (7.3, 7.7 and 7.9 % of DM in 10^6, 10^7 and 10^8 cfu/g, respectively) and formic acid (3.0, 3.3, and 3.4% of DM in 0.2, 0.3 and 0.4% formic acids, respectively) compared to the non-treated control at the dough stage (1.9 % of DM). Lower concentrations of ammonia-N were observed in additive-treated silages at all maturity stages. The results indicate that as the additive levels increase, the silage quality is improved, even with low levels of additives. Therefore, we conclude that the optimum addition levels of LAB and formic acid are 10^6~10^7 cfu/g and 0.2~0.3% of the fresh silage weight, respectively.

Key Words: Whole Crop Rice Silage, Silage Additives

T79 Harvesting alfalfa at different stage of growth on nutrient concentrations and digestibility. G. Ayangbile*, K. Kammes, D. Spangler, R. Smith, and K. Thompson, *Agri-King Inc.*, *Fulton, IL*.

This study evaluated the effects of harvesting alfalfa at different stage of growth on: 1) total nutrient profiles, 2) ruminal, abomasal, and intestinal organic matter digestibility, and 3) ruminal and abomasal minerals disappearance. Scissor cuttings of alfalfa were collected once a week for a duration of six weeks from five different farms in Wisconsin. The cuttings were obtained at six stages of maturity ranging from vegetative stage to 75% bloom. Harvested samples from the five locations were processed and analyzed for the initial organic matter nutrient profile using NIRS, Philips XRF 2640. Portions of the samples were grouped together by the stage of maturity, and placed into in situ dacron bags which were suspended for 8 h in the rumen of fistulated non-lactating Holstein cows. This was followed by a 2 h in vitro abomasal and 24 h intestinal incubations. Non-incubated samples and the residues of the in situ and in vitro incubations were chemically digested and analyzed for minerals with Varian Vista-MPX CCP simultaneous ICP-OES. The progression from vegetative stage to 75% bloom resulted in increased NDF, ADF, lignin, NDIP and ADIP for the non-incubated samples, but decreased values for the 54 h IVDMD (92-75%), NFC (36-28%), CP (31-23%), Ca (1.5-1.3%), P (0.44-0.32%), Mg (0.38-0.26%), and S (0.34-0.25%). The in situ ruminal DMD at vegetative stage to 75% bloom declined from 73-57% (P<0.001), but to a lesser range of disappearance (P< 0.005) for Mg (98.2-94.5%), P (97.5-95.2%), Ca (94.7-87.9%), and Mn (92.2-83.3%).

Acknowledgements: The authors appreciated Mr. Mike Kabat for harvesting and transporting the forages.

Key Words: Mineral Disappearance, In Situ Disappearane, In Vitro Disappearance

T80 The effects of temperature, rainfall, month of harvest, and/or pasture management on the mineral composition of kikuyu grass (*Pennisetum clandestinum*). V. T. Humphreys*[1], J. R. Carpenter[1], and B. W. Mathews[2], [1]*University of Hawaii at Manoa*, *Honolulu*, [2]*University of Hawaii*, *Hilo*.

Kikuyu grass, a major pasture species found in tropical and subtropical regions, is very persistent and capable of producing large quantities of forage dry matter year-round. However, its rapidly changing nutrient composition, which is affected by environmental factors, influences intake, digestibility, and grazing animal performance. The objective of this study was through a retrospective study to determine whether factors such as temperature, rainfall, month of harvest, and/or pasture management significantly altered the macro- (Ca, Mg, P, Na, K, S) and micro- (Cu, Zn, Fe, Mn) mineral content of grazed kikuyu grass. Macro- and micro-mineral profiles of clipped pasture grass samples, taken every 4 to 6 weeks over a 15 year (1989-2003) period just prior to turning cattle into paddocks at the Mealani Experimental Station (in Kamuela on the Big Island of Hawai'i), were analyzed by inductively coupled plasma emission spectroscopy. Harvest months were categorized into seasons by rainfall (wet, dry, average) based on historical weather data (1919-2002) for the Mealani region. Average temperature and rainfall for the 14 and 28 day re-growth periods just prior to sampling were calculated from weather data collected at the Experimental Station. Comparisons of mineral levels by year, harvest month, paddock, treatment, season, and average rain and temperature at 28 and 14 days of re-growth were made. A total of 1405 samples were included in the data base ranging from a low of 60 samples in Feb to 194 samples in July. Ca averaged 0.42% (DMB) and P 0.27%. P was low (<0.25%) during the Jan-Mar time frame and highest (>0.27%) during the Summer and Fall. Mean K was 1.99% (1.71% in July to 2.65% in Dec). Zinc averaged 44ppm and remained relatively constant throughout the year, but both Cu and Mg varied (P<.05) with month of harvest, season, and paddock. Correlations were higher between mean temp (14 and 28 day periods) and mineral levels than they were for rainfall minerals. Data suggests that type and/or level of mineral supplement may need to be varied with seasons.

Key Words: *Pennisetum clandestinum*, Tropics, Macro- & Micro-Minerals

T81 Effect of dry versus plastic wrapped hay on concentration of crude protein and digestible dry matter in large round baled hay. E. Rayburn[1], W. Shockey*[1], J. Hatton[2], and B. O'Doherty[3], [1]*West Virginia University*, *Morgantown*, [2]*USDA, NRCS*, *Kingwood, WV*, [3]*WVCA*, *Morgantown*.

After mowing, hay normally cures for 2 to 3 days so that dry matter (DM) content can increase to approximately 85% and allow hay to be stored as large round bales (DRB) without spoilage. Plastic wrapped, large round bales (WRB) can be stored at 40 to 60% DM without spoilage. Hay stored at 40 to 60% DM requires only 1 or 2 days of curing and reduces the potential for field DM losses and weather damage. In 2003 and 2004, 781 mixed grass hay samples (50:30:20

orchardgrass:timothy:tall fescue) were collected from farms in North Central WV (NCWV). Samples were analyzed by a commercial laboratory for crude protein (CP) and digestible dry matter (DDM). There were no significant differences (P>0.05) in CP or DDM (% DM, standard deviation) between samples from hay stored as DRB (CP = 10.8, 3.0; DDM = 57.5, 2.0) or WRB (CP = 12.7, 4.3; DDM = 58.7, 2.6). The general assumption that WRB are of higher nutritive value than hay stored as DRB is not supported by analysis of on-farm data adjusted for date-of-cut. Analysis by date-of-cut showed that producers tended to harvest first cut hay 7 days earlier when storing hay as WRB compared to DRB (P=0.15). Although producers used wrapping technology to harvest first cut hay earlier, the mean harvest date of June 30 is well beyond the date when nutrients in forage are high in NCWV. For aftermath cuttings, producers tended to harvest hay 15 days later when storing hay as WRB compared to DRB (P=0.08). Producers used wrapping technology to extend the harvest season for aftermath cuttings into periods of the year when it is particularly difficult to cure hay for dry storage. On-farm data shows that NCWV livestock producers use wrapping technology to extend harvest periods, thus increasing the quantity of hay harvested in the fall. This use of wrapping technology suggests that, because of the physiological needs of the livestock, NCWV livestock producers are not using wrapping technology optimally to improve hay quality adequately to pay for the use of this technology.

Key Words: Forage, Hay, Large Round Bales

T82 Factors affecting the quality of corn silage grown in hot, humid areas 3: Effect of maturity at harvest of corn hybrids differing in staygreen ranking. K. G. Arriola*, A. T. Adesogan, D. B. Dean, S. C. Kim, N. K. Krueger, S Chikagwa-Malunga, T Ososanya, and M Huisden, *University of Florida*, *Gainesville*.

To address producer concerns about when to harvest corn hybrids with high staygreen rankings, this study determined the effect of maturity at harvest on the nutritive value and aerobic stability of corn hybrids differing in stay-green ranking. One high stay-green corn hybrid and one average stay-green hybrid with similar relative maturity (118 d) were selected from each of two seed companies. The four hybrids were grown in 1 x 6 m plots at random locations within each of four blocks. The hybrids were harvested at 26 (C1), 34 (C2), and 39 (C3) % DM and ensiled (15 kg) in quadruplicate within plastic bags in 20 l mini-silos. After at least 107 d of ensiling, the silos were opened and the silages were chemically characterized and analyzed for aerobic stability and microbial counts. A Split plot design was used for the study. The staygreen ranking or source (seed company) of the hybrids did not affect their quality. However concentrations (g/kg DM) of CP, NDF, ADF, residual sugars, NH3N, lactate and acetate were greater (P<0.001) at C1, than at C2 or C3, and similar (P>0.05) at C2 and C3. In contrast, pH was greater (P<0.05) at C2 (3.77) and C3 (3.78) than at C1 (3.71). In vitro DM digestibility and aerobic stability were unaffected by maturity. Yeasts counts (log cfu/g) were lower (P<0.05) at C1 (5.93) and C2 (6.05) than at C3 (7.04), but mold counts (log cfu/g) were greater (P<0.05) at C1 (3.28) than at C2 (2.60) and C3 (2.44). In conclusion, harvesting the hybrids at 26% DM seems most appropriate.

Key Words: Corn, Maturity at Harvesting, Stay Green Ranking

T83 Effect of maturity at harvest on the nutritive value and biomass yield of Mucuna pruriens. S. Chikagwa-Malunga*, A. Adesogan, N. Krueger, D. Dean, and L. Sollenberger, *University of Florida*, *Gainesville*.

Four, 5 x 1 m plots of Mucuna pruriens, velvet bean, were randomly established within each of 6 blocks in order to determine the effect of maturity at harvest on DM yield and nutritive value. The Mucuna foliage within each of four quadrats (0.5 m2) that were randomly thrown on six of the plots was harvested at 77, 90, 110 and 123 days after planting (DAP). The total foliage harvested from all the quadrats on each of the six plots was weighed to determine biomass yield. Subsequently, the contents of one of the four quadrats from each plot were chemically analyzed. Mucuna yield increased (P<0.001) with maturity and the peak biomass yield was obtained at 110 DAP. Biomass yields (t/ha) at 110 (8.64) and 123 DAP (9.22) were similar (P>0.05) and higher (P<0.001) than those at 77 and 90 DAP. Concentrations of DM (18.0, 19.6, 26.0, 42.2 %)and NDF (31.0, 46.0, 44.6, 48.5 %) increased (P<0.001) with maturity, but concentrations of CP (13.1, 13.1, 15.8, 15.9 % DM) and EE (1.22, 0.97, 1.37, 1.29 % DM) were unaffected (P>0.05) by maturity. Total tannin concentration (% DM) was highest (P<0.001) at 110 DAP (5.6) followed by 123 DAP (4.4), and lowest at 90 DAP (3.0). Whole plant IVDMD was highest (P<0.001) at 110 DAP (54.9 % DM) when Mucuna had lower (P<0.001) lignin concentration (11.7% DM) than at 123 DAP (49.0 % DM IVDMD, 14.1% DM lignin). Concentrations (% DM) of P (0.29, 0.28, 0.24, 0.21; P<0.001), and Ca (1.21, 1.11, 0.88, 1.17; P=0.0694) also decreased with maturity. Lysine concentration (% CP) was unaffected (P>0.05) by maturity, but methionine concentration (% CP) decreased (P<0.05, 1.30, 1.12, 0.99, 1.06) with maturity. In conclusion, Mucuna should be harvested at approximately 110 DAP to optimize biomass yield and nutritive value.

Key Words: Mucuna pruriens, Nutritive Value, Yield and Maturity

Goat Species: Growth, Genetics, Physiology, Health, and Products

T84 Predictive models for goat cheese yield using milk composition. S. S. Zeng*[1], K. Soryal[2], B. Fekadu[3], and M. Villaquiran[1], [1]*School of Agric. & Applied Sciences, Langston University*, *Langston, OK*, [2]*Desert Research Center*, *Matareya, Cairo, Egypt*, [3]*Debub University*, *Awassa, Ethiopia*.

Prediction of yield and quality of different types of cheeses that could be produced from a given type and/or amount of goat milk is of great economic benefit to goat milk and cheese producers. Bulk tank goat milk was used for manufacturing hard, semi-hard and soft cheeses (N = 25, 25 and 24, respectively) during a whole lactation to develop predictive models of cheese yield based on milk composition. Percentages of fat, total solids, total protein and casein in milk and moisture-adjusted cheese yield were determined to establish relationships between milk composition and cheese yield. In soft cheese, individual components of goat milk or a combination of two or three components predicted cheese yield with a reasonably high correlation coefficient (r^2 = 0.73-0.81). However, correlation coefficients of predictions were lower for both semi-hard and hard cheeses. Overall, total solids of goat milk was the best indicator of yield in all three types of cheese, followed by fat, total protein and casein. When compared with moisture-adjusted cheese yield, the developed yield formulae in this study predicted yield of semi-hard and hard cheeses as well as the standard formula used for cow cheese (Van Slyke formula). In soft cheese, however, the Van Slyke formula under-estimated, while the newly derived formulae over-estimated yield. Further validation of the yield predictive models for hard and semi-hard cheeses of goat milk using larger data sets over several lactations might be needed, because of variations in relationships between milk components due to breed, stage of lactation, season and feeding regime.

Key Words: Goat Milk, Cheese Yield, Predictive Models

T85 Distribution of conjugated linoleic acids and *trans*-fatty acids in longissimus muscles of sheep and goats. J. H. Lee*, G. Kannan, K. R. Eega, B. Kouakou, W. R Getz, and Y. W Park, *Fort Valley State University*, *Fort Valley, GA*.

Meat from ruminants contains high proportions of saturated fatty acids and small amounts of *trans*-fatty acids, both of which are associated with high blood

cholesterol in humans. However, conjugated linoleic acids (CLA) are naturally present in ruminant fats, which have anti-atherogenic and anti-carcinogenic effects. Objective of this study was to determine variations in the distribution of conjugated linoleic acids (CLA) and *trans*-fatty acids in loin chops from sheep and goat carcasses. Sheep (n = 16) and goats (n =16) raised on pasture (mixture of rye grass and cover) with a concentrate supplement (1.0 kg/head/d, 16% CP for goats, 17% CP for sheep) were slaughtered. Intramuscular fat, sampled from the loin chops by removing external fat layers, was extracted by the chloroform (0.013% BHT)-methanol. Extracted lipids were prepared for the fatty acid methyl esters (FAME), and were analyzed by gas chromatography. Proximate analysis was done using the muscle tissue from loin chops. Analysis of data as a Completely Randomized Design showed no significant differences ($P > 0.05$) in moisture, protein, and fat percentages between *longissimus dorsi* (LD) muscles of sheep and goats. LD muscles from sheep and goats contained 69.0 and 68.3% moisture, 23.4 and 23.4% protein, 4.56 and 4.97% fat, and 1.17 and 1.73% ash, respectively. The ash content in goat LD muscles was higher ($P < 0.05$) than that in sheep LD muscles. Four major fatty acids, palmitic (16:0), stearic (18:0), oleic (18:1n9), and linoleic (18:2n6) acids, made up 91% of the total lipids in the loin chops of either species. Compared to sheep, goats had a higher level of 18:1n9 and lower levels of 16:0 and 18:0 in the loin chops. Loin chops from sheep and goats contained 4.6% and 5.5% polyunsaturated fatty acids (PUFA), respectively. Compared to sheep, goats had a higher ($P < 0.05$) level of *cis*-9, *trans*-11 CLA in the loin chops. No significant differences ($P > 0.05$) were found in the levels of other CLA isomers and *trans*-fatty acids (18:1t) in the loin chops. The results indicate that goat meat may have healthier fatty acid profiles compared with lamb.

Key Words: Sheep and Goat, Trans Fatty Acids, Conjugated Linoleic Acids

T86 Prediction of meat goat body weight from heart girth measurement, body condition score and sex. M. Villaquiran*, S. Hart, T.A. Gipson, G. Detweiler, R. M. Merkel, A. Patra, and T. Ngwa, *E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*.

Body weights are needed for accurate dosing of medicine and for marketing and management decisions. However, producers do not always have access to scales. Therefore, other means of predicting body weights are needed. Prediction equations using heart girth exists for dairy goats, no such equations are available for meat goats. Breeds of meat goats differ greatly in conformation and may require different prediction equations. It is not known if body condition score or sex affects these equations. The objective of this study was to develop equations to predict body weight of meat goats from heart girth measurements. The meat goat herd at Langston University was weighed (BW, kg), body condition scored (BCS) and heart girth (cm) measured four times throughout the year (N=3374). Genotypes represented included Spanish (S), Boer (B), Boer × Spanish cross (BX), Fainting goats (F), and Angora (A). Prediction equations were developed using the GLM procedure of SAS. Heterogeneity of slopes analysis indicated that 10 equations were adequate to predict the 7 genotypes represented. Sex affected the equations for S, F, 3/4 and 7/8 BX goats. For S and F females BW = -46.52+1.14* cm (r^2= 0.82, N=729) and for S and F males BW = -53.54+1.26* cm (r^2= 0.88, N=61). For 3/4 and 7/8 BX females, BW = -57.42+1.34* cm (r^2= 0.91, N=624); for 3/4 and 7/8 BX males, BW = -49.75+1.20* cm (r^2= 0.87, N=320). BCS affected the equations for 1/2 BX and for A. For BCS < 2.5, BW = -39.36+1.04* cm (r^2= 0.81, N=665); for BCS = 2.5, BW = -57.44+1.32* cm (r^2 = 0.77, N=705). Sex and BCS affected the equations for B. For females with BCS = 2.5, BW = -60.54+1.41* cm (r^2= 0.91, N=104), for BCS = 3.0 BW = -54.80+1.34* cm (r^2= 0.81, N=30), for males with BCS = 2.5, BW = -73.56+1.64* cm (r^2= 0.92, N=106), for BCS = 3.0 BW = -107.52+2.11* cm (r^2= 0.95, N=30). Bodyweight of meat goats could be predicted with acceptable accuracy, but it was necessary to use separate equations for sex and BCS for some genotypes.

Key Words: Goats, Body Weight, Heartgirth

T87 Effect of feeding system on performance test traits of young meat bucks in a central performance test. T. A. Gipson*[1], L. J. Dawson[2], and T. Sahlu[1], [1]*E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*, [2]*Oklahoma State University*, *Stillwater*.

Central performance testing of meat goats is increasing in popularity in the US as indicated by increasing number of bucks on-test and increasing number of test stations. Various feeding systems are available which enable measurement of individual performance traits such as intake, gain, etc. The objective of this research was to compare the effect of two different feeding systems on performance test traits. In 2004, 56 young meat bucks (entry age 101 ± 20.0 d and weight 24.3 ± 5.8 kg), predominately Boer, were enrolled in the buck performance test at Langston University. Bucks were ranked by weight and alternately assigned to Calan (C) gate feeders or to automated Feed Intake Recording Equipment (F) feeders. The F system is a completely automated electronic feeding system, which records body weight and feed intake of each individual animal's visit. For the C feeders, each buck wears a collar with an electronic key, which allows access to an individual feeder, feed is weighed and intake is calculated manually. For both C and F feeders, all bucks were weighed weekly for the 12 wk of the performance test. Beginning weight, end weight, gain, average daily gain (ADG; calculated by linear regression), feed intake (FI), feed conversion ratio (FCR), and residual feed intake (RFI) were analyzed using general linear models procedure of SAS. After a 2-wk adjustment period, bucks averaged 29.4 kg for C and 30.7 for F (± 6.9 kg, $P = 0.49$). At the end of the performance test, bucks averaged 52.9 kg for C and 55.6 for F (± 8.0 kg, $P = 0.24$). Gain was 23.5 kg for C and 24.9 for F (± 3.9 kg, $P = 0.22$), which resulted in an ADG of 290.2 g/d for C and 297.3 for F (± 43.2 g/d, $P = 0.56$). FI averaged 160.5 kg for C and 166.1 for F (± 29.3 kg, $P = 0.49$), which resulted in a FCR of 0.149 for C and 0.150 for F (± 0.02, $P = 0.83$). RFI averaged -0.003 kg/d for C and -0.008 for F (± 0.13 kg/d, $P = 0.89$). The type of feeding delivery system had no effect upon any of the performance test traits. Therefore, the feeding delivery system should have no effect upon a buck's final ranking on a central performance test.

Key Words: Central Performance Test, Feeding Systems, Goats

T88 Factors influencing urea space estimates in goats. A. Asmare[1,2], L. J. Dawson[3], R. Puchala[1], T. A. Gipson[1], M. Villaquiran[1], I. Tovar-Luna[1], G. Animut[1,3], T. Ngwa[1], R. C. Merkel[1], G. Detweiler[1], and A.L. Goetsch*[1], [1]*Langston University*, *Langston, OK*, [2]*Alemaya University*, *Dire Dawa, Ethiopia*, [3]*Oklahoma State University*, *Stillwater,*.

Female Alpine goats, 18 approximately 17 mo (yearling) and 18 that were 5 mo (growing), were used to determine effects of animal age, urea dose (100, 130, and 160 mg/kg BW), and time without feed and water (shrink; 0, 16, and 24 h) on urea space estimates. A 20% (wt/vol) urea solution was infused into a jugular vein, with blood sampled before infusion and every 3 min to 21 min later. Body weight was 49.8, 47.4, and 47.0 kg for yearlings and 26.1, 24.6, and 23.9 kg for growing animals after 0, 16, and 24 h shrinks, respectively (SE = 0.80). Time of urea equilibration with body water, determined by a grafted polynomial quadratic-linear model, was affected by a dose x age x shrink interaction ($P < 0.05$); yearling means did not differ (ranging from 7.3 to 10.8 min), whereas those for growing animals were greater ($P < 0.05$) for 0 h-130 mg (13.0 min) and 24 h-130 mg (13.2 min) compared with 24 h-100 mg (7.6 min) and 16 h-130 mg (7.1 min). Based on these times, 12-min samples were used to determine urea space. Urea space was influenced by an age x shrink interaction ($P < 0.05$), being similar among shrinks for yearlings (17.8, 18.8, and 18.9 kg) and greater ($P < 0.05$) for growing animals after 0 than 24 h shrink (12.9, 11.3, and 10.0 kg for 0, 16, and 24 h, respectively). Hemoglobin concentration in plasma, as an index of hemolysis, was greater ($P < 0.05$) for growing than for yearling animals (1.16 vs 1.86%), lowest among doses ($P < 0.05$) for 100 mg (1.05, 1.74, and 1.75% for 100, 130, and 160 mg, respectively), and highest among shrinks ($P < 0.05$) for 24 h (1.46, 1.42, and 1.61% for 0, 16, and 24 h, respectively). In conclusion, 13 min after infusion appears a reasonable sampling time for determining urea space in goats. Shrink time may have greater effect on urea space with growing vs older goats, and 24 h of shrink or at least 16 seem desirable before estimating urea space. Urea space estimates were similar with urea doses of 130 and 160 mg/kg BW, and a lower dose such as 100 mg, though

lessening hemolysis, could allow relatively greater effect of shrink time on urea space.

Key Words: Goats, Body Composition, Urea Space

T89 Effects of insulin administered to a perfused area of skin on mohair growth in Angora goats. R. Puchala*, S. G. Pierzynowski, A. L. Goetsch, and T. Sahlu, *E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*.

The effect of insulin on mohair growth of Angora goats was investigated using a skin perfusion technique. Seven Angora wethers (average BW 32 ± 4 kg) were implanted bilaterally with silicon catheters into the superficial branches of the deep circumflex iliac artery and vein. Goats were shorn before the 28 d experimental period. For the first 14 d of the experiment, the deep circumflex iliac arteries were infused with 2.4 mL/h of saline solution. The infusate for one side contained insulin, delivered at 48 mIU/h and estimated to triple the blood concentration in the perfused region. The area of skin supplied by the deep circumflex iliac artery was approximately 250 cm^2. An area of 100 cm^2 within the perfused region was used to determine mohair growth. Two weeks after cessation of infusions, perfused areas were shorn. Greasy and clean mohair production from the perfused region was not affected by insulin infusion compared with the side infused with saline (4.57 vs 4.69 and 3.67 vs 3.74 g/(100 cm^2 x 28 d), respectively; $P > 0.10$). Similarly, insulin did not change mohair fiber diameter or length ($P > 0.10$). Plasma glucose concentration was lower ($P < 0.05$) in blood from the deep circumflex iliac vein on the side infused with insulin vs the control side (57.2 vs 63.4 mg/dL). Blood flow and plasma concentrations of amino acids were not different between treatments ($P > 0.10$). The lack of an insulin effect on mohair fiber growth may be due to limited influence on fiber producing follicles.

Key Words: Mohair, Insulin, Skin Perfusion

T90 Heritability of kidding rates and the effect of number of offspring per litter on kid birth weights in the Caprine species. N. Buzzell*, J. Altbuch, S. Blash, D. Melican, and W. Gavin, *GTC Biotherapeutics*, *Spencer, MA*.

Increased reproductive capacity is an important selection criterion for breeding goats to maximize the number of offspring produced from a given animal. This is especially true in a biotechnology setting when dealing with expansion of a herd from one transgenic founder animal. Additionally, another important selection criterion is kid birth weight, as higher birth weight kids are expected to reach an acceptable breeding weight in a shorter period of time. A retrospective study was undertaken to evaluate the heritability of kidding rates and to evaluate the effect of number of offspring per litter on kid birth weights. Non-transgenic goats were divided into two groups for this analysis based on having been born as either a singleton (n=79) or as part of a multiple kid birthing (n=183). Kidding rates in these goats were compared in their first parturition. Does born from a multiple kidding event compared with does born as singletons produced significantly more offspring on their first parturition, 1.75 ± 0.05 vs. 1.55 ± 0.64 kids, respectively ($p < 0.05$). In addition, does that produced multiple kids on their first gestation (n=89) compared with does that produced singletons (n=54) produced significantly more offspring per subsequent parturition, 2.08 ± 0.07 vs. 1.70 ± 0.09 kids, respectively ($p = 0.01$). Birth weights were significantly different for female singletons (n=66), twins (n=153), and triplets (n=41) at 3.8±0.08, 3.4±0.05 and 2.9±0.12 kg, respectively ($p<0.05$). Birth weights were also significantly different for male singletons (n=73), twins (n=139), and triplets (n=40) at 4.2±0.09, 3.8±0.06 and 3.2±0.13 kg, respectively ($p<0.05$). In summary, this analysis shows that fecundity as measured by kidding rates is a heritable trait and should be considered when making decisions for breeding and management. This study also found an effect of number of kids per birthing on birth weight which should be a further consideration for selecting offspring for herd expansion and breeding.

Key Words: Birth Weight, Goat, Kidding Rate

T91 Cholesterol-loaded cyclodextrin improves post-thaw goat sperm motility. M. H. Barrera-Compean*[1], P. H. Purdy[2], J. M. Dzakuma[1], G. R. Newton[1], and L. C. Nuti[1], [1]*Prairie View A&M University*, *Prairie View, TX*, [2]*National Animal Germplasm Program, USDA-ARS*, *Fort Collins, CO*.

Membrane destabilization can occur when the sperm plasma membrane undergoes a phase transition from the liquid crystalline phase to the gel phase due to a decrease in temperature. Various lipids have been added to sperm prior to cooling to avoid this phase transition. It is documented that increasing the cholesterol membrane concentration of liposomes removes the phase transition during cryopreservation. Furthermore, treating bull, ram, and stallion sperm with cholesterol-loaded-cyclodextrin (CLC) prior to cryopreservation results in higher proportions of motile and membrane intact sperm after thawing. Application of the CLC treatment has not been documented using goat sperm. Therefore, the goal of this study was to determine if treating buck sperm with CLC in a Tris-citric acid-fructose diluent (15% egg-yolk, 7% glycerol) would improve the post-thaw sperm quality. Semen samples were collected from 25 bucks. Aliquots (240 x 10^6 sperm) from each ejaculate were treated with 0 (control), 1.5, 2.0, 2.5, and 3.0 mg CLC in separate test tubes and then cryopreserved. After thawing, sperm motility, plasma membrane integrity, and acrosome integrity were assessed using a computer assisted sperm analysis system and flow cytometry. Treatment differences between control and CLC-treated sperm for motility and membrane integrities were determined by ANOVA. CLC treatment resulted in significantly higher proportions of motile sperm at 1.5, 2.0, 2.5, or 3.0 mg CLC dosages (46, 50, 52 and 50%, respectively) compared to control sperm (42%; $P < 0.0003$). No significant differences were detected in the plasma membrane or acrosomal membrane integrity analyses. These results demonstrate that treating buck sperm with cholesterol prior to cryopreservation results in higher post-thaw motility without affecting plasma membrane and acrosomal membrane integrity.

Key Words: Goat Sperm, Cryopreservation, Cholesterol-Loaded-Cyclodextrin

T92 Factors influencing pregnancy rate after AI with fresh and chilled semen in meat goats treated with melengestrol acetate. S. Wildeus* and J. R. Collins, *Virginia State University*, *Petersburg*.

Artificial insemination (AI) is routinely used in the U.S. dairy goat industry, but this technology has not found widespread application in meat goat production. This experiment evaluated factors influencing pregnancy rate in primi- and multiparous Spanish and Myotonic goats (n=57) inseminated with extended semen during the breeding season (September). For estrus synchronization does were group-fed once daily a corn/soybean meal supplement (16% CP) providing 1.13 µg/kg BW/d melengestrol acetate (MGA) for 12 d. At the end of feeding, sterile harnessed bucks were placed with the does and estrus marks recorded twice daily (AM/PM). Does were inseminated by the AM - PM rule, approximately 12 h after first estrus marks with either fresh (within 2 h of collection) or chilled (stored at 4°C for 24 h) semen extended in one step in a Tris-egg yolk-fructose diluent at 200 million sperm/ml and packaged in 0.5 cc straws. The site of semen deposition was recorded. Pregnancy rate was determined by transrectal ultrasound 25 d after AI. The effect of semen type (fresh vs. chilled), breed, site of deposition, days after MGA feeding, and time of insemination (AM vs PM) on pregnancy rate was determined by Chi-square analysis. MGA feeding resulted in 95% of does displaying estrus within 120 h of last MGA feeding, with a peak activity between 84-96 h (57%). Pregnancy rates were higher ($P<0.01$) in does inseminated with fresh (65%) than chilled semen (29%), and were higher for semen deposited in the uterus (70%), than in the cervix (43%), cervical os (42%), or posterior vagina (40%). Pregnancy rates were also higher ($P<0.01$) for PM (65%) than AM (28%) inseminations, and tended to decrease ($P<0.1$) from 75% to 48% to 29% for inseminations on d 3, 4 and 5 after last MGA feeding, respectively. There were no differences between Myotonic (58%) and Spanish (44%) does. Results demonstrate a considerable decline in fertility of extended chilled semen after 24 h of storage and suggest the need to penetrate the cervix to achieve satisfactory pregnancy rates in a meat goat AI system.

Key Words: Meat Goats, Artificial Insemination, Melengestrol Acetate

T93 Phenotypic and genotypic aspects of *Staphylococcus aureus* isolated from chronic subclinical infections in dairy goats. P. Moroni[1], G. Pisoni[1], C. Vimercati[1], M. Antonini[2], B. Castiglioni[2], P. Cremonesi[2], and P. Boettcher*[2], [1]*University of Milan*, *Milan, Italy*, [2]*Institute of Agricultural Biology and Biotechnology, National Research Council*, *Milan, Italy*.

The objectives of this study were to identify goats with chronic infections by *Staphylococcus aureus* (SAUR), isolate bacteria from these animals, genotype the bacteria to identify different strains, and perform tests of antimicrobial sensitivity. A herd of 75 Alpine goats in Northern Italy was monitored for a complete production season. Bacterial cultures were taken from each udder half during eight monthly visits. Goats with at least 2 consecutive positive tests for SAUR (n = 28) in the same udder half were identified as chronically infected. Goats with no infections in either udder half during any visit were considered healthy (n = 26). The bacteria isolated from one sample from each infected goat were genotyped based on variable numbers of tandem repeats in 6 genomic regions. One sample from each animal was also subject to a test for beta-lactamase production and to Minimum Inhibitory Concentration tests for 11 antimicrobial agents: benzylpenicillin, ampicillin, amoxicillin, amoxicillin plus clavulanic acid, cloxacillin, cephalonium, cephoperazone, oxytetracycline, doxicycline, kanamycin, and lincomicin. A linear mixed model was used to examine the relationship between chronic infection by SAUR and somatic cell score. This analysis involved 841 records. Factors in the statistical model were sample day, parity, infection status, goat, and udder half nested within goat. No genetic variability was observed among the bacteria isolated, suggesting that all were from the same strain. All SAUR isolates were negative for the beta-lactamase production test and no isolate was resistant to any of the antimicrobial agents used. Penicillins were the most effective drugs tested, however. As expected, SCS was significantly higher in infected goats (least-square mean = 7.55) than in healthy goats (LSM = 5.50). With regard to specific udder halves, mean SCS from infected udder halves (LSM = 8.02) was greater than in uninfected udder halves from the same goats (LSM = 6.44). No differences were observed in milk yield or fat and protein percentages between infected and healthy goats.

Key Words: Goat, Staphylococcus Aureus, Subclinical Infection

Graduate Student Competition—CSAS

T94 Validation of a new equation predicting digestible energy of forage for sheep. M. Vachon*[1,2], J. F. Bernier[1], G. Allard[1], A. Brégard[1], and D. Pellerin[1], [1]*Université Laval*, *Québec, Québec, Canada*, [2]*Centre d'expertise en production ovine du Québec*, *La Pocatière, Québec, Canada*.

Single-component equations are actually used to evaluate DE of forages for sheep in Quebec. Previous study pointed out that multi-component empirical models generally improve slightly the precision of digestibility determination. The aim of this project was to compare the precision of a new multi-component empirical model (new) to predict DE of forages fed to sheep (DE Mcal kg^{-1} =3.245+0.035xCP%-0.024xADF%-0.003LEGUME% (R2=0.52;n=202)) with the equation actually used in Quebec (old) for grasses (DE Mcal kg^{-1} =4.681-0.0573xADF% (R2=0.68;n=69)). Comparisons were made in two separate trials with 48 lactating and 46 pregnant ewes in a 2 X 2 factorial arrangement. Factors were two equations used to predict DE of forage (old vs. new) and two grass hays harvested at different stage. ME requirements were calculated with the NRC model (1985) and with a factorial model based on the NRC (1985) and ARC (1980). Residual ME (intake - requirements) was used to evaluate precision of equations. The new equation predicted more DE in forages so less concentrates were needed to meet energy requirements of ewes. Feeding costs were thus lower when the new equation was used. Lactating ewes lost more weight (-0.25 vs. -0.19 kg d^{-1} p=0,01) and more body condition score (-0.61 vs. -0.33 p=0.05) and their lambs gained less weight (0.52 vs. 0.57 kg d^{-1} p=0.04) when the new equation was used. Residual ME was closer to 0 (lactation: old 0.36 vs. 2.18 Mcal d^{-1}, new 1.12 vs. 2.94 Mcal d^{-1} p<0.01; pregnancy: old -0.64 vs. -0.95 Mcal d^{-1}, new -0.16 vs. -0.46 Mcal d^{-1} p<0.01) when the NRC model (1985) was used to calculate ME requirements. For lactating ewes, residual ME was closer to 0 (0.36 vs. 1.12 Mcal d^{-1} p<0.01) with the old equation. For pregnant ewes, residual ME was not different from 0 (Student t, p<0.05) with the new equation but was different from 0 (Student t, p<0.05) with the old one. These results do not allow to recommend the systematic use of the new empirical model to predict forage energy for sheep.

Acknowledgements: This study was financed by the Conseil pour le developpement de l'agriculture du Quebec.

Key Words: Digestible energy, Forage, Sheep

T95 Nutrient digestibility of diets containing graded levels of meat and bone meal for pigs and ducks. S. A. Adedokun* and O. Adeola, *Purdue University*, *West Lafayette*.

Apparent digestibility of calcium (Ca), phosphorus, (P) and nitrogen (N) of diets containing meat and bone meal (MBM) were determined using 288 barrows with an average weight of 35 kg. Apparent N utilization was also determined in 288 ducks with mean weight of 3.4 kg. For each of 12 MBM samples, diets were formulated by substituting 0, 5, or 10 % MBM in a basal 170 g CP kg-1 corn-soybean meal diet; corn and soybean meal were adjusted at the same ratio to account for the substitution. Each diet was fed to 8 barrows in individual metabolism crates in a digestibility assay that employed a 5-d acclimation followed by a 5-d period of total collection of feces. Each of the diets was also fed to 8 ducks in a metabolism assay that employed a 4-d acclimation and 3-d period of excreta collection. The gross energy (GE), CP, crude fat (CF), ash, Ca, and P contents of the MBM samples, on per kg dry matter basis, ranged from 3,493 to 4,732 kcal, 496.7 to 619.1 g, 91.1 to 151.2 g, 200.3 to 381.9 g, 54.3 to 145.8 g, 25.6 to 61.7 g, respectively.. In most of the diets, there were increases in dietary Ca, P and CP with increase in substitution levels of MBM from 0 to 10 %. Calcium digestibility in pigs increased linearly (P < 0.05) for diets containing MBM samples 3 and 8 and decreased linearly (P < 0.05) for diets containing MBM sample 1. Phosphorus digestibility in pigs increased linearly (P < 0.05) with MBM samples 3, 7 and 10 with an increase in MBM substitution. Nitrogen digestibility was either unaffected (MBM 3 or 9) or decreased (MBM samples 2, 4, 5, 11 or 12, P < 0.05) in the pigs and an increase in N utilization (MBM samples 3 and 9, P < 0.05) for ducks. This study shows that the digestibility of N, Ca and P in diets supplemented with MBM compares favorably with that of the diet supplemented from inorganic sources when MBM replaced up to 10 % corn and SBM in the basal diet.

Key Words: Duck, Pig, Meat and bone meal

T96 Growth performance, carcass characteristics and fat quality of pigs fed Manitoba-grown corn cultivars. F. O. Opapeju*, C. M. Nyachoti, and J. D. House, *University of Manitoba*, *Winnipeg, MB, Canada*.

An experiment was conducted to determine growth performance, carcass characteristics and fat quality of growing-finishing pigs fed diets based on two widely grown corn cultivars in Manitoba. Twenty-four Cotswold growing pigs (~41 kg initial BW) individually housed in floor pens were blocked by BW and sex and randomly allotted from within block to one of three diets to give eight replicate pigs per diet. Experimental diets consisted of a control based on barley and two corn based diets containing corn cultivar 1 or corn cultivar 2 as the main energy source. A three-phase feeding program for 20-50 kg (phase 1), 50-80 kg (phase 2) and 80-110 kg (phase 3) BW range was used. Diets for each phase contained 3.5 Mcal/kg DE but total lysine was 0.95%, 0.75% and 0.64% in phase 1, 2 and 3 diets, respectively. Average daily gain (ADG), average daily feed intake (ADFI) and gain to feed ratio (G:F) were monitored weekly during each phase. Pigs were slaughtered after reaching a minimum BW of 100 kg. There were no ef-

fects ($P > 0.05$) of diet on ADG (mean ± SE) (0.87 ± 0.04, 0.85 ± 0.05 and 0.90 ± 0.05 kg for phase 1, 2 and 3, respectively), ADFI (mean ± SE) (1.96 ± 0.07, 2.46 ± 0.08 and 2.86 ± 0.09 kg for phase 1, 2 and 3, respectively) and G:F (mean ± SE) (0.45 ± 0.02, 0.34 ± 0.02 and 0.31 ± 0.02 for phase 1, 2 and 3, respectively) in all the three phases. Carcass length, dressing percentage, loin eye area, loin depth, backfat thickness, belly firmness and L*, b* and a* fat color were similar ($P > 0.05$) across dietary treatments. Pigs fed the diet based on corn cultivar 2 had a higher ($P < 0.05$) amount of polyunsaturated fatty acids in their backfat compared with those fed the barley-based diet but the amount of saturated, monounsaturated and total unsaturated fatty acids in the belly fat and backfat were similar ($P > 0.05$) across dietary treatments. The results suggest that growth performance, carcass characteristics and fat quality of pigs fed diets based on Manitoba-grown corn cultivars and those fed the barley-based diet were comparable.

Key Words: Corn, Performance, Pigs

T97 Bioavailability of phosphorus in peas for growing pigs. A. M. Hawkins*[1], C. M. Nyachoti[1], B. A. Slominski[1], and H. A. Weiler[2], [1]*Department of Animal Science, University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Department of Human Nutritional Sciences, University of Manitoba*, *Winnipeg, MB, Canada*.

The nutritional evaluation of field peas for swine has primarily focused on its energy and protein value. However, the bioavailability of phosphorus (P) in peas for pigs has only been examined to a limited extent. Thus, an experiment was conducted to determine the bioavailability of P in peas fed to growing pigs and to investigate bone mineral density using dual-energy x-ray absorptiometry as an alternative indicator for determining P bioavailability. Thirty-five individually housed barrows with an initial BW of 6.85 ± 1.40 kg (mean ± SD) were blocked on the basis of BW and randomly assigned from within block to seven semi-purified experimental diets to give five pigs per treatment. The test diets consisted of a cornstarch-soybean meal basal diet (0.6% Ca, 0.25% P), and the basal diet supplemented with 0.05, 0.10. or 0.15% P from monosodium phosphate (MSP) or common yellow pea (PEA). Feed and water were provided for ad libitum intake throughout the 5-wk study period. ADFI, ADG, and FE were measured weekly. At the end of the study, pigs were euthanised for collection of the femurs for measurements of bone mineral density. ADG (0.276, 0.341, 0.344 and 0.247, 0.275, 0.280 kg/d from MSP and peas, respectively) was linearly ($P < 0.05$) increased with incremental P supplementation, while improvement in gain:feed (0.470, 0.614, 0.634 and 0.452, 0.438, 0.426 kg/d from MSP and peas, respectively) was only linear ($P < 0.05$) for MSP but not for pea supplementation. ADG and bone measurements were regressed on supplemental P intake, and P bioavailability from peas was determined by the slope ratio technique. Estimates for the bioavailability of P (relative to MSP) for peas from growth rate and bone mineral density data were 43.29% and 37.28%, respectively. The P bioavailability value determined with the bone mineral density data in the present study was comparable with values determined in previous research.

Key Words: Peas, Phosphorus bioavailability, Growing pigs

T98 True phosphorus digestibility and the endogenous phosphorus losses associated with barley for pigs. Y. Shen*, R. R. Hacker, and M. Z. Fan, *University of Guelph*, *Guelph, Ontario, Canada*.

True phosphorus (P) digestibility and the endogenous P outputs associated with barley for pigs were determined by using the regression analysis technique. Two groups of four pigs, representing weanling and growing pigs with an average initial BW of 7.5 and 25.0 kg, respectively, were fitted with a T-cannula at the distal ileum. These two groups of pigs were each fed four semi-purified diets according to a 4 x 4 Latin square design. The diets were cornstarch-based and contained four levels of P, with 0.9, 1.6, 2.3, and 2.9 g/kg DM for the weanling pigs and 0.9, 1.7, 2.3, and 3.1 g/kg DM for the growing pigs, respectively. The linearity between digestible P input and dietary P intake at both the ileal and the fecal levels was present only with the growing pigs ($P < 0.05$) but not ($P > 0.05$) with the weanling pigs. High dietary inclusions of barley in some diets might have affected the normal digestion of the feed in the weanling pigs. Thus, true P digestibility and the endogenous P outputs associated with barley were estimated by linear regression analysis only for the growing pigs. The true P digestibility (57.2 ± 11.6 vs. 64.7 ± 7.3%) and the endogenous P outputs (0.463 ± 0.230 vs. 0.507 ± 0.156 g/kg DMI) associated with barley were not different ($P > 0.05$) between the ileal and the fecal levels. Fecal true P digestibility was not affected by the higher ($P<0.05$) phytate degradation rate (84.0%) at the fecal level than that (51.7%) at the ileal level in the growing pigs. About 65% of the total P in conventional barley is digested and absorbed in growing pigs.

Key Words: Barley, True phosphorus digestibility, Pigs

T99 Estimation of true phosphorus digestibility and the endogenous phosphorus losses associated with wheat for pigs. Y. Shen*, R. R. Hacker, and M. Z. Fan, *University of Guelph*, *Guelph, Ontario, Canada*.

True phosphorus (P) digestibility, phytate-P degradation rates and the endogenous P outputs associated with a conventional wheat sample were measured in pigs by the regression analysis. Four weanling and four growing pigs, with average initial body weight of 7.7 and 28.4 kg, respectively, were fitted with a T-cannula and fed four diets according to a 4 x 4 Latin square design. Four cornstarch-based semi-purified diets, containing four levels of P at 0.9, 1.6, 2.2 and 2.8 g/kg dry matter intake (DMI) for the weanling pigs and 0.9, 1.4, 2.3 and 3.1 g/kg DMI for the growing pigs, were formulated from the wheat. The apparent ileal and fecal P digestibility in wheat were linearly affected ($P<0.05$) by P contents in the diets in the growing pigs but not ($P > 0.05$) in the weanling pigs. The increase in dietary P content from 0.9 to 3.1 g/kg DMI lead to a linear increase ($P<0.05$) in apparent ileal and fecal P digestibility in the growing pigs from 5.2 to 25.8% and from 9.0 to 31.0%, respectively. Phytate P degradation was not affected ($P>0.05$) by the dietary P levels. True P digestibility and the endogenous P outputs associated with the wheat were determined to be 33.5 ± 6.8% at the ileal level and 41.2 ± 4.1% at the fecal level with the endogenous P outputs being 0.320 ± 0.143 at the ileal level and 0.341 ± 0.086 g/kg DMI at the fecal level, respectively, in the growing pigs. The higher phytate-P degradation rate at the fecal level (53.4%) than that (28.9%) at the ileal level contributed little to the true fecal P digestibility in the growing pigs. True fecal P digestibility measured in the selected conventional wheat sample for growing pigs is somewhat lower than expected. More experiments need to be conducted to measure true P digestibility in wheat samples for pigs.

Key Words: True phosphorus digestibility, Pigs, Wheat

T100 Persistence of the *cp4 epsps* transgene in ruminal and duodenal fluids from sheep fed diets containing Roundup Ready® canola meal. T. Alexander*[1,2], R. Sharma[1], W. Dixon[2], E. Okine[2], and T. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*University of Alberta*, *Edmonton, AB, Canada*.

The increased use of genetically modified plants over the last nine years has created interest in the fate of transgenic plant DNA throughout animal digestive tracts. The present study examined the persistence of transgenic DNA encoding the synthetic CP4 EPSPS protein in ruminal fluid (RF) and duodenal fluid (DF) collected from sheep fed either a high fiber (HF, 15.22% DM; n = 3) or low fiber (LF, 7.37% DM; n = 3) diet containing 15% Roundup Ready® canola meal (DM basis). Wethers were restricted to 95% of *ad libitum* intake and fed once in the morning. Digesta samples were collected at 1, 4, 7, 10, 13, 17, 21, and 25 h after feeding. Immediately after collection, whole digesta samples were divided into two equal portions. One portion was frozen in liquid nitrogen and later freeze-dried. The second portion was centrifuged to obtain a supernatant free of plant cells. DNA was extracted from the freeze-dried material using a CTAB

method and from the supernatant using a Qiagen DNeasy Plant Mini Kit. A TaqMan® PCR assay was used to quantify the *cp4 epsps* transgene in 245 ng of extracted DNA from whole and supernatant samples of RF and DF. Fiber content did not affect the persistence of the *cp4 epsps* transgene in RF or DF ($P > 0.05$). In whole RF, the *cp4 epsps* copy number was greatest for the HF and LF diets (2635 and 2432 copies, respectively) 1 h after being fed and eventually decreased to below the limit of quantification (less than 20 copies) by 21 h after feeding. In contrast, the *cp4 epsps* copy number in whole DF peaked at 7 h after feeding for both HF and LF treatments (245 and 278 copies, respectively) and decreased to below the limit of quantification by 21 h. The transgene was not detected in any of the supernatant samples devoid of plant cells. This study suggests that the transgenic DNA detected in RF and DF was mainly associated with solid undigested plant material.

Key Words: Genetically modified, Transgene, Real-time PCR

Meat Science and Muscle Biology: Meat Quality Prediction and Enhancement

T101 Prediction of monounsaturated fatty acid in the rib eye marbling of Japanese Black by image analysis using high resolution digital image. K. Kuchida*[1], Y. Hirayama[1], A. Oka[2], E. Iwamoto[2], and M. Fukushima[3], [1]*Obihiro University of Agriculture and Veterinary Medicine*, *Obihiro-shi, Hokkaido, Japan*, [2]*Hyogo Prefectural Agricultural Institute*, *Kasai-shi, Hyogo, Japan*, [3]*Hyogo Prefectural Hokubu Agricultural Institute*, *Wadayama-cho, Hyogo, Japan*.

Evaluation of beef meat quality based on objective metrology and eating quality will be needed in the future, although the evaluation now depends more on the judgment by the naked eye. The purpose of this research was to predict the ratio of monounsaturated fatty acid (MUFA) of marbling fat in the rib eye muscle by detailed image analysis using high resolution carcass images. Japanese Black (29 steers and 17 females) cattle, which were slaughtered at 24-30 months (average: 27.7 months), were used in this study. The ratio of marbling area to rib eye area (FATPER), overall coarseness of marbling (O_COARSE), coarseness of the largest marbling particle in rib eye (M_COARSE), coarseness of single marbling particle (S_COARSE), ratio of minor and major axis of rib eye (MM_RATIO), and complexity of rib eye shape (COMP) were calculated by image analysis. The original images of rib eye were converted into binary images, which were then thinned by 5 and 10 rounds while maintaining the connection of pixels. The hairline (width of line being 1 pixel) of the thinned image was retained (hairline image). The pixels of each hairline, second moment, maximum length, pattern width, pattern direction, equivalent circular diameter, degree of circularity, ruggedness degree, circumference length, number of hairlines and total area were calculated for the hairline image by image analysis. MUFA was obtained by an official method. The range of MUFA was 51.0-62.5% (average: 56.7%), and the correlation coefficient of MUFA with marbling score and the O_COARSE were 0.15 (NS) and 0.47 ($p<0.01$), respectively. As the result of stepwise regression analysis, the M_COARSE, average of circumference length of hairline image, green color component of marbling, MM_RATIO and COMP were selected for the multiple regression equation for the prediction of MUFA (R^2=0.82). For the confirmation of the equation, an additional 10 steers were analyzed. The MUFA could be predicted using different data set (R^2=0.73).

Key Words: Image Analyisis, Monounsaturated Fatty Acid, Japanese Black

T102 Development of photography equipment for the cross section of beef and its use in the evaluation of beef marbling and color of rib eye. K. Takahashi*[1], K. Kuchida[1], T. Hori[2], M. Nami[2], T. Honma[2], H. Kotaka[3], and H. Tsukuda[4], [1]*Obihiro University of Agriculture and Veterinary Medicine*, *Obihiro, Hokkaido, Japan*, [2]*Hokkaido Industrial Research Institute*, *Sapporo, Hokkaido, Japan*, [3]*Hayasaka Science and Engneering Corporation*, *Sapporo, Hokkaido, Japan*, [4]*Livestock Improvement Association of Japan*, *Makubetsu, Hokkaido, Japan*.

In Japan, the area, marbling and color of rib eye of Wagyu are economically important traits at the purchasing by buyer. Although marbling and meat color are subjectively evaluated currently, an objective method is more desirable from the viewpoint of equitable evaluation. The aim of this study was to develop a photography equipment (to) that could obtain clear images of beef carcass cross-section and to evaluate marbling and meat color using the equipment. The view angle of the equipment was 384mm×318mm and the resolution of the digital camera (Kodak DCS Pro 14n) combined with the equipment was 13.5 million pixels. A super wide lens (Nikkor Ai AF ED 14mm F2.8D) was attached to this digital camera. Two line lightings of white LED (CCS Co. Ltd. LND-300H - SW-DF) were used. The rib eye images of the cross-section between the 6th and 7th ribs of 240 Japanese Black steers were analyzed by computer image technique. Nine variables (marbling percentage, marbling coarseness, etc.) were calculated for the estimation of the Beef Marbling Standard (BMS) number, and 108 variables (R, G and B components of color of marbling or lean, etc) calculated for the estimation of Beef Color Standard (BCS) number were computed as image analysis traits from these images. The BMS and BCS numbers assigned by the grader were predicted using these image analysis traits by multiple linear regression analysis. Four variables were selected in the multiple regression equation of the BMS number ($R^2 = 0.84$). Percentages of 71.7% and 96.7% for the differences between the BMS numbers predicted by image analysis and assigned by the grader were within ±0 and within ±1, respectively. The multiple regression equation of the BCS number was composed of 5 image analysis traits (R^2=0.74). Ratios of the difference between BCS number predicted by image analysis and BCS number assigned by grader being ±0 and within ±1 were 81.6% and 100%.

Key Words: Beef Carcass, Marbling, Meat Color

T103 Prediction of BMS number by image analysis and comparison of estimated BMS numbers in different cross sections of Holstein steers. Y. Hamasaki*, K. Kuchida, S. Hidaka, K. Shimada, and M. Sekikawa, *Obihiro University of Agriculture & Veterinary Medicine*, *Obihiro-shi, Hokkaido, Japan*.

In Japan, the 6-7th rib of carcass cross section has been used in meat quality evaluation of beef. Marbling scores in *M. longissimus thoracis* are classified into 12 levels and have a large economic impact. Marbling scores evaluated by different graders have some discrepancy in the same carcass and even in the same muscle when the section is different. The aims of this study were to develop a prediction method of the BMS (Beef Marbling Standard) number by image analysis and to investigate the difference between BMS numbers in the 6-7th ribs and those in other areas. Digital images of the 6-7th cross section from 61 Holstein steers were used to predict BMS number with a multiple regression equation. The ratio of marbling to rib eye area (FATPER), the coarseness of marbling and the shape of rib eye were considered as independent variables, and the BMS number evaluated by a grader was a dependent variable for the multiple regression analysis. The multiple regression equation was applied to 4 cross sections, which were cut in 2.5 cm intervals from the 6-7th cross section toward the direction of the lumbar of 18 other Holstein steers. Selected variables of the multiple regression equation for estimating the BMS number were FATPER, the area of the largest marbling particle, coarseness of a single marbling particle and rib eye area ($R^2 = 0.71$). The differences of the image analyzed BMS numbers between the 6-7th cross section and the other 3 cross sections were not large, ranging from -0.99 to 0.72. Samples with large differences of the BMS numbers among the cross sections contained a huge marbling particle in the rib eye. After removing the huge marbling particle by image processing, the BMS number was predicted again using the multiple regression equation, and the differences of the BMS numbers between the 6-7th cross

section and the other 3 cross sections were smaller. This result indicated that the huge marbling particle should not be treated as the marbling in meat quality evaluation.

Key Words: Image Analysis, Marbling Scores, Beef

T104 Prediction of total and regional carcass lean content by DXA cross-sectional analysis of pork carcasses. A. Mitchell*[1], A. Scholz[2], and V. Pursel[1], [1]*USDA, Agricultural Research Service, Beltsville, MD*, [2]*Ludwig Maximillians University-Munich, Oberschleissheim, Germany*.

The primary means of establishing the value of pork carcasses is based on lean yield. Dual energy X-ray absorptiometry (DXA) can be used to measure pork carcass composition by performing a total scan of the half-carcass. The scan can be analyzed for total or regional fat, lean, and bone mineral content, but is too slow for on-line slaughter application. The purpose of this study was to determine the feasibility of predicting carcass lean yield based on a single-pass cross-sectional measurement. A total of 327 right half-carcasses (43.2 ± 4.8 kg) were scanned by DXA. The DXA scans were analyzed for percentage lean in the entire half-carcass as well as the shoulder, ham, loin, and side regions. A total of 14 cross-sections (57.6 mm wide) were analyzed: 6 in the shoulder/thoracic region, 3 in the loin region, and 5 in the ham region. Regression analysis was used to compare the DXA lean measurements (kg) in the total carcass with those of the various regions. Carcass lean (kg) was predicted using carcass weight and the DXA value of percentage lean in a single slice from the ham region (R^2=0.94, SEE=0.66 kg), loin region (R^2=0.96, SEE=0.53 kg), or shoulder region (R^2=0.96, SEE=0.53 kg). The prediction was improved only slightly by using carcass weight in combination with a slice from each region (R^2=0.97, SEE=0.46 kg). The combination of carcass weight and DXA percentage lean in a single slice was less accurate for predicting the primal cut lean yield (kg) in the shoulder region (R^2=0.75, SEE=0.54 kg) or ham region (R^2=0.84, SEE=0.43 kg). These results indicate that carcass lean yield can be measured by performing a single-pass cross-sectional scan that would be compatible with on-line processing; however additional refinements are needed for accurate prediction of lean yield of primal cuts.

Key Words: Carcass Composition, DXA, Swine

T105 Potential of an electronic nose based on mass spectrometry to sort out boar tainted carcasses. S. Ampuero, P.-A. Dufey, and G. Bee*, *Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP), Posieux, Fribourg, Switzerland*.

Based on a parliamentary decision, in the year 2009 castration of male piglets without anesthesia will be banned in Switzerland. Thus, pork producers are forced to search for alternatives to the common practice. Rearing intact male pigs to market weight could constitute one possible alternative solution. However, producers, retailers, and consumers are concerned about the incidence of taint in pork. Therefore, a reliable, fast, and objective method to detect carcasses with the undesirable odor is a prerequisite for boar production. The aim of this study was to evaluate the potential of the electronic nose (SMart Nose 151, LDZ, Switzerland) with a mass spectrometer (quadripole) as a detector to classify boar tainted carcasses. In back fat (**BF**) samples of 35 boars and three castrates obtained from the loin region the concentrations of androstenone, skatole, and indole were determined by HPLC technique. The androstenone, skatole, and indole concentration in the BF of boars ranged between 0.2 - 4.4, 0.02 - 0.68, and 0 - 0.14 mg/kg, respectively. As expected, the androstenone, skatole, and indole levels in the BF of castrates were lower and ranged between 0 - 0.32, 0 - 0.04, and 0 - 0.01 mg/kg, respectively. These results revealed that the highest androstenone and skatole concentrations in the BF samples of the castrates were higher than the lowest concentrations determined in the BF of the boars. Subsequent analyses of the BF samples with the SMart Nose were carried out using two different sampling modes: solid phase micro extraction (**SPME**) fiber (divinylbenzen / carboxen / polydimethylsiloxane) and pyrolyser. The obtained spectra were subjected to Principle Component Analysis and revealed that with SPME 99% of the BF samples and with the pyrolyser, directly coupled to the injector, 100% of the BF samples of boars were correctly discriminated against the BF samples of the castrates. These preliminary results demonstrated the potential of the electronic nose to detect low levels of boar taint, independently of the kind of substance, and therefore to sort-out boar tainted carcasses.

Key Words: Electronic Nose, Boar Taint

T106 Relationship of pork longissimus muscle fatty acid profile with pork loin texture and sensory traits. S. Lonergan*[1], K. Stalder[1], T. Knight[1], R. Goodwin[2], K. Prusa[1], and D. Beitz[1], [1]*Iowa State University, Ames*, [2]*Goodwin Family Farms, Ames, IA*.

The objective this project was to determine the contribution of lipid composition and lipid profile to textural and sensory properties of fresh pork. Pigs (n=2009; from 306 sires and 1030 dams) from the 1991, 1992, 1994, and 2001 National Barrow Show Sire Progeny Test were used in this study. The test included purebred Berkshire (269), Chester White (175), Duroc (360), Hampshire (228), Landrace (196), Poland China (130), Spotted (195), and Yorkshire (456) barrows (1178) and gilts (831). Diets were uniform within test and across breeds. The halothane (Hal 1843™) genotype was determined. Pigs were slaughtered at 105 kg body weight, and samples of the longissimus muscle were obtained from each carcass at the 10th rib. Star probe, sensory traits, lipid content, and fatty acid profile were determined on the longissimus muscle from each pig. Data were analyzed using a mixed linear model including test, gender, halothane genotype, breed, and breed-by-gender interaction as fixed effects, with sire and dam within breed included as random effects. Total lipid content was correlated with saturated fatty acids and negatively correlated with unsaturated fatty acids. Myristic acid was positively correlated with tenderness and negatively correlated with star probe. Negative correlations between stearic acid and the traits of tenderness and juiciness were detected. No other fatty acid component was determined to have a strong correlation with pork texture or sensory traits. The results suggest that,when pigs are fed a similar diet, normal variations in pork loin fatty acid profile have little contribution to pork texture and sensory traits.

Pearson correlation coefficients for lipid composition and pork quality traits.

	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C20:3,C20:4
Lipid %	-.395	.443	.297	.187	.444	-.688	-.633
Star Probe	-.219	-.172	-.037	.025	-.031	.148	.191
Juiciness	.234	-.003	-.155	-.336	-.118	.109	-.017
Tenderness	.271	.031	-.122	-.330	-.095	.061	.064
Flavor	-.027	.028	.175	.172	.112	-.137	-.076

Key Words: Fatty Acids, Pork, Sensory Quality

T107 Effect of dietary conjugated linoleic acids (CLA) and sex on intramuscular collagen and bone characteristics in heavy pig. G. Maiorano*[1], A. Manchisi[1], K. Paolone[1], L. Costanza[1], M. Musella[2], and C. Corino[2], [1]*University of Molise, Campobasso, Italy*, [2]*University of Milano, Milano, Italy*.

Twenty-two heavy crossbred pigs (Goland x Hypor), 12 barrows and 10 gilts, were used to study the effects of dietary CLA supplementation (0.75% of the total diet) and sex (S) on intramuscular collagen (IMC) properties (collagen and crosslink concentrations) and skeletal development. *Longissimus dorsi* muscles and 3rd and 4th metacarpal and metatarsal bones were collected from chilled carcasses. Muscles were trimmed of fat and epimysium, lyophilized, and hydrolysed in 6N HCl for determination of hydroxyproline (Hyp) and hydroxylysylpiridinoline (HLP) crosslinks, which are regarded as main factors

contributing to meat tenderness. On bones were determined: length, diaphyseal diameter, fresh weight, and moisture. Moreover, on 3th metacarpal bone was measured growth plate width, site of the longitudinal bone growth. Collagen amount was calculated assuming that it weighted 7.25 times the Hyp weight. HLP was quantified by RP-HPLC. Data were analyzed by ANOVA. CLA reduced HLP concentration (6.29 vs 7.58 μg/mg; P=0.032), index of collagen crosslinking (which has been related to change in meat tenderness), whereas had very little effect on both IMC content and collagen maturity (HLP/IMC ratio). Gilts compared to castrate had higher amount of IMC (10.85 vs 8.83 μg/mg; P=0.014) tending to be less mature (-13.7% HLP/IMC), this confirms that castration reduces collagen synthesis and turnover. Metacarpal bones were affected by CLA supplementation, resulting more long (P=0.079) and less large (P=0.018) in treated animals. In addition, CLA reduced (P=0.08) growth plate width. S did not significantly influence bone characteristics, except for metatarsal diameter that was higher (P=0.047) in barrows than gilts. These results suggest that CLA supplementation has a positive effect on texture and tenderness of pork meat and skeletal development, who may condition muscle growth and fat deposition. Whereas S has limited influence on IMC properties and bone characteristics.

Key Words: Pork Quality, CLA, Sex

T108 Histochemical properties and meat quality traits of porcine muscles during growth: Effect of feed restriction in pigs slaughtered at the same weight and different age. G. Bee*, M. Calderini, C. Biolley, G. Guex, and W. Herzog, *Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP)*, *Posieux, Fribourg, Switzerland*.

Results of a previous study revealed that when the slaughter weight of pigs is lower at the same age the light portion of the semitendinosus (**STL**) was more oxidative, the LM and STL exhibited smaller myofibers, and these differences negatively affected meat tenderness. The aim of the study was to compare the histochemical properties of myofibers and meat quality traits of the LM and STL in pigs slaughtered either at the end of the growing or finishing period at the same BW but different age. Swiss Large White barrows (n = 24) from six litters were given ad libitum (**A**) or restrictive (**R**) access to a grower and finisher diet from 19.8 to 60 kg and 60 to 100 kg BW, respectively. Two littermates from each feeding regimen were slaughtered at 61 (**A60** and **R60**) or 101 kg (**A100** and **R100**). Muscle fibers were stained and classified based on the stain reaction as slow-oxidative (**SO**), fast oxidative-glycolytic (**FOG**), and fast glycolytic (**FG**), and fiber area and distribution were determined. In addition, percentages of cooking loss and shear force were assessed. Regardless of the BW at slaughter, while myofibers size was unaffected, the relative amount of SO was lower (8 vs. 12%; $P = 0.06$) and that of FG fibers was higher (71 vs. 64%; $P < 0.01$) in the LM of R60- and R100-pigs compared with the LM of A60 and A100-pigs. The SO fibres were more abundant in the STL of R60- (15%) than R100-pigs (5%), which were similar to the relative amount, found in the A60- (4%) and A100-pigs (6%) (feed restriction x weight interaction; $P = 0.02$). Compared to pigs of the ad libitum group, the STL of the restricted pigs was less tender (shear force of 4.3 vs. 3.3 kg; $P < 0.01$) and percentages of cooking loss were higher (23 vs. 19%; $P = 0.02$). Size of SO (r = -0.44), FOG (r = -0.41), and FG (r = -0.33) fibers were negatively ($P \leq 0.03$) correlated with shear force. In conclusion, at the same slaughter weight, myofiber size was unaffected by the age of the animal but the LM of restricted pigs was more glycolytic and a clear negative relationship existed between fiber size and meat tenderness.

Key Words: Slaughter Weight, Muscle Fibers, Meat Quality

T109 Effect of sire line and sex on productive performance and carcass quality of Iberian pigs. M. P. Serrano[1], D.G. Valencia[1], R. Lázaro[1], A. Fuentetaja[2], and G.G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Madrid, Spain*, [2]*Copese*, *Segovia, Spain*.

The production of Iberian pigs, the ancestral dark hairy pig original from Spain, has increased dramatically for the last 10 years, and current number of sows is close to 300.000. Cured products from Iberian pigs are characterized for its high quality but the productivity of sows and fattening pigs is low. A total of 180 pigs was used to study the influence of terminal sire line (DD, Danish Duroc; SD, Spanish Duroc; IB, Iberian) and gender (barrows, gilts) on performance and carcass quality of pigs sacrificed at 146 kg body weight. The female line used was pure Iberian in all cases. Treatments were arranged factorially (3 × 2) with five replicates (six pigs) per treatment. Crossbreds from DD and SD grew faster (682 and 672 vs 534 g/d; $P \leq 0.001$) and were more efficient (3.88 and 3.96 vs 4.56 g/g; $P \leq 0.001$) than pure IB. Barrows ate more feed (2673 vs 2488 g/d; $P \leq 0.01$) and were less efficient (4.26 vs 4.00 g/g; $P \leq 0.01$) than gilts. SD sired pigs had less carcass yield (80.2 vs 81.0 and 81.2%; $P \leq 0.05$) than DD and IB sired pigs. Iberian pigs were fatter (79.8 vs 50.0 and 50.9 mm at P_2 and 64.8 vs 42.7 and 44.4 mm at m. *Gluteus medius*; $P \leq 0.001$) and had higher pH at 2 and 24 h *post mortem* ($P \leq 0.001$) than DD or SD pigs. Primal trimmed cuts yield was higher for DD and SD than for IB sire line pigs (32.21 and 31.66 vs 24.81%; $P \leq 0.001$). Gilts had less carcass yield (80.3 vs 81.3%; $P \leq 0.01$) and carcass fat (58.9 vs 60.8 mm at P_2 and 48.8 vs 51.9 mm at m. *Gluteus medius*; $P \leq 0.01$) and had lower pH at 2 and 24 h *post mortem* ($P \leq 0.10$) than castrates. Also, gilts had more loin (4.32 vs 3.93%; $P \leq 0.001$), trimmed hams (18.28 vs 18.00%) and trimmed shoulders (11.62 vs 11.42%) yield than barrows ($P \leq 0.05$). We conclude that gilts had better productivity and yield of primal cuts but less carcass yield than barrows and that DD boars are a good alternative to pure IB boars for production of heavy pigs destined to the dry-cured industry.

Key Words: Iberian Pigs, Productive Performance, Carcass Quality

T110 Comparison of mineral content in beef, lamb and pig meat. G. Maiorano*[1], C. Cavone[1], C. Tarasco[2], L. De Tullio[2], and E. Gambacorta[3], [1]*University of Molise*, *Campobasso, Italy*, [2]*ARPA Molise*, *Campobasso, Italy*, [3]*University of Basilicata*, *Potenza, Italy*.

Minerals are essential trace nutrients in man diet, and deficiency causes abnormalities of growth and metabolism. The need to constantly update nutrient composition of different meats is well beyond discussion, because of their potential usefulness for food composition databases, research studies, nutritional education and patient counselling. Therefore, this study was designed to compare mineral composition (mg/100g of edible portion) in raw meat of beef, pig and lamb. *Longissimus dorsi* muscles were collected from chilled carcasses of 17 Podolian beefs, 16 Comisana lambs and 18 Large White pigs, slaughtered at 399.3, 18.6 and 179.3 kg LW, respectively, for Na, K, Mg, Ca, Fe and Zn determination. Samples were analysed in duplicate using flame atomic absorption spectrophotometry (wave-length: Na, 589.0 nm; K, 766.5 nm; Mg, 285.2 nm; Ca, 422.7 nm; Fe, 248.3 nm; Zn, 213.9 nm), after digestion in hydrochloric acid. Data were analysed by ANOVA. By comparison with data extracted from the Italian Food Composition Tables, was observed a similar mineral composition, except for Zn and Ca of beef meat, that were highest and lowest, respectively. However, the analysis of variance showed that lamb meat has significantly ($P<0.01$) highest level of Zn (3.4±1.1), Fe (2.1±0.3) and Na (94.2±15.4). Whereas, pig meat was richer ($P<0.01$) in K (430.0±53.2) than that of beef (347.1±41.1) and lamb (364.9±22.4), but poorest ($P<0.01$) in Fe (1.2±0.3). When compared to values of pig, beef meat was similar for Zn ($P>0.05$; 1.6±1.1 vs 2.2±0.5, for beef and pig, respectively) and higher for Fe ($P<0.01$; 1.7±0.3 vs 1.2±0.3 for beef and pig, respectively) and Na ($P<0.05$; 53.2±10.5 vs 41.2±5.7 for beef and pig, respectively) amount. No significant differences were found for Ca (7.7÷10.5) and Mg (24.8÷26.5) level. By meat mineral content comparison of different meat types, lamb meat results more valuable source of Zn and Fe than that of beef and pig, but too much rich of Na; while pork meat is better for both K and Na content.

Key Words: Beef, Meat, Minerals

T111 Effect of sex and castration ages on fatty acids composition of longissimus muscle in Hanwoo. N. H. Park*[1], J. Jeong[1], S. S. Lee[1], K. C. Lee[2], and C. B. Choi[2], [1]*Livestock Research Institute, National Agricultural Cooperative Federation*, *Ansung, Korea*, [2]*Yeungnam University*, *Kyungsan, Korea*.

To determine effects of sex and castration at different ages on fatty acids composition of longissimus muscle in Hanwoo, 75 Hanwoo were randomly assigned to one of five treatments(intact, castration at 5, 8, 12 and 16Mo of age). All animals were slaughtered at 26Mo of age. Regardless of sex and ages of castration, unsaturated fatty acids(UFA) were higher than saturated fatty acids(SFA). UFA from the castration groups, animals castrated at 8Mo of age had the highest of 59.24±.84%, followed by animals castrated at 16(58.09±.79%), 12(57.22±.85%), and 5Mo(53.55±1.26%) of age. Monounsaturated fatty acid(MUFA) was the highest in animals castrated at 8Mo of age and the lowest in intact animals(50.36±.84 vs 47.36±.98%, p≤0.05). Also UFA/SFA, MUFA/SFA and PUFA/SFA were 1.58±.05, 1.35±.04, and .23±.02%, respectively, in animals castrated at 8Mo of gae showed that fatty acids composition was the best out of all. Regardless of sex and ages of castration, C16:0 and C18:1 were the highest among SFA and UFA, respectively. Animals castrated at 8Mo of age had the highest of C18:1(42.57±.77%) followed by animals castrated at 12(40.19±.76%), 16(39.84±.80%), 5Mo(39.48±.74%) of age and intact animals(38.03±.90%). Except animals castrated at 16Mo of age, C14:0, C16:0, and C18:1 were higher in castration groups than in intact. The remnants of C14:1, C15:0, C16:1, C17:0, C18:0, C18:2, and C18:3 were higher in intact than castration groups. Varying the ages of castration may be used as a tool to manipulate fatty acids composition of carcass to meet market specification.

Key Words: Castration, Fatty Acids, Hanwoo

T112 Eating quality of forage-finished beef produced in Hawaii as compared to the imported mainland beef. M. DuPonte*, J. Dobbs, H. M. Zaleski, and Y. S. Kim, *University of Hawaii*, *Honolulu*.

Forage-finished beef contains a much lower amount of intramuscular fat, higher amount of omega-3 and unsaturated fatty acids than grain-finished beef. Forage-finished beef, however, is generally known to be less tender and less palatable than grain-finished beef. The objective of the study was to evaluate the sensory characteristics of locally-produced forage-finished beef in comparison to that of imported mainland beef. Rib steaks from 15 local forage-finished cattle, as well as 8 imported select and 8 imported choice steaks were used for sensory panel evaluation and shear force measurement. Average quality grade of the local forage-finished beef was low select. Local forage-finished beef had the lowest lipid content (3.12%) of ribeye muscle among the three beef types. Local forage-finished steaks had higher (p<0.05) shear force values than choice grade steaks. No difference in shear force was observed between the local forage-based steaks and select grade steaks. Sensory panel did not find a difference in flavor intensity and juiciness between the local forage-finished steaks and that of imported mainland beef. However, local forage-finished steaks scored lower (p<0.05) ratings in overall tenderness and overall palatability as compared to choice grade steaks. Increasing aging period of the local forage-finished steaks from 2 weeks to 3 weeks did not significantly affect the shear force and panel scoring of any of the sensory traits evaluated. Local forage-finished steaks showed wide variation in sensory traits, particularly tenderness, as compared to choice grade steaks, indicating an inconsistency in eating quality of the local forage-finished steaks. The results of this study suggest that identifying factors causing the inconsistency in tenderness of forage-finished beef is critical for a successful marketing of forage-finished beef.

Key Words: Forage-Finished Beef, Sensory Characteristics

T113 Effect of dietary lipid supplement on the performance and muscle fatty acid composition of beef bulls. D. A. Kenny*[1], R. P. Malone[1], E. Jordan[1], M. G. Diskin[2], B. Murray[4], and A. P. Moloney[3], [1]*University College Dublin*, *Belfield, Dublin, Ireland.*, [2]*Teagasc Research Centre*, *Athenry Co. Galway, Ireland.*, [3]*National Food Centre*, *Ashtown, Co. Dublin, Ireland*, [4]*Grange Research Centre*, *Dunsany, Co. Meath, Ireland*.

This study was designed to examine the effect of two different soyaoil supplementation strategies as well as the combination of soyaoil with fishoil, on tissue concentrations of conjugated linoleic acid (CLA) in cattle. Forty-eight continental cross bulls with a mean ± s.e. age and liveweight of 244 ± 2.29 days and 347 ± 3.63 kg respectively, were blocked on age, bodyweight, and breed and within block, randomly assigned to one of four dietary treatments over a 100-day finishing period. Animals were individually offered straw (10% of DMI) and barley based concentrate rations (90% of DMI) ad libitum. The concentrates contained one of the following: (i) no added lipid (CON); (ii) whole untreated soyabeans (WSB); (iii) 6% soyabean oil (SO), or (iv) 4% soyabean oil and 2% fish oil (FSO). Treatments (ii) to (iv) included 6% added oil in the dry matter and were isonitrogenous (18% CP). Feed intake was monitored on a daily basis. Following slaughter steaks were recovered from the M. longissimus dorsi and were analysed for fatty acid profile by GC. Daily DMI was lower for animals on WSB and FSO (P < 0.05) than CON and SO. Average daily gain, slaughter weight and carcass weight did not differ (P>0.05) between animals on CON, SO and FSO but tended (P=0.07) to be lower for animals on WSB when compared to FSO. The weight of kidney and channel fat (KCF) was highest for animals on SO. Intramuscular fat content was not different (P>0.05) between treatments. Concentrations of TVA were higher (P<0.001) in FSO and SBO than CON or WSB. The concentration of CLA cis-9, trans-11, was higher in animals on the supplemented treatments than on CON (P<0.001) and there was a tendency for this fatty acid to be higher in animals on SO (P=0.09). The omega-6:omega-3 ratio was lowest for FSO (P<0.001). Inclusion of soyaoil or a blend of fish and soya oil can increase tissue CLA concentration and feed conversion efficiency while maintaining satisfactory animal performance relative to a cereal based diet. Steaks from animals fed a combination of fish and soyaoil also had a low -6:-3 fatty acid ratio, which would be of additional benefit to human health.

Key Words: CLA, Fatty Acids, Beef

T114 Meat quality on female calves feeding high oil corn. G. J. Depetris*[1], F. J. Santini[1,2], E. L. Villarreal[1], E. E. Pavan[1], and D. H. Rearte[1], [1]*INTA EEA Balcarce*, *Balcarce, Argentina*, [2]*Fac. Cs. Agrarias, UNMdP*, *Argentina*.

Forty-two Angus female calves (FC; 160 ± 12 kg BW) were fed for 70-d on high concentrate diet consisting of either high oil corn (T1; 75% of ration) or conventional corn (T2; 75 % of ration). Twelve FC (248.8 ± 2.5 kg BW; P=0.17) per treatment were slaughtered in a commercial abattoir to carry out the carcass measurements. After 24 h postmortem, *Longissimus dorsi m.* (LM, 11th to 13th rib) was removed and cut into 15 cm steaks and frozen (-20ºC) for latter analysis of Warner-Bratzler shear force (WBSF), meat color (L* a* and b*), muscle ultimate pH, cooking loss and i.m. fatty acid (FA) composition. Carcass weight was affected by diet (T1:137.8 vs. T2: 133.5 kg; P = 0.07), but no differences was observed in dressing percentage (T1: 54.82 and T2: 54.24 %; P = 0.29). Kidney fat and total LM lipid content was greater (P = 0.03) in T1 (2.63 kg, 2.96 %) than in T2 (2.03 kg, 2.34%). Female calves fed T1 have a higher proportion (mg/100 mg fatty acid) of saturated FA (T1: 40.0 vs. T2: 38.4; P = 0.02) and conjugated linoleic acid *cis-9 trans-11* (CLA; T1: 0.36 vs. T2: 0.30; P = 0.09) than those fed T2 and lower proportion of unsaturated FA (T1: 47.84 and T2: 50.03; P = 0.01). No diet effect for n-3, n-6 FA, momounsaturated FA and polyunsaturated FA was observed (0.69, 7.97, 39.82, 9.11 mg/100 mg FA, respectivamente). FC fed T1 had lower WBSF (T1:4.05 vs. T2: 5.10 kg P < 0.05) and muscle pH values (T1: 5.56 vs. T2: 5.97; P < 0.01) but higher b* value (T1: 15.93 vs T2: 13.37). No differences were observed for a* and L* value or for cooking losses (%) between treatments (14.82, 36.21, 30.0%; P > 0.05). These data suggest that substituting high oil corn for conventional corn in diets for finishing FC improved meat quality by decreasing the ultimate pH and by increasing tenderness and i.m. fat content, however, although high oil corn tend to increase the desired CLA in the i.m. fat also increased the proportion of the less desired saturated FA.

Key Words: High Oil Corn, Female Calves, Meat Quality

T115 Predicting beef tenderness: the relationship between myosin light chain 1 and fast myosin heavy chain fragments. R. Johnson*, J. Sawdy, M. Updike, N. St-Pierrre, and M. Wick, *The Ohio State University*, *Columbus*.

A correlation study was conducted to determine the relationship between the electrophoretic fingerprint quantity of myosin light chain I (MLC1) and the electrophoretic fingerprint quantity of fast myosin heavy chain (fMyHC) fragments from longissimus dorsi taken at 36 h post-harvest from cattle with differing Warner-Bratzler shear force values at 7 d. Data were analyzed using SAS; Proc Corr. Although the electrophoretic fingerprint intensities of MLC1 and both fMyHC fragments were predictive of tenderness at 7 d, neither of the two fMyHC fragments band intensities were correlated with each other. However, MLC1 band intensity was found to have a correlation of 0.5 with the individual band intensities of each fMyHC fragment ($p \leq 0.05$). Analyses of these results support the hypothesis that an increased association of MLC1 with fMyHC results in an improvement in meat quality. This implies that fMyHCs that are associated with higher MLC1/MLC3 ratio are more susceptible to proteolytic digestion than are fMyHCs with lower MLC1/MLC3 ratios.

Key Words: Tenderness, Myosin, Fingerprinting

T116 Enhancement with varying phosphate types, concentrations, and pump rates, without sodium chloride on beef biceps femoris quality and sensory characteristics. R. T. Baublits*, F. W. Pohlman, A. H. Brown, and Z. B. Johnson, *University of Arkansas*, *Fayetteville*.

Beef biceps femoris muscles (n = 45) were used to evaluate the effect of enhancement with solutions containing either sodium hexametaphosphate (SHMP), sodium tripolyphosphate (STPP), or tetrasodium pyrophosphate (TSPP) at either 0.2% or 0.4% of product weight, without sodium chloride. All solutions were injected into muscle samples at either 112% (12% pump) or 118% (18% pump) of raw product weight. Muscles enhanced with STPP or TSPP had a higher ($P < 0.05$) pH than SHMP or untreated muscles (CNT), whereas there was no difference ($P > 0.05$) in pH between SHMP and CNT. Muscles enhanced with STPP had less ($P < 0.05$) free water than CNT, whereas SHMP and TSPP did not differ from CNT. However, direct comparison of phosphate types revealed no difference ($P > 0.05$) in free water. Steaks enhanced with SHMP had greater ($P < 0.05$) cooking losses than CNT, whereas steaks treated with STPP or TSPP did not differ ($P > 0.05$) from CNT. Additionally, phosphate inclusion at 0.2% allowed for greater ($P < 0.05$) cooking losses than CNT, whereas 0.4% phosphate inclusion exhibited similar ($P > 0.05$) cooking losses as CNT. Although there were no differences ($P > 0.05$) in cooking loss between pump rates, steaks enhanced at an 18% pump rate had greater ($P < 0.05$) cooking losses than CNT, whereas those enhanced at 12% had similar ($P > 0.05$) cooking losses as CNT. Enhancement with either of the three phosphate types or either concentration did not improve ($P > 0.05$) sensory tenderness or juiciness characteristics compared to CNT, but enhancement at an 18% pump rate allowed for increased ($P < 0.05$) tenderness, compared to a 12% pump rate. These results suggest that, while phosphate enhancement independent of sodium chloride generally produced similar yields and palatability as untreated samples, utilizing higher phosphate concentrations, or utilizing STPP or TSPP effectively retained the additional water associated with solution enhancement, allowing for similar free water and cook yields as untreated samples.

Key Words: Beef, Phosphate, Sodium Chloride

T117 Enhancement effects of phosphate type, concentration, and pump rate, without sodium chloride on beef biceps femoris instrumental color characteristics. R. T. Baublits*, F. W. Pohlman, A. H. Brown, and Z. B. Johnson, *University of Arkansas*, *Fayetteville*.

Enhancement of beef biceps femoris muscles (n = 45) with solutions comprising sodium hexametaphosphate (SHMP), sodium tripolyphosphate (STPP), or tetrasodium pyrophosphate (TSPP) at either 0.2% or 0.4% of product weight, with the exclusion of sodium chloride, was performed to observe the independent phosphate effects on whole-muscle instrumental color during simulated retail display. All solutions were injected into muscle samples at either 112% (12% pump) or 118% (18% pump) of raw product weight. All three phosphate types maintained higher ($P < 0.05$) L* values than untreated steaks (CNT) through 5 days of display, and SHMP had higher ($P < 0.05$) L* values than STPP and TSPP through 7 days of display. Additionally, steaks with 0.2% phosphate inclusion were lighter (L*; $P < 0.05$) than CNT throughout display, and were lighter ($P < 0.05$) than steaks enhanced with 0.4% phosphates through 7 days of display. Steaks enhanced with TSPP had higher ($P < 0.05$) a* values than CNT on days 5 and 7 of display, whereas SHMP- or STPP-enhanced steaks had similar ($P > 0.05$) a* values as CNT. Direct comparison of phosphate concentrations revealed no differences ($P > 0.05$) in a* values. Steaks enhanced with TSPP had higher ($P < 0.05$) proportions of oxymyoglobin (630/580 nm) than CNT on days 5 and 7 of display. However, direct comparison of phosphate types indicated that TSPP- and STPP-enhanced steaks had similar ($P > 0.05$) oxymyoglobin proportions during display. Phosphate inclusion at 0.4% maintained higher ($P < 0.05$) oxymyoglobin proportions than 0.2% phosphate inclusion through 5 days of display. These results indicate that while 0.2 % phosphate concentrations maintain lighter color (L*), 0.4% concentrations can more effectively retain oxymyoglobin during display. Additionally, steaks enhanced with TSPP were redder (a*) and had higher oxymyoglobin proportions than untreated steaks during the latter stages of display.

Key Words: Beef, Phosphate, Instrumental Color

T118 Withdrawn.

Nonruminant Nutrition: Amino Acids and Dietary Restrictions

T119 Development of the enzymes of homocysteine metabolism from birth through weaning in the pig. D. M. Ballance* and J. D. House, *Department of Animal Science*, *University of Manitoba, Winnipeg, MB, Canada*.

In humans, non-human primates and rats, cysteine (CYS) is considered to be a conditionally indispensable amino acid. Developmental delays in the activity levels of a key enzyme from the transulphuration pathway, cystathionine-β-synthase (CBS) and cystathionine-γ-lyase (CGL) may contribute to the limitation in endogenous CYS availability. As CYS is an important precursor for protein and glutathione synthesis, information on the developmental patterns of these enzymes for the pig is important for the optimization of diets for cysteine delivery, especially when pigs are weaned at an early age. To this end, a study was designed to measure the activities of CBS and CGL, and associated metabolite profiles, from birth through to post-weaning in the pig. Piglets were collected from eight litters at six time points: Days 0 (pre-suckle), 1, 9, 18 (pre-wean), 19 (post-wean) and 26. Blood was collected and plasma retained for total CYS and homocysteine (HCY) measurements. Piglets were killed by overdose of barbiturates, and livers and kidneys were weighed and retained for CBS and CGL activity measurements and CYS levels. Hepatic activities for both CBS and CGL were low at birth and increased ($P < 0.001$) immediately thereafter. Plasma CYS and HCY levels were lowest at birth and increased 2.5- and 5-fold, respectively, up to weaning, with levels declining post-weaning ($P < 0.001$). Despite changes in enzyme activities and plasma concentrations, hepatic CYS levels were constant from birth through weaning, but increased by 50% at d 26. The current data provide evidence that hepatic CBS and CGL activities increase from birth, providing a partial explanation for changes in plasma CYS and HCY levels. However, hepatic CYS levels appear to be insensitive to changes

in key enzyme activity levels during the suckling period. Factors contributing to the post-weaning changes in metabolite profiles require further attention in order to optimize endogenous CYS supply to the young pig.

Developmental pattern of enzymes of homocysteine metabolism from birth through weaning in the pig

	d 0	d 1	d 9	d 18	d 19	d 26	SEM	P-value
CBS-L	116[a]	347[a,b]	458[b,c]	471[b,c]	589[c]	578[b,c]	54	< 0.001
CGL-L	96[a]	527[c]	383[b,c]	316[c]	380[b,c]	359[b,c]	38	< 0.001

Acknowledgements: NSERC

Key Words: Pig, Homocysteine, Sulfur Amino Acid Metabolism

T120 Effects of increasing true ileal digestible amino acid to lysine ratios on grower pig performance. A. Yager*, D. Sholly, L. Wilson, J. Beagle, R. Hinson, K. Saddoris, M. Walsh, B. Richert, A. Sutton, and J. S. Radcliffe, *Purdue University*, *West Lafayette, IN*.

Two experiments evaluated the effects of increasing the true ileal digestible (TID) amino acid ratios, relative to Lys, on grower pig performance. Pigs (Exp. 1, n = 210; Exp. 2, n = 120) were housed at seven pigs/pen in Exp. 1 and four pigs/pen in Exp. 2. Individual BW and pen feed intakes were recorded weekly and ultrasonic estimates of 10th rib LEA and BF thickness were determined at the start, middle, and end of each experiment on four pigs/pen. All diets were corn-soybean meal based and formulated to meet or exceed all the 1998 NRC nutrient requirements. Diets were fed in two, 3-wk phases. In Exp. 1, Diet 1 (0.35% Lys-HCl), contained 100% NRC TID Lys, TSAA, and Thr. Diets 2-4 were Diet 1 plus a 5% increase in TID Thr, TSAA, or both TSAA and Thr, respectively. Diet 5 was a commercial control (0.13% Lys-HCl). In Exp. 2, Diet 1 (0.35% Lys-HCl) contained 100% NRC TID Lys, Trp, Val, and Ile, and 105% NRC TID TSAA and Thr. Diets 2-5 were Diet 1 plus synthetic Met and Trp, Val, Ile, or all four amino acids to meet the TID amino acid levels in Diet 6, respectively. Diet 6 (0.13% Lys-HCl) served as a commercial control. In Exp. 1, increasing the TID TSAA:Lys and/or the TID Thr:Lys had no effect (P > 0.10) on ADG, ADFI, G:F, or 10th rib BF. Pigs fed Diet 5 (commercial control) had higher (P < 0.05) overall ADG than pigs fed Diet 1. The overall change in last rib BF tended (P < 0.10) to be lower for pigs fed Diet 5 compared to pigs fed Diets 2 and 3. In Exp. 2, increasing the TID amino acid content of the diet had no effect (P > 0.10) on ADFI, G:F, or 10th rib LEA. Overall ADG increased (P < 0.01) when the TID TSAA and Trp, or Val were increased compared to Diet 1. Increasing the TID Val content increased 10th and last rib BF (P < 0.05) compared to all other diets. Pigs fed Diet 4, with added Ile, had smaller increases in LEA compared to pigs fed Diets 1, 2, and 5 (P < 0.05). Based on these results, increasing the TID TSAA, Trp, or Val content in high synthetic amino acid diets is necessary to restore performance to that of a commercial diet.

Key Words: Pig, Amino Acids, Growth

T121 Effect of dietary L-Arginine inclusion rate on stress responses in pigs subjected to a high-intensity handling model. M. J. Ritter*[1], M. Ellis[1], D. H. Baker[1], C. R. Bertelsen[1], and K. K. Keffaber[2], [1]*University of Illinois*, *Urbana-Champaign*, [2]*ELANCO Animal Health*, *Greenfield, IN*.

This study was carried out to investigate the impact of dietary L-arginine on stress responses and plasma acid-base status in finishing pigs subjected to high-intensity handling. A completely randomized design with a 4 × 2 factorial arrangement of treatments was used: 1) dietary arginine (ARG) level (0, 1, 2, and 3%) and 2) gender (barrows and gilts). At 110 kg BW, 96 pigs were allotted to treatments and allowed an 11 d acclimation period after which the treatment diets were issued, fed for 7 d, and BW and feed intake were recorded. The higher ARG levels (2 and 3%) reduced (P < 0.05) final BW, ADG and ADFI when compared to 0 and 1% ARG, which did not differ for these traits. Also, 0 and 1% ARG had higher (P < 0.05) G:F ratios than 2% ARG. Gender had no effect on growth performance. At the end of the feeding period, pigs were subjected to a high-intensity handling model. Pigs were moved individually through a course for eight laps and each pig received four shocks from an electric goad per lap. Rectal temperature and blood acid-base status were measured 2 h before (baseline), immediately after, and 2 h post-handling. Diet did not affect acid-base status at any sampling time, while gender differences in acid-base status were small. Rectal temperature was lower (P = 0.01) at baseline in pigs fed 2% ARG than in the controls, was lower (P < 0.05) immediately after handling in pigs fed 1% ARG than in pigs fed 0 or 2%, but no effects of ARG on rectal temperature were seen 2 h post-handling. Gilts had lower (P < 0.05) rectal temperatures than barrows at all three sampling times. The percentage of pigs classifed as non-ambulatory, non-injured after handling was lower (P < 0.05) in gilts (5.2%) than in barrows (18.8%), but only numerical reductions (P = 0.28) were observed for ARG (20.8, 8.3, 14.6, and 4.2 ± 6.43% for 0, 1, 2 and 3%, respectively). Feeding 2 and 3% ARG adversely affected growth performance, and ARG did not affect blood acid-base status before or after handling.

Key Words: Pigs, Acid-Base, Handling

T122 Effects of protein source and metabolizable energy concentration on the growth of the pancreas, stomach, and small intestine in early-weaned pigs. T. Buhay*, S. Carter, R. Cueno, M. Lachmann, J. Park, and J. Schneider, *Oklahoma State University*, *Stillwater*.

Previous work from our lab suggests that CP source may affect ME utilization in early-weaned pigs. Therefore, as part of a larger study to examine the effects of CP source (soy protein concentrate, SPC vs. spray-dried porcine plasma, SDPP) and ME level on organ and pancreatic enzyme development, an experiment utilizing 100 pigs (avg BW = 5.2 kg; avg age = 18 d) was conducted to determine the effects of these factors on the growth of the pancreas, stomach, and small intestine in weanling pigs. Pigs were allotted to four dietary treatments (five pigs/pen) in a 2 x 2 factorial arrangement with two CP sources (SPC vs. SDPP) and two ME levels (3,523 vs. 3,323). All diets (1.35% digestible Lys) contained corn, soybean meal, dried whey, lactose, and fishmeal. SDPP replaced SPC on an equivalent digestible lysine basis and the dietary ME level was adjusted using soybean oil. On d 0, 3, 7, and 14, one pig was removed from each pen, weighed, and euthanized. The pancreas, stomach, and small intestine (SI) were excised carefully, emptied and washed as needed, and weighed. Overall, the growth of the pancreas, stomach, and SI were highly correlated (r > 0.85, $P < 0.01$) with BW. Furthermore, the weights of these organs were associated with increasing BW and age ($R^2 > 0.70$, $P < 0.01$). There were no day by treatment interactions; and ME level did not affect ($P > 0.10$) the growth of the organs on any day. However, CP source affected the growth of the organs such that on d 7, SI weight was lower ($P < 0.05$) in pigs fed SDPP compared to pigs fed SPC. On d 14, both the individual and combined weights of the stomach and SI were lower ($P < 0.05$) in pigs fed SDPP compared to those fed SPC. There were no CP source by ME level interactions. These results suggest that CP source (SPC vs. SDPP), but not ME level, can dramatically affect the growth of the stomach and SI. Also, it appears that BW may be used to predict the weight of the pancreas, stomach, and small intestine in early-weaned pigs.

Key Words: Pig, Protein, Organ Weights

T123 Impact of spray-dried plasma form and feeding duration on broiler performance. J. M. Campbell*[1], J. D. Crenshaw[1], L. E. Russell[1], and H. J. Koehnk[2], [1]*APC, Inc.*, *Ankeny, IA*, [2]*ARKO Laboratories, Ltd.*, *Jewell, IA*.

An experiment was conducted with 240 Ross × Ross 308 male broilers (six broilers per pen, eight pens per treatment). The effect of duration of feeding (continuous or discontinued after d 14) and form (granular vs. powder) of spray-dried plasma (SDP) on performance and mortality of broilers under simulated

production conditions was evaluated. Dietary treatments were control (0% SDP) or SDP (1.0, 0.5, and 0.25% for day 0-14, 15-28, and 29-35, respectively) as powder or granular included in the pellet and fed continuously (d 0 to 35) or discontinued after d 14. During the experiment, broilers developed necrotic enteritis and tissue cultures were positive for *E. coli* and *Salmonella*. Addition of SDP to the feed improved ($P < 0.05$) ADG, feed intake, and feed efficiency for each time period of the study (d 0 to 14, 15 to 28, 29 to 35, and 0 to 35). Continuous feeding of SDP improved ($P < 0.05$) ADG, feed intake, and feed efficiency from d 15 to 35 compared to broilers fed SDP only to d 14. Survival was improved ($P < 0.05$) in broilers consuming SDP either for 14 d only or for 35 d continuously compared to control broilers. Spray dried granular plasma was more effective than spray dried powder plasma. The results of this experiment confirmed that SDP improved growth rate, feed intake and feed efficiency of broilers. The response to SDP was independent of age of the broiler.

Key Words: Broiler, Spray-Dried Plasma, Necrotic Enteritis

T124 Effect of mash conditioning temperature on performance of broilers fed pellets containing spray-dried plasma. J. M. Campbell*[1], J. D. Crenshaw[1], L. E. Russell[1], K. C. Behnke[2], and P. M. Clark[2], [1]*APC, Inc.*, *Ankeny, IA*, [2]*Kansas State University*, *Manhattan*.

Two experiments evaluated the effects of mash conditioning temperature on performance of broilers fed pelleted diets containing spray-dried plasma (SDP). In Exp. 1, 308 Ross x Ross male broilers were randomly assigned to one of three dietary feeding programs (six broilers per pen and 10 pens per treatment). The feeding program consisted of three phases with starter from d 0 to 14, grower from d 15 to 28, and finisher from d 29 to 42. Within each phase, treatments were formulated to be equal in lysine and metabolizable energy. All diets were conditioned for 15 seconds at 85°C then pelleted through a 4 mm x 32 mm die. Dietary treatments were: control (0% SDP); SDP (1.0, 0.5, and 0.25% for phase 1, 2, and 3, respectively) applied post-pelleting, and SDP (1.0, 0.5, and 0.25% for phase 1, 2, and 3, respectively) mixed into the mash and then pelleted. Exp. 2 was designed similarly to Exp. 1, with the exception that only eight pens (six broilers per pen) per treatment were used and two additional treatments were added to include SDP mixed into the mash then pelleted at either 90 or 95°C. In Exp. 1, ADG and feed intake were improved ($P < 0.05$) for broilers fed SDP from d 0 to 28 with greater body weight at d 42. In Exp. 2, both in early (d 0 to 28) phases and overall (d 0 to 42), broilers fed SDP had improved ($P < 0.05$) gain and efficiency. Body weight was improved ($P < 0.05$) due to plasma consumption compared to controls on d 14 to 42. Overall, results of both experiments indicated that mash conditioning temperature from 85 to 95°C does not impair the positive growth effects of SDP in pelleted broiler feed.

Key Words: Spray-Dried Plasma, Broiler, Mash Conditioning Temperature

T125 A spreadsheet program for identifying the limiting amino acids in various combinations of feed ingredients for swine. G. L. Cromwell* and B. G. Kim, *University of Kentucky*, *Lexington*.

One of the most effective methods of reducing N excretion by pigs is to reduce the dietary protein level and supplement with amino acids (AA). However, effective AA supplementation requires knowledge of the order in which AA become limiting as dietary protein is reduced in diets containing various combinations of feed ingredients, as well as knowledge of the relative magnitude of difference between the AA in their limitation order. This information is fairly well known for grain-soy diets, but is less well known for diets containing various combinations of feedstuffs. A user-friendly Microsoft® Excel program was designed to address this issue for pigs at all stages of growth and for gestating and lactating sows. The program allows users to include numerous feedstuffs that contribute AA to the diet and graphically illustrates the order that AA become limiting as the dietary level of the major protein source(s) decreases. The program converts the dietary concentrations of AA to a percentage of the pig's requirement, then regresses those percentages on the inclusion level of the major protein sources in the diet. As the protein source decreases from a level that meets >100% of the pig's AA requirements to a level of zero, the regression line for each AA intersects a horizontal line, which is set as 100% of the requirement for each AA. Proceeding along the horizontal line, one can readily assess the order and spacing between the AA as they become limiting. The program is applicable for AA on a total, apparent digestible, or true digestible basis. An economic component also is included. The validity of the output is dependent upon the accuracy of the AA requirements and the accuracy of the AA analysis of the feedstuffs. Information generated from this program allows nutritionists to identify potentially limiting AA in different feedstuff or growth stage scenarios. It will also help to more precisely determine the amount of intact protein that can be replaced with AA to minimize N excretion when various combinations of feedstuffs are fed to pigs.

Key Words: Amino Acid, Diet Composition, Pig

T126 Apparent and true digestibility and endogenous urinary excretion of amino acids in adult roosters. L. Babinszky*[1], J. Tossenberger[1], and A. Lemme[2], [1]*University of Kaposvár, Department of Animal Nutrition*, *H-7400 Kaposvár, POB 16, Hungary*, [2]*Degussa AG, Feed Additives*, *D-63457 Hanau, Germany*.

Digestibility of dietary amino acids (AA) might be most accurate considering both separation of faecal and urinary AA excretions, and endogenous AA excretion. Therefore, the aim of the experiment was to determine endogenous faecal and urinary AA excretions and to examine the difference between apparent [(AA intake - AA faeces)/AA intake] and true AA digestibility [(AA intake - AA faeces + AA $faeces_{end}$)/AA intake] and apparent [(AA intake - AA faeces - AA urine)/AA intake] and true AA availability [(AA intake - AA faeces - AA urine + AA $faeces_{end}$ + AA $urine_{end}$)/AA intake] in adult roosters. Endogenous faecal and urinary AA excretions were measured by feeding a N-free diet. Using these data, apparent or true AA digestibility and availability of a test diet containing 13.4 MJ AMEn, 160 g CP, 9.9 g Lys, 0.37 g Met and 0.30 g Cys per kg was determined. Both trials were conducted with a total of 16 adult colon-cannulated Hy-Line brown roosters (four birds/treatment in two replicates). Trial data were analyzed by means of ANOVA. Adult roosters excreted a total of 4.7, 6.7, and 15.5 mg/$kg^{0.75}$/d endogenous Met, Cys and Lys, respectively, of which 9, 32 and 28 % were contributed by urinary excretions. The differences between apparent and true AA digestibility of the test diet, e.g. 0.902 vs. 0.939, 0.878 vs. 0.929 and 0.888 vs. 0.926 for Met, Cys and Lys, respectively, were significant ($P \leq 0.05$). The differences were also significant ($P \leq 0.05$) between the apparent and true availability of the dietary Met (0.895 vs. 0.936), Cys (0.831 vs. 0.905) and Lys (0.865 vs. 0.917), respectively. In conclusion, differences between true digestibility and true availability ranged only between 0.003 (Met) and 0.024 (Cys) suggesting only a marginal impact of urinary AA losses on their dietary availability. However, substantial differences between apparent and true AA digestibility/availability were confirmed.

Key Words: Rooster, Amino Acids, Endogenous Urinary Excretion

T127 Protein restriction during the weaner phase affects subsequent feed intake, growth performance and carcass characteristics. C. L. Collins*[1,3], D. J. Henman[2], B. J. Leury[3], R. G. Campbell[4], B. G. Tatham[1], and F. R. Dunshea[1,3], [1]*Primary Industries Research Victoria*, *Werribee, Victoria, Australia*, [2]*QAF Meat Industries*, *Corowa, NSW, Australia*, [3]*Faculty of Land and Food Resources, University of Melbourne*, *Parkville, Victoria, Australia*, [4]*Ausgene International*, *Gridley, IL*.

rotein restriction during the early stages of rearing results in subsequent compensatory growth, although the impact of the severity and timing of the restriction is unclear. To examine these effects, 400 boars and 400 gilts were selected at 28 days of age and allocated to 40 pens of 20 pigs per pen. Pigs were offered ad libitum access to commercial weaner/grower/finisher diets from weaning to slaughter, except during their allocated restriction period. The periods of protein restriction were 4 to 7 weeks of age (Phase 1) and 7 to 10 weeks of age (Phase 2). Pens of 20 pigs of each sex were allocated to one of five treatments:

control, phase 1 available (Av) Lys:DE restricted by 20%, phase 1 Av Lys:DE restricted by 40%, phase 2 Av Lys:DE restricted by 20%, and phase 2 Av Lys:DE restricted by 40%. Daily gain was reduced ($P < 0.05$) during all periods and levels of restriction with the greatest effects occurring at the highest level of restriction and during the second period of restriction. Dietary protein restriction resulted in compensatory growth in all restriction groups with the responses being most pronounced in the early finisher (116-138 days of age) phase (746, 726, 847, 756 and 813 g/d for control, phase 1 20% restriction, phase 1 40% restriction, phase 2 20% restriction, and phase 2 40% restriction, respectively; SED = 34 g/d, $P < 0.001$). The improvements in daily gain over this period were largely due to an improvement in FCR (2.58, 2.73, 2.39, 2.48 and 2.39; SED = 0.092, $P < 0.001$). While the increased compensatory gain was insufficient to return carcass weights to control values (71.4, 68.8, 68.3, 67.8, 67.1 kg; SED = 1.40, $P < 0.024$) this may be offset by a reduction in P2 backfat (9.5, 8.9, 9.3, 9.2, 8.9 mm; SED = 0.24, $P = 0.079$) and cost of feed. These data suggest that strategic lysine restriction may be commercially applicable particularly when protein costs are high and when producers are penalised on backfat.

Acknowledgements: Supported in part by Australian Pork Limited.

Key Words: Compensatory Growth, Pig, Dietary Protein

T128 Effect of early dietary amino acid restrictions on serum metabolites in pigs selected for lean growth efficiency. H. R. Mule*, L. I. Chiba, J. Fabian, D. L. Kuhlers, S. B. Jungst, L. T. Frobish, K. Nadarajah, W. G. Bergen, and E. G. Welles, *Auburn University*, *Auburn, AL*.

Thirty-two select line (SL) and 32 control line (CL) pigs (average, 20 kg) were used in each of the two experiments to assess the effect of dietary AA restrictions during the grower (G) phase on serum metabolites. In Exp. 1, 16 pens with two gilts and 16 pens with two barrows per pen were assigned within the genetic line to G diets (6.1 or 11.1 g Lys/kg) and finisher (F) diets (6.1 or 8.9 g Lys/kg) in a 2 x 2 x 2 factorial arrangement. Similarly, 16 pens with two gilts and 16 pens with two barrows per pen were assigned within the genetic line to G diets (5.0, 7.0, 9.0, or 11.0 g Lys/kg) in a 2 x 4 factorial arrangement, and then offered common F 1 and 2 diets in Exp. 2. In both experiments, blood samples were collected at the end of the G and F phases. In Exp. 1, the SL pigs had higher concentrations of cholesterol (Chol; $P = 0.009$) during the G phase and triglyceride (TG; $P = 0.036$) and albumin (Alb; $P = 0.016$) during the F phase than the CL pigs. Serum concentrations of Alb ($P = 0.001$) during the G phase and Chol ($P = 0.029$) and Alb ($P = 0.001$) during the F phase were greater in pigs fed the high-Lys G diet than those fed the low-Lys G diet. During the F phase, TG ($P = 0.029$), Alb ($P = 0.005$), and glucose ($P = 0.027$) concentrations were reduced in pigs fed the high-Lys F diet as compared with those fed the low-Lys F diet. In Exp. 2, the SL pigs had greater concentrations of TG ($P = 0.001$), total protein (TP; $P = 0.041$), and glucose ($P = 0.005$) during the G phase and TG ($P = 0.031$) and TP ($P = 0.001$) during the F phase than the CL pigs. As the Lys content of G diets increased, Chol was reduced [linear (Ln), $P = 0.005$; quadratic, $P = 0.026$; cubic, $P = 0.039$], but TP (Ln, $P = 0.040$) and Alb (Ln, $P = 0.001$) concentrations were increased during the G phase. Serum Chol was correlated negatively with Lys intake ($r = -0.38$; $P = 0.039$) and urea N ($r = -0.39$; $P = 0.032$) during the G phase in Exp. 1 and positively with ultrasound backfat ($r = 0.78$; $P = 0.001$) at the end of the G phase in Exp. 2. The results indicated that the metabolic profile can be affected by both the genotype and early dietary AA restrictions.

Key Words: Pigs, Genotypes, Amino Acid Restrictions

T129 Effect of early feed restriction on carcass yield, carcass components and gonads of Japanese quail breeder. G. Contreras*, C. B. Castro, J. J. Portillo, and F. G. Rios, *FMVZ-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

The objective of this study was to determine the effect of early feed restriction (FR) on carcass yield, carcass components and gonads weight of Japanese quail breeder. The breeders were restricted in rearing period during three weeks (two to five weeks old) by feeding ad libitum (Control, CO), FR-10%, FR-20% and FR-30%. Birds were fed a diet containing 25% CP and 2.85 Mcal ME/kg. After feed restrictions, 320 quails (240 females and 80 males) were allocated to two batteries with five levels, and each level with four cages (40 cages). Each cage contained six females and two males. Birds were fed a diet containing 21.43% CP and 2.86 Mcal ME/kg. Lighting program was 16L:8D (0630 to 2230). Levels were considered as blocks and cages as experimental units. Data were analyzed as a randomized block design. At the end of experiment, ten quails (five females and five males of 98 days old) of each feed restriction were stunned, slaughtered and carcass traits measured. Average final weight (299.04 g) and carcass yield (53.69%) were unaffected ($P > 0.05$) by feed restriction. Feed restriction did not influence ($P > 0.05$) carcass weight (160.35 g), total meat (88.67 g), total bone (42.56 g), or whole breast (47.31 g). Disectable fat of birds restricted at FR-20% was lower ($P < 0.05$) by 32.7% (24.51 vs. 16.5 g) compared to birds fed CO. Ovary weight (10.47 g) and testes weight (7.39 g) were not modified ($P > 0.05$) by feed restriction. It is concluded that feed restriction did not influence carcass yield neither gonad weight.

Key Words: Food Deprivation, Carcass Yield, *Coturnix coturnix japonica*

T130 Effect of early feed restriction on productive and reproductive performance of Japanese quail breeder. G. Contreras*, C. B. Castro, J. J. Portillo, and F. G. Rios, *FMVZ-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

The objective of this study was to determinate the effect of early feed restriction (FR) on productive and reproductive performance of Japanese quail. The breeders were restricted in rearing period during the 3-week (two to five weeks old) by feeding ad libitum (Control, CO), FR-10%, FR-20% and FR-30%. Birds were fed a diet containing 25% CP and 2.85 Mcal ME/kg. After feed restrictions, 320 quails (240 females and 80 males) were allocated to two batteries, each battery with five levels and each level with four cages (40 cages). Birds were fed a diet containing 21.43% CP and 2.86 Mcal ME/kg. Lighting program was 16L:8D (0630 to 2230). Cage levels were considerer as blocks and cages as experimental units. Data were analyzed as a randomized block design. Specific predetermined contrasts were used to test differences between CO and FR. Average daily feed intake of quails restricted increased ($P < 0.05$) by 5.1% (42.2 vs. 44.3 g) than control. Feed restriction delayed ($P < 0.05$) age at the onset production by 6.3 days (42.0 vs. 48.37 d) and age at 5% production by 6 days (44.8 vs. 50.8 d). Weight of first egg was not affected by feed restriction (10.91 g). Percentage hen day production (79.12) was not modified ($P = 0.22$) by feed restriction. Weight of egg laying of birds restricted at 30% was heavier ($P < 0.05$) by 2.5% (13.34 vs. 13.68 g) than others treatments, although weight of hatching egg (13.66 g) was not affected ($P > 0.10$) by treatments. Percentage of hatching egg was diminished ($P > 0.06$) in 2.2% by feed restriction (79.19 vs. 77.44), but fertility (86.38%) and hatchability (82.60%) was not affected by restriction. Embryo mortality (17.4%) was not modified by feed restriction. Hatching egg of quails without restriction had 6.78% more living chick (59.98 vs. 53.2%) than feed restriction at 30%. It is concluded that feed restriction at 10 and 20% maintains the productive performance and chick production.

Key Words: Food Deprivation, Productive Performance, *Coturnix coturnix japonica*

T131 The effects of fermented soy protein in creep diet on growth performance in piglets and backfat loss in lactating sows. B. J. Min*[1], O. S. Kwon[1], K. S. Son[1], J. H. Cho[1], Y. J. Chen[1], I. H. Kim[1], S. S. Lee[2], and W. T. Cho[2], [1]*Department of Animal Resource & Science, Dankook University*, *Cheonan, Korea*, [2]*Genebiotech Co. Ltd.*, *Korea*.

This study was conducted to evaluate the effects of fermented soy protein in creep diet on growth performance in piglets and backfat loss in lactating sows. Thirty sows (Yorkshire x Landrace x Duroc, 4.52 ± 0.54 parities) and their 344 progenies (average body weight, 2.04 ± 0.11 kg) were used in 21 days (from farrowing to weaning). Piglets were allowed freely consume creep diet and sow's milk after farrowing. Dietary treatments included: 1) FSP0 (no added fermented soy protein), 2) FSP5 (added 5% fermented soy protein as protein source), and 3) FSP10 (added 10% fermented soy protein as protein source). At weaning day (21 d), body weight and weight gain of piglets fed fermented soy protein were increased compared with FSP0 treatment (6.88 and 4.78 vs. 6.28 and 4.36, respectively). However, there were no statistically significant differences ($P > 0.05$). Feed intake was not affected by treatments. Survivability of piglets tended to increase in FSP5 (94.10%) and FSP10 (93.55%) treatments compared with FSP0 (90.98%) without statistically significant differences ($P > 0.05$). In sows, fermented soy protein didn't affect sow's backfat thickness losses from farrowing to weaning. Results suggest that feeding fermented soy protein in piglets may increase the weight gain and survivability.

Key Words: Fermented Soy Protein, Piglets, Growth Performance

T132 Effect of wheat gluten and spray-dried egg protein on growth performance of nursery pigs. H. Yang[1], T. Shipp*[2], J. Less[3], T. Radke[1], M. Cecava[1], and D. Holzgraefe[1], [1]*ADM Alliance Nutrition*, *Quincy, IL*, [2]*ADM Animal Health and Nutrition*, *Quincy, IL*, [3]*ADM Specialty Feed Ingredients*, *Decatur, IL*.

Two 26-d trials were conducted to compare the effects of adding wheat gluten (WG) or spray-dried egg protein (SDEP) on nursery performance. In Exp. 1, pigs (n = 160; 5.30 kg BW) were blocked by initial weight to one of five dietary treatments (trt), which consisted of: 1) negative control (NC, containing no WG or SDEP), 2) NC + 1.5% WG (Provim ESP™), 3) NC + 3.0% WG, 4) NC + 6.0% WG, and 5) NC + SDEP (3.0 and 1.5% SDEP in phases 1 and 2, respectively). In Exp. 2, pigs (n = 70; 4.32 kg BW) were blocked by initial weight to one of two dietary trts, which were either 3% WG or 3% SDEP. There were seven pens per trt and four or five pigs per pen in both studies. The three phases (P) ended at d 6, 13, and 26. Pelleted treatment diets were fed in P1 and P2, and a common meal diet was fed in P3. Diets contained 1.75%, 1.50% and 1.40% lysine (ideal protein ratio) for P1, P2, and P3, respectively. In Exp. 1, polynomial analysis using trt 1 to 4 found that WG had a cubic effect on ADG ($P = 0.11$) from d 0 to 13 (262, 249, 271, 251, and 252 g/d for trt 1 to 5, respectively) and a quadratic effect on ADG ($P = 0.01$) from d 0 to 26 (415, 435, 449, 419, and 435 g/d for trt 1 to 5, respectively), suggesting 3% WG was the optimal inclusion level. WG linearly improved G/F ($P = 0.05$) from d 0 to 13 (0.95, 0.95, 0.97, 1.00, and 0.90 for trt 1 to 5, respectively) and d 0 to 26 (0.82, 0.84, 0.84, 0.85, and 0.83 for trt 1 to 5, respectively). Statistical contrast between SDEP and the average of the three WG diets indicated that G/F improved for pigs fed WG vs. SDEP from d 0 to 13 ($P < 0.01$). In Exp. 2, pigs fed 3% WG tended to grow faster than pigs fed 3% SDEP (222 vs. 208 g/d; $P < 0.10$) and had a greater G/F (0.83 vs. 0.77; $P < 0.05$) from d 0 to 13 but similar thereafter (data not shown; $P > 0.10$). In summary, data suggest that 3% WG is optimal for performance benefits and that WG may result in better G/F compared with SDEP.

Key Words: Pigs, Wheat Gluten, Egg

T133 Productive performance of early-weaned pigs fed different vegetable protein sources. D. G. Valencia, M. P. Serrano, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

A trial was conducted to test the influence of the inclusion of several vegetable protein sources in the diet on productivity of young piglets (26 to 56 d of age) in the absence of in-feed growth promoters. From 26 to 49 d of age, piglets were fed one of seven experimental diets in which the main difference was the nature of the vegetable protein used; soybean meal 45.2% CP (SBM; average particle size of 883, 400, or 137 µm), full fat soybean 34.9% CP (FFSB; average particle size of 780 or 82 µm), soy protein concentrate 56% CP (SPC), and pea protein concentrate 52.5% CP (PPC). The protein source tested supplied in all cases 5.5% of the total dietary protein. From 49 to 56 d of age, all pigs received a common starter diet based on cereals and soybean meal. Each treatment was replicated five times (six piglets penned together). From 26 to 36 d of age piglets fed the diet with SPC grew faster (267 vs. 242 vs. 214 g/d; $P \leq 0.05$) and had better feed to gain ratio (0.87 vs. 0.92 vs. 0.98; $P \leq 0.05$) than piglets fed diets with FFSB or PPC. Productivity of piglets fed diets containing SBM was intermediate but close to that of piglets fed SPC. Reducing the particle size of SBM or FFSB did not improve piglet performance ($P \geq 0.10$). The differences in productivity observed among treatments disappeared with age and were not significant at 49 d or 56 d of age ($P \geq 0.10$). The reasons for the poor performance observed in piglets fed PPC or FFSB meal for the first ten days of trial are not known but might be related to the high trypsin inhibitor content found in these diets. We concluded that soy protein concentrate is a vegetable protein source of choice for weanling piglets from 26 to 36 d of age. However, in piglets weighing 10 kg or more, the soy protein concentrate can be substituted for soy bean meal or pea protein sources reducing the diet cost.

Key Words: Piglet Performance, Soybean Protein, Pea Protein.

T134 The effect of dietary crude protein level, cereal type and exogenous enzyme supplementation on nutrient digestibility, nitrogen excretion, faecal volatile fatty acid concentration and ammonia emissions from pigs. J. M. O'Connell, J. J. Callan, and J. V. O'Doherty*, *University College Dublin*, *Ireland*.

A 2 x 2 x 2 factorial was used to investigate the interaction between dietary crude protein (CP) level (220 vs. 160 g/kg), cereal type (wheat vs. barley) and exogenous enzyme supplementation (with or without a glucanase/xylanase mix) on nutrient digestibility, nitrogen (N) balance and manure ammonia emission. Urine and faeces were collected over 7 days from 32 boars (four/treatment, 80.0 kg live weight) that were housed in metabolism crates. There was an interaction ($P < 0.05$) between cereal type and enzyme supplementation in gross energy digestibility (GED) and total faecal volatile fatty acid concentration. Pigs offered the barley diets containing an enzyme had a higher GED and a lower concentration of total faecal volatile fatty acids than unsupplemented barley diets. However, there was no effect of enzyme supplementation in wheat diets. Pigs offered diets containing 220 g/kg CP excreted ($P < 0.05$) more N, urinary N and faecal N than those offered diets containing 160 g/kg CP. Pigs offered barley-based diets excreted less urinary N ($P < 0.05$) and more faecal N ($P < 0.05$) and had a lower N digestibility ($P < 0.05$) than pigs offered wheat based diets. There was a significant 3-way interaction in ammonia emissions from 0 to 240 h ($P < 0.05$). Enzyme supplementation increased ammonia emissions in the barley diet at the 220 g/kg CP level while it had no effect on the wheat diet. However, at the 160 g/kg CP level, enzyme supplementation had no effect on ammonia emissions. In conclusion, it was found that the excretion of pollutants viz. nitrogen, ammonia, and volatile fatty acids could be beneficially affected by reducing dietary CP level and/or by increasing the level of barley in the diet. Enzyme supplementation increased ammonia production in barley diets at 220 g/kg CP.

Key Words: Cereal, Enzyme, Crude Protein

T135 Effect of ground flaxseeds on the performance and carcass traits of finishing pigs. K. Sasaki*[1], S. K. Baidoo[2], and Q. Yang[2], [1]*Akita Prefectural Livestock Experiment Station, Jinguji-aza, Kamioka-machi, Senboku-gun, Akita-ken 019-1701, Japan*, [2]*University of Minnesota, Waseca*.

The objective of this study was to determine the effects of dietary supplementation of ground flaxseeds (FS) on the growth performance and carcass traits of finishing pigs. One hundred and twelve pigs (barrow: 71, gilt: 49) with the average body weight at 101 kg were allotted to three dietary treatments, a control (CTL) diet, 5% and 10% ground flaxseed supplemented diets, for the final 4 weeks before slaughter. The pigs were group-fed with eight pigs per pen and five pens (replicates) per treatment. Pigs were allowed access to feed and water ad libitum. Pig weight was recorded at the both of beginning and finishing of the feeding period and the feed consumption was recorded. There was no dietary effect on growth performance. The average daily gain of pigs fed the CTL, 5% and 10% flaxseed diets was, respectively, 994, 1,018 and 988 grams (P = 0.64). The gain/feed for the CTL, 5% and 10% flaxseed diets was, respectively, 0.30, 0.31 and 0.30 (P = 0.38). The average body weight of pigs fed the CTL, 5% and 10% flaxseed diets was, respectively, 128.8, 129.2 and 128.7 kg (P = 0.97) at the end of trial. For the carcass traits, the thickness of back fat for the CTL, 5% and 10% flaxseed diets was, respectively, 21.2, 20.0 and 22.1 mm, and the dressing percentage for the CTL, 5% and 10% flaxseed diets was, respectively, 76.1%, 75.7% and 76.4%. The back fat thickness (P = 0.13) and dressing percentage (P = 0.14) for the 5% flaxseed added diet tended to be lower than those for the CTL and 10% flaxseed diets. The loin depth for the CTL, 5% and 10% flaxseed diets was, respectively, 7.33, 7.25 and 7.32 cm (P = 0.78) and the lean percentage for the CTL, 5% and 10% flaxseed diets was, respectively, 55.2, 55.4 and 55.0% (P = 0.43). The carcass grade for the CTL, 5% and 10% flaxseed diets was, respectively, 7.18, 7.14 and 7.18 (P = 0.99). In conclusion, feeding ground flaxseed during the last 28 days before slaughter did not affect growth performance or carcass traits in this experiment.

Key Words: Flaxseeds, Performance and Carcass Traits, Finishing Pig

T136 Effect of barley substitution for corn on pigs fed diets containing ractopamine. B. Kremer*[1] and B. Zimprich[2], [1]*Elanco Animal Health, Greenfield, IN*, [2]*Ransom County Extension Service, Ransom County, ND*.

Numerous studies have shown the effect of ractopamine (RAC; Paylean®; Elanco Animal Health) in pigs fed diets containing corn and soybean meal (SBM) as the primary components. Ractopamine has been shown to increase average daily gain (ADG) and gain:feed (GF). The inclusion of RAC has also been shown to increase the loin muscle area in finishing pigs. This trial was designed to determine if pigs fed RAC in diets that were based on barley and SBM would respond the same as pigs fed corn and SBM based diets. This project was conducted at the North Dakota State University Swine Unit. The pigs were housed in the research room at the swine unit where there were 24 pens that held eight pigs per pen for a total of 192 pigs. Pens were randomly assigned to four treatments: 1) corn-based diet with 10 ppm RAC, 2) corn-based control diet, 3) barley-based diet with 10 ppm RAC, and 4) a barley-based control diet. The diets were formulated to be isocaloric, isonitrogenous, and isolysinic. Each diet was formulated to 16% crude protein and 1.05% lysine. The barley diets had vegetable oil added to increase energy levels to be the level of the corn diets. There were no RAC by grain source interactions (P > 0.10). Pigs fed RAC had increased (P < 0.01) ADG, while pigs fed barley based diets had lower ADG (corn + RAC = 1.02 kg/d, corn control = 0.87 kg/d, barley + RAC = 0.91 kg/d, and barley control = 0.83 kg/d). Ractopamine feeding improved (P < 0.01) GF in corn- and barley-based diets. Ractopamine-fed pigs had larger (P < 0.01) loin eye areas when pigs received either corn or barley diets. Pigs fed RAC also had increased (P < 0.01) dressing percentage on skinned carcasses in both corn and barley diets. Minolta color scores for redness and yellowness were reduced (P < 0.01) with RAC feeding; however, there was no effect of RAC on the Minolta color scores for lightness. In summary, pigs fed diets containing barley as the primary cereal grain responded to RAC in similar manner as pigs fed a corn based diet.

Key Words: Ractopamine, Barley, Corn

T137 Condensed corn distillers' solubles in swine liquid feeding: growth performance and carcass quality. J. M. Squire*, C. L. Zhu, E. A. Jeaurond, and C. F. M. de Lange, *University of Guelph, Guelph, ON, Canada*.

Condensed corn distillers' solubles (CDS), a co-product from the ethanol industry, has become available as feedstuff for swine liquid feeding. CDS has a pH of about 3.5, contains about 28% dry matter, and, on a dry matter basis, 24% protein, 21% fat and 9% ash. Studies were conducted to evaluate the influence of feeding fresh and fermented CDS (fermCDS) on pig growth performance and carcass quality. Optimum fermentation conditions were established previously and involved raising pH to about 6.0, inoculation with L. acidophilus and B. subtilis, and a minimum of 2 days storage. In a palatability study, it was established that increasing the dietary inclusion level of CDS from 15.0 to 22.5% of diet DM reduced feed intake (P < 0.05). In a performance study (23 to 50 kg BW), six pens with 10 pigs per pen were assigned to a corn and soybean meal based diet (control), or diets containing either 15% CDS or 15% fermCDS. Diets were formulated to be similar in DE and digestible amino acid contents. Pigs were fed semi-ad libitum using a Big Dutchman Hydrojet© computerized liquid feeding system. Only pigs on control and CDS were raised to market weight for carcass evaluation. At slaughter, back fat and loin depth were measured using a Hennesy grading probe for estimation of carcass lean yield according to the Canadian pig carcass grading system. Feeding CDS reduced growth rates (898 vs. 952 g/d; SEM, 22) and daily feed intake (1.49 vs. 1.62 g/d; SEM, 0.03) as compared to the control (P < 0.05). Pigs on fermCDS had intermediate growth performance (898 g/d gain and 1.61 kg/d intake). Feeding CDS did not impact (P > 0.05) carcass dressing percentage (82.6 vs. 82.1 %; SEM, 0.3), backfat depth (17.1 vs. 16.6 mm; SEM, 0.4), muscle depth (53.7 vs. 54.3 mm; SEM, 0.8), and estimated carcass lean yield (60.8 vs. 61.1 kg; SEM, 0.2). The feeding value of CDS can be enhanced by controlled fermentation. Feeding CDS slightly reduced pig growth performance, but did not influence routine carcass measurements.

Key Words: Liquid Feeding, Corn Distillers' Solubles, Pig Growth

T138 Ileal amino acid digestibility in wheat dried distillers' grains with solubles fed to growing pigs. Y. Lan*, F. O. Opapeju, and C. M. Nyachoti, *University of Manitoba, Winnipeg, MB, Canada*.

As dried distillers' grains with solubles (DDGS) derived from wheat become increasingly available in western Canada, there is great interest in evaluating its potential as a feedstuff for pigs. Thus, the apparent, standardized and true ileal crude protein (CP) and amino acid (AA) digestibilities in wheat DDGS were determined. Six finishing pigs (82 kg initial BW) with a T-cannula at the distal ileum were fed a diet containing either wheat DDGS or 5% casein as the sole protein source in a simple crossover design. Chromic oxide (CO, 0.3%) and acid insoluble ash (AIA, 1.0%) were included as digestibility markers. The casein diet was used to estimate endogenous protein and AA losses for determining true digestibilities. Standardized digestibilities were calculated using published basal endogenous protein and AA losses. A 5-d adaptation period was followed by a 12-h digesta collection period each on d 6 and 7. Endogenous flow of CP, Arg, His, Ile, Leu, Lys, Met, Phe, Thr, and Val averaged 24.18, 0.44, 0.43, 0.49, 0.62, 0.57, 0.10, 0.33, 0.94, and 0.62 g/kg DMI, respectively. Ileal digestibilities (mean ± SD) of CP and AA in wheat DDGS as determined with CO as a marker are shown in the Table. Ileal digestibility values obtained with the AIA as a marker were similar to those obtained with CO ($P > 0.05$). Among the essential AA, the digestibility of Lys was lowest, which suggest its reduced availability, perhaps due to the effects of the drying procedures used in producing the DDGS sample evaluated.

Item	Digestibility measurement		
	Apparent	Standardized	True
CP	64.13 ± 2.53	71.81 ± 3.11	81.14 ± 3.11
Arg	73.01 ± 2.47	82.70 ± 2.86	91.68 ± 3.17
His	68.03 ± 1.35	74.64 ± 2.98	79.03 ± 2.35
Ile	72.71 ± 1.47	79.75 ± 2.54	81.00 ± 2.42
Leu	77.40 ± 1.07	84.92 ± 3.07	83.02 ± 1.68
Lys	35.51 ± 2.94	47.74 ± 5.08	56.96 ± 4.01
Met	70.92 ± 1.65	76.33 ± 3.03	77.06 ± 2.05
Phe	81.77 ± 0.89	89.68 ± 3.03	85.98 ± 1.56
Thr	62.18 ± 2.35	69.61 ± 3.88	78.96 ± 2.65
Val	71.02 ± 1.20	79.04 ± 3.34	79.15 ± 2.37

Key Words: Amino Acid Digestibility, Pigs, Wheat Dried Distillers' Grains with Solubles

T139 True phosphorus digestibility associated with lentils for growing pigs. Z. R. Wang*[1], C. B. Yang[2], Y. Shen[3], Y. L. Yin[2], T. Archbold[3], and M. Z. Fan[3], [1]*College of Animal Science*, *Xinjiang Agricultural University, Urumqi, Xinjiang, China*, [2]*The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [3]*University of Guelph*, *Guelph, Ontario, Canada*.

The objectives of this study were to determine true phosphorus (P) digestibility and the endogenous P outputs associated with conventional lentils for growing pigs by using the regression analysis technique. Four barrows, an average initial BW of 22 kg, were fitted with a T-cannula and fed four diets according to a 4 x 4 Latin square design. Four cornstarch-based lentil diets, containing four levels of lentils at 20, 40, 60 and 80%, were formulated. Each experimental period comprised 8 d with 4-d adaptation and 4-d collection of ileal digesta and fecal samples. The apparent ileal and fecal P digestibility values in lentils were affected ($P < 0.05$) by P contents in the assay diets. Linear relationships ($P < 0.05$), expressed as g/kg DMI, between the apparent ileal and fecal digestible P and the total intake of dietary P, suggested that true P digestibility and the endogenous P outputs associated with lentils for growing pigs could be determined by the regression analysis technique. There were no differences ($P > 0.05$) in true P digestibility values (47.2 ± 7.0 vs. 41.9 ± 6.9%) between the ileal and the fecal levels. About 40% of the total P in lentils is digestible in growing pigs.

Key Words: True Phosphorus Digestibility, Lentils, Growing Pigs

T140 Additivity of apparent and true fecal phosphorus digestibility measured in soybean meal, peas, faba bean, corn, oats, broken rice meal, rough rice meal, buckwheat, and sorghum for growing pigs. R. J. Fang*[1], K. N. Wang[2], C. H. Huang[1], J. H. He[3], J. R. Wang[1], Y. L. Yin[1], and M. Z. Fan[4], [1]*The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Sichuan University of Agriculture*, *Yaan, Sichuan, China*, [3]*Hunan Agricultural University*, *Changsha, Hunan, China*, [4]*University of Guelph*, *Guelph, Ontario, Canada*.

Two digestion experiments were conducted to determine the apparent and true fecal P digestibility in soybean meal, peas, faba bean, corn, oats, broken rice meal, rough rice meal, buckwheat, and sorghum for growing pigs. In experiment 1, six diets were formulated with the soybean meal (SBM)-based as the basal, and four other diets were substituted with corn, oats, rough rice meal, and broken rice meal at the expense of SBM, respectively. In experiment 2, six diets were formulated with the soybean meal (SBM)-based as the basal, and four other diets were substituted with buckwheat, sorghum, peas, and faba bean at the expense of SBM, respectively. The last diet was a mixture of soybean meal, buckwheat, sorghum, peas, and faba bean. Chromic oxide (0.3%) was used as a digestibility marker in both experiments. Each period lasted for 8 d with a 4-d adaptation to the diets and 4 d of fecal collection. In both experiments, six barrows, with average initial BW of 20.5 ± 2.0 kg, were used and fed the six diets according to a 6 × 6 Latin square design. The apparent and true fecal P digestibility values in the nine tested ingredients were measured by the substitution method. There were differences ($P < 0.05$) between the directly determined and the predicted apparent fecal P digestibility values in the mixture of the experiment 1 but no differences ($P > 0.05$) between the directly determined and the predicted apparent fecal P digestibility values in the mixture of the experiment 2. However, there were no differences ($P < 0.05$) between the directly determined and the predicted true fecal P digestibility values in both experiments. These results have indicated that true fecal P digestibility values are additive, whereas the apparent fecal P digestibility values measured in single feed ingredients are not always additive in growing pigs.

Key Words: Additivity, Phosphorus Digestibility, Growing Pigs

T141 Nutritional evaluation of sorghum for pigs and broiler chicks. E. K. D. Nyannor*[1], S. A. Adedokun[1], B. R. Hamaker[2], G. Ejeta[3], and O. Adeola[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Purdue University*, *West Lafayette, IN*, [3]*Purdue University*, *West Lafayette, IN*.

Two experiments were conducted to evaluate three varieties of sorghum (Axtell 4, Axtell 5, and P721N) when compared with corn in the diets of pigs and broiler chicks. In the first study, 12 pigs were fed diets containing 94% sorghum or corn in a 2-period cross-over design to determine total tract or ileal digestibility of nutrients. There was no difference in either ileal or total tract digestibility of percent DM, Energy, P, Ca, or N. A total of 192 broiler chicks grouped by weight into eight blocks of four cages with six birds per cage were used in the second study. Chicks were fed either a corn-soybean or sorghum-soybean diet for 21 d and switched onto diets containing 93% of the corresponding corn or sorghum for 7 d. Weight gain, feed intake and feed efficiencies were not different for the chicks fed either the sorghum-soybean or corn-soybean diets. Total tract digestibility of DM and metabolizable energy (ME) were not different between the corn-soybean and Axtell 4 or Axtell 5-soybean diets but were higher ($P < 0.05$) than the P721N-soybean diet. There was no difference in the P digestibility between corn and Axtell 4 which was also not different from the other two sorghum varieties, Axtell 5 and P721N. Ileal digestibility of DM, energy and P as well as ME were not different in chicks fed the straight grain diets. However, total tract digestibility of DM, energy and P as well as ME of corn was higher ($P < 0.05$) than the three sorghum varieties. Total tract P digestibility of Axtell 4 was better ($P < 0.05$) than P721N but not different from Axtell 5. Sorghum could serve as an excellent substitute for corn in corn-soybean diets for pigs and broiler chicks.

Key Words: Sorghum, Pigs, Broiler Chicks

T142 Amino acid digestibility in dry extruded-expelled soybean meal fed to pigs and poultry. F. O. Opapeju*, C. M. Nyachoti, A. Golian, and L. D. Campbell, *University of Manitoba*, *Winnipeg, MB, Canada*.

The digestibility of amino acids (AA) in dry extruded-expelled soybean meal (DESB) and regular solvent extracted soybean meal (RSB) was determined in pigs and poultry. In the pig assay, four Cotswold barrows (average initial BW of 80.4 kg) equipped with a T-cannula at the distal ileum were allotted to four semi-purified diets in a 4 x 4 Latin square design. Diet 1, a low protein diet (5% casein), was used to quantify endogenous crude protein (CP) and AA losses. Diets 2, 3 and 4 contained 35% of RSB, sample one of DESB (DESB-1) and sample two of DESB (DESB-2), respectively, as the sole source of protein. The DESB samples were obtained from two different batches. Chromic oxide (0.3%) was included as a digestibility marker in all diets. Apparent and true ileal digestibilities of CP and AA in RSB, DESB-1 and DESB-2 were not different ($P > 0.05$). True ileal lysine digestibility (%) in RSB, DESB-1, and DESB-2 was 91, 88 and 88, respectively. In the poultry assay, four dietary treatments were each assigned to sixty adult cecectomized roosters in a completely randomized design. Treatment 1, a non-nitrogen diet (NND) (90% sucrose and 10% vegetable oil), was used to estimate endogenous AA losses. Treatments 2, 3 and 4 contained RSB, DESB-1 and DESB-2 as the only source of protein.

Each of these diets was tube-fed in 25 g quantities as a mixture with NND formulated to provide 5 g of CP from the respective soybean meal source. Except for Cys, true digestibility (TD, %) values of all AA in RSB and DESB-2 were similar ($P > 0.05$). Compared with DESB-1, TD of AA in RSB was only higher ($P < 0.05$) for Ile (98 vs. 92), Leu (97 vs. 94) and Cys (91 vs. 82). Compared with pigs, TD of Ile, Leu, and Phe in RSB, Val, Leu, Lys and Phe in DESB-1, and Leu, Lys, Met and Phe in DESB-2, were higher ($P < 0.05$) in poultry than in pigs. The results suggest that CP and AA digestibility in dry extruded soybean meal are comparable to RSB in pigs and that AA digestibility in soybean meal was different for pigs and poultry.

Key Words: Pigs, Poultry, Extruded Soybean Meal

Physiology and Endocrinology II

T143 Daylength induces changes in leptin and leptin receptors gene expression in adipose tissue of lactating dairy cows. U. Bernabucci*[1], N. Lacetera[1], L. Basiricò[1], F. Rueca[2], D. Pirazzi[1], B. Ronchi[1], E. Seren[3], and A. Nardone[1], [1]*Dipartimento Produzioni Animali*, *Viterbo, Italy*, [2]*Dipartimento Patologia, Diagnostica e Clinica Veterinaria*, *Perugia, Italy*, [3]*Dipartimento Morfofisiologia Veterinaria e Produzioni Animali*, *Bologna, Italy*.

Leptin is mainly secreted by adipocytes and is implicated in the regulation of numerous physiological processes. Effects of daylength on adipose tissue gene expression of leptin in ruminants have been studied mainly on sheep, and no information are available on lactating dairy cows. The aim of the present research was to verify the effect of DL on adipose tissue gene expression of leptin and leptin receptors. Four lactating and pregnant Holstein cows were used. The animals were housed in a climatic chamber. The trial lasted 51 d. The first 30 d were used to adapt animals to the new housing conditions. During that period the DL adopted was 12 h light/12 h dark (12/12). The experimental period lasted 21 d. Phase (Ph) 1: 7 d neutral DL 12/12; Ph2: 7 d long DL (18 h light/6 h dark); Ph3: 7 d short DL (6 h light/18 h dark). During the experimental period milk yield and feed intake were recorded, and blood samples were taken. In addition, at the end of each phase, subcutaneous adipose tissue biopsy was carried out. On plasma samples glucose, NEFA and BHBA were determined. Abundance of leptin mRNA, and ObRa and ObRb leptin receptors were determined by ribonuclease protection assay. Daylength did not affect feed intake. Exposure to short DL reduced significantly milk yield ($P<0.05$). NEFA were slightly reduced by short DL, and glucose and BHBA were not affected by DL. Gene expression of leptin and its receptors were strongly ($P<0.01$) affected by DL. Both leptin and leptin receptors mRNA increased ($P<0.05$) with long DL and declined ($P<0.05$) with short DL. Results of the present study seem to exclude an effect of feed intake and metabolic status on leptin gene expression. A possible direct effect of photoperiod on leptin modulation may be hypothesized in dairy cows.

Acknowledgements: Supported by MIUR-FIRB Project

Key Words: Leptin, Dairy Cow, Photoperiod

T144 Relationship between serum leptin concentration and BW, feed intake, ultrasound traits and carcass merit of hybrid beef cattle. J. D. Nkrumah*[1], C. Hansen[1], D. H. Keisler[2], C. Li[1], B. Irving[1], Z. Wang[1], and S. S. Moore[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*University of Missouri*, *Columbia*.

Leptin is the hormone product of the obese gene synthesized and secreted predominantly by adipocytes. It functions as a lipostatic signal regulating body weight, food intake, energy expenditure, reproduction and certain immune system functions. This study determined the relationship of serum leptin concentration with BW, DMI, ultrasound traits (n = 307) and carcass merit (n = 243) of beef cattle sired by Angus, Charolais or Hybrid bulls at the Kinsella Research Station of the University of Alberta. Serum leptin concentration averaged 13.33 (SD = 6.27) ng/ml and ranged from 2.19 to 39.70 ng/ml. Compared to Charolais-sired steers, Angus sired steers, respectively tended to have a higher serum leptin (14.0 ± 0.6 vs. 11.9 ± 0.9, P = 0.06), higher ultrasound backfat thickness (8.90 ± 0.31 vs. 7.01 ± 0.44, $P < 0.01$) and marbling score (5.30 ± 0.10 vs. 4.62 ± 0.13, $P < 0.01$). Serum leptin concentration was correlated ($P < 0.05$) with DMI ($r = 0.20$, $P < 0.05$), residual feed intake ($r = 0.15$, $P < 0.05$), mid-point weight ($r = 0.26$, $P < 0.05$), final BW ($r = 0.25$, $P < 0.05$), ultrasound marbling score ($r = 0.32$) and backfat thickness ($r = 0.45$). Serum leptin was unrelated to ADG or FCR ($P > 0.20$). There were correlations between serum leptin and carcass grade fat ($r = 0.37$, $P < 0.01$), carcass marbling score ($r = 0.25$, $P < 0.01$), lean meat yield ($r = -0.33$, $P < 0.01$) and carcass rib eye area ($r = -0.13$, $P < 0.05$). Ultrasound backfat thickness was correlated with ultrasound marbling score ($r = 0.49$, $P < 0.001$) but not with rib eye area ($r = -0.02$). In addition, carcass grade fat and carcass marbling score were correlated with each other ($r = 0.52$, $P < 0.001$) and were respectively correlated with lean meat yield ($r = -0.90$ and -0.55, $P < 0.01$) and carcass rib eye area ($r = -0.29$ and -0.21, $P < 0.01$). These phenotypic associations indicate that serum leptin concentration is related to the body weight, feed intake and body composition of cattle. However, the relationships with body fatness were stronger than those with DMI or BW.

Key Words: Beef Cattle, Carcass Merit, Performance

T145 Failure of short term feed restriction to effect leptin secretion and subcutaneous adipose tissue expression of leptin or long form leptin receptor (Ob-r) in the prepuberal gilt. H. A. Hart*[1], M. J. Azain[1], G. J. Hausman[2], D. E. Reeves[1], and C. R. Barb[1], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS, Athens, GA*.

Ovariectomized prepuberal gilts averaging 164 days of age and 79.2 ± 3.8 kg body weight (BW) were either fed to appetite (FA; n = 6) or feed restricted (RST; 40% of FA diet; n = 6) for 7 seven days to determine the effects of feed RST on serum leptin concentrations, metabolism, leptin, Ob-r and transcription factor expression in subcutaneous back fat (BF). On day 8, blood samples were collected every 15 min for 8 h. Serum concentrations of glucose, T3, T4, NEFA, insulin, and leptin were determined. Real-time PCR was performed on mRNA extracted from subcutaneous adipose tissue collected on day 0 (start RST) and day 9. FA gilts gained ($P<.0001$) more BW (8.3 ±.6 kg) than RST (-2.5 ± .6 kg) gilts, however BF thickness did not change. A treatment x time interaction ($P<.009$) was detected for serum glucose concentrations. Serum insulin ($P<.07$), T3 ($P<.08$), and T4 ($P<.04$) concentrations were reduced and NEFA levels ($P<.05$) were greater during h 1, 6, 7 and 8 in RST gilts compared to FA animals demonstrating a metabolic response to RST. Serum leptin concentrations, leptin pulse amplitude, and leptin pulse frequency were not effected by RST. RST failed to effect subcutaneous BF leptin, Ob-r, AFABP (adipocyte fatty acid binding protein), C/EBP-alpha (CCAAT/enhancer binding protein alpha), or PPAR- gamma 2 (peroxisome proliferator activated receptor gamma 2) mRNA expression compared to FA gilts. These results may in part be related to the failure of RST of this duration to influence subcutaneous BF. Thus, the leptin response to RST may require energy levels and (or) BF reduction reaching a putative inhibitory threshold.

Key Words: Pig, Feed Restriction, Leptin

T146 Sequencing, chromosomal mapping and expression of the bovine deiodinase type II (*DIO2*) and deiodinase type III (*DIO3*) genes. E. E. Connor*[1], E. C. Laiakis[1], V. M. Fernandes[1], J. L. Williams[2], and A. V. Capuco[1],

[1]*USDA-ARS, BARC, Bovine Functional Genomics Laboratory*, *Beltsville, MD*, [2]*Roslin Institute (Edinburgh)*, *Midlothian, Scotland, UK*.

Thyroid hormones are critical for normal mammalian development and metabolism and their activity is regulated in a highly complex, tissue-specific manner by three isoforms of deiodinases. We determined the full-length bovine type II deiodinase (*DIO2*) and type III deiodinase (*DIO3*) mRNA sequences and characterized expression levels of each of the three deiodinase isoform transcripts in bovine diaphragm, heart, hypothalamus, kidney, liver, lung, mammary gland, pituitary gland and thyroid gland (n = 2 animals/tissue) collected at slaughter. Further, bovine *DIO2* and *DIO3* were positioned on chromosomes 10 and 21, respectively, by radiation hybrid mapping. Sequencing of bovine *DIO2* and *DIO3* cDNAs revealed a high degree of predicted amino acid sequence identity with their orthologs in other mammalian species and demonstrated the conservation of selenocysteine residues within the catalytic domains of both bovine proteins. Expression patterns of the three deiodinase isoforms in bovine tissues were similar for deiodinase type I (*DIO1*) and *DIO2* to those observed in other species. Expression level of *DIO3* transcripts was greatest in bovine mammary gland and kidney, although expression was detected in all tissues sampled. Results of this work will aid in the study of deiodinase gene expression and thyroid hormone regulation in cattle.

Key Words: Deiodinase, Thyroid Hormone, Gene Mapping

T147 Cloning and expression of bovine sodium/glucose cotransporter SGLT2. F.-Q. Zhao*, T. B. McFadden, E. H. Wall, B. Dong, and Y.-C. Zheng, *University of Vermont*, *Burlington*.

The second member of the Na+/glucose cotransporter family, SGLT2, is a low-affinity active glucose transporter. In human, it is predominantly located on the apical membrane of the S1 and S2 segments of renal convoluted proximal tubules, and, thus, may be mainly responsible for the reabsorption of D-glucose from the glomerular filtrate. By BLAST searching GenBank, we found EST sequences of SGLT2 in the cDNA library of bovine mammary tissues, indicating its expression in bovine mammary gland. To facilitate study of the role and mechanism of glucose reabsorption in bovine kidneys to maintain glucose homeostasis of lactating cows and of the potential role of SGLT2 in the mammary gland, we cloned bovine SGLT2 and examined the distribution of its mRNA expression in bovine tissues. The full length mRNA of bSGLT2 is 2275 base pairs and is predicted to encode a protein of 673 amino acids, with a molecular weight of approximately 73 kDa. The deduced amino acid sequence of bovine SGLT2 is 91%, 90%, 91%, and 90% identical to human, rabbit, mouse, and rat SGLT2, and is 58% and 48% identical to bovine SGLT1 and SGLT5, respectively. The sequence of bSGLT2 contains several conserved sodium:solute symporter family signatures that are characteristic of the sodium:solute symporter family. Analysis of current bovine genomic data indicates that the bovine SGLT2 gene may consist of 14 exons. The major in vitro transcription and translation product of bovine SGLT2 cDNA migrated at an apparent molecular weight of 55 kDa. The SGLT2 mRNA was detected predominantly in bovine kidney as a 2.3 kb transcript and at lower levels in all other bovine tissues we examined, including the mammary gland, liver, lung, spleen, intestine and skeletal muscle, as a 3.0 kb transcript. SGLT2 mRNA expression in bovine mammary gland increased more than ten-fold from late pregnancy to early lactation, similar to SGLT1. This indicates that SGLT2 may play a role in milk synthesis in the lactating mammary gland.

Key Words: Glucose Tansporter, Kidney, Mammary Gland

T148 Molecular cloning and expression of bovine leptin receptor isoforms. H. Kawachi*, A. Hamano, S. H. Yang, T. Matsui, and H. Yano, *Kyoto University*, *Kitashirakawa-oiwake, Sakyo-ku, Kyoto, Japan*.

Leptin, the 16 kDa protein product of the *ob* gene, is a hormone that is secreted mainly by adipocytes and regulates feed intake and energy expenditure. Leptin signal is accomplished via a receptor with strong sequence homology to the class I cytokine receptor family. At least five leptin receptor isoforms (Ob-Ra-e) have been cloned from mouse, rat and human, and exhibit widespread distribution among tissues. In bovine, however, there is little information about the sequence and tissue distribution of Ob-R isoforms. To further investigate the characterization of bovine Ob-R isoforms, we have cloned the full length bovine Ob-R isoforms and examined the expression of each isoform mRNA in bovine tissues. Oligonucleotide primers for cloning of bovine Ob-R were designed from the entered several partial fragments of the bovine Ob-R in GenBank. RT-PCR was performed using total RNA from bovine kidney as template. The complete nucleotide sequences of the Ob-R isoforms were determined by cDNA cloning based on 3'-RACE and 5'-RACE. PCR products were subcloned into TA cloning vector and sequenced. To elucidate Ob-R isoforms mRNA expression in cattle, semi-quantitive RT-PCR was carried out using oligonucleotide primer pairs specific for each Ob-R isoform. Each Ob-R isoform gene expression was quantified relative to 18S rRNA. Sequence analysis revealed that we cloned two full length bovine Ob-R isoform cDNAs, the long form (Ob-RL; GenBank accession number AB199589) and the short form (Ob-RS; accession number AB199590). The open reading frame of Ob-RL and Ob-RS gene were 3,498bp and 2,673bp, respectively. Ob-RL and Ob-RS were single transmembrane proteins, and differed in the C-terminal amino acid sequences. These bovine Ob-R isoforms shared significant homology to mouse Ob-Rb and Ob-Ra (73 and 74 % identity at amino acid level, respectively). Moreover, RT-PCR analysis revealed that Ob-R isoform mRNAs were distributed among a wide range of bovine tissues.

Key Words: Leptin Receptor, Bovine, Ob-R

T149 Effect of interval from timed AI to initiation of resynchronization of ovulation using Ovsynch on fertility of lactating dairy cows. R. A. Sterry*[1], M. L. Welle[2], and P. M. Fricke[1], [1]*University of Wisconsin*, *Madison*, [2]*Miltrim Farms, Inc.*, *Athens, WI*.

Nonpregnant lactating Holstein cows (n=695) at various DIM (112.4±2.3; range 50-445) and prior AI services (1.1±0.1; range 0-10) were submitted for timed AI (TAI) using $PGF_{2\alpha}$ (PG, 25 mg) and GnRH (G, 100 µg) in an Ovsynch protocol as follows: (G, d 0; PG, d 7; G+TAI, d 9). Cows were randomly assigned at initial TAI to receive the first G of Ovsynch at 26 d (D26) or 33 d (D33) after TAI to resynchronize cows failing to conceive to initial TAI (Resynch). All D26 cows received G 26 d after TAI and continued Ovsynch only if diagnosed nonpregnant using ultrasonography 33 d after TAI, whereas all D33 cows initiated Ovsynch only if diagnosed nonpregnant 33 d after TAI. Pregnancy status for cows diagnosed pregnant at 33 d was reconfirmed 40 d after initial TAI. Conception rate 33 d after initial TAI was 47% (n=695) and was greater (P<0.01) for cows receiving initial TAI after Presynch/Ovsynch (55%; n=354) than for cows resynchronized using Ovsynch for second and greater TAI (39%; n=341). Treatment did not affect pregnancy loss which was 4.0% (n=326) from 33 to 40 d after TAI. Nonpregnant cows within the D26 and D33 Resynch treatments lacking a CL >10 mm at 33 d (n=51) received a CIDR insert between the first two injections of Resynch. Thus, Resynch conception rates were compared for D26 (n=159) vs. D33 (n=142) cows and for D26+CIDR (G, d 26; G+CIDR in, d 33; PG+CIDR out, d 40; G+TAI, d 42; n=24) vs. D33+CIDR (G+CIDR in, d 33; PG+CIDR out, d 40; G+TAI, d 42; n=27) cows. Conception rate 33 d after Resynch tended to be greater (P=0.09) for D33 (38%) than for D26 (29%) cows but did not differ statistically between D26+CIDR (29%) and D33+CIDR (52%) cows. Pregnancy loss from 33 to 40 d after Resynch was 6.0% (n=99) and did not differ between treatments. Initiation of Ovsynch 26 d after TAI tended to decrease conception rate compared with initiation of Ovsynch 33 d after TAI (9 percentage point difference; 24% decrease) for resynchronizing cows failing to conceive to initial TAI.

Key Words: Resynch, Ovsynch, Pregnancy Loss

T150 Effects of the time of PGF2α in fixed time embryo transfer protocol on synchronization and conception rates in IVF fresh embryo recipients. O. G. SáFilho, J. L. M. Vasconcelos*, R. M. Santos, E. Oba, and G. C. Perez, *FMVZ-UNESP*, *Brazil*.

This trial tested if PGF2α injection on day 7 in relation to on day 9 of a fixed time embryo transfer (FTET) protocol alters reproductive parameters in IVF fresh embryo recipients. Cycling crossbred heifers (n=153), BCS 3.3±0.17, were divided in 4 groups: G1 (n=42), estradiol benzoate (EB, 2mg) + new CIDR on day 0, PGF2α (Lutalyse, 25mg) on day 7, CIDR removed on d 9, EB (0.8mg) on d 10, and FTET on day 18; G2 (n=41) similar to G1, but with already used CIDR for 9 d; G3 (n=35) EB (2mg)+ new CIDR on d 0, CIDR removed on d 9 + PGF2α, EB (0.8mg) on d 10 and FTET; G4 (n=35) similar to G3, but with already used CIDR for 9 d. All cows received fresh IVF embryos (grade 1 or 2) transferred by one trained technician. Ovulatory follicle diameter at time of CIDR removal, CL diameter and serum P4 at FTET were analyzed by GLM; synchronization (presence of CL at FTET), conception and pregnancy rates were analyzed by logistic regression. There was no effect of treatment on ovulatory follicle diameter (10.6±0.56; 11.1±0.63; 11.1±0.58; 10.7±0.56mm), synchronization rate (83.3; 65.9; 82.9; 80.0%), CL diameter (18.9±0.66; 19.7±0.71; 19.2±0.66; 18.9±0.67mm) or serum P4 (2.9±0.33; 2.3±0.33; 2.7±0.34; 2.1±0.35ng/mL) on G1, G2, G3, and G4, respectively. Treatment tended (P=.14) to affect conception (38.2; 30.8; 13.8; 25.0%) and pregnancy rates (31.7; 20.0; 11.4; 20.0%) for G1, G2, G3, and G4, respectively . Recipients receiving PGF2α on d-7 tended to have greater serum P4 concentrations than recipients receiving PGF2α on d-9 (G1+G3: 2.8±0.24; G2+G4: 2.2±0.24ng/mL; P=.06). Independent of treatment, ovulatory follicle diameter affected positively ovulation rate (P<.001) and CL diameter (P<.001). Serum P4 concentrations were affected positively by CL diameter (P<.05) and tended to be affected positively by ovulatory follicle diameter (P=.07). Conception and pregnancy rates were affected positively by serum P4 concentration (P<.01) and CL diameter (P<.01). These data suggest that synchronization protocols to embryo recipients should improve ovulatory follicle diameter due to these could improve synchronization and pregnancy rates.

Key Words: ET, CIDR, PGF2α

T151 Effect of duration of Norgestomet implant during CRESTAR protocol in Nellore cows. G. C. Perez*, R. M. Santos, and J. L. M. Vasconcelos, *FMVZ-UNESP*, *Brazil*.

Perez et al. (2004) showed that cows with lower BCS had smaller follicular diameter at implant removal and lower conception rate. The present trial tested if one more day of norgestomet implant during CRESTAR protocol could improve follicular diameter at implant removal and subsequent synchronization, pregnancy and conception rates. Nellore cows (n=439) with 79±26 DPP, BCS between 2.25 to 3.0 (1-5) were assigned to 4 groups: G1 (n=114) CRESTAR; G2 (n=107) CRESTAR+eCG (Folligon, 400UI) at implant removal+Calf Removal-CR (50h); G3 (n=112) CRESTAR 10 (Norgestomet implant for 10 days) and G4 (n=106) CRESTAR 10+eCG+CR. TAI was performed in the 4 groups 46-50 h after implant removal. Ovarian structures and pregnancy were evaluated by ultrasound. Cyclicity was determined before the beginning of the protocol by 2 ultrasound examinations 7 days apart. Follicular diameter was analyzed by GLM; synchronization, pregnancy and conception were analyzed by logistic regression. Follicular diameter (mm) at implant removal was not affected by duration of implant (9 d-10.97; 10 d-11.03) but it was affected (P<.05) by BCS (2.25-10.6; 2.5-11.0; 2.75-10.9; 3.0-11.6) and DPP (<60d-10.8; 61-80d-10.9; 81-100d-11.3; 101-120d-11.7; >120d-11.0). Synchronization rate (ovulation until 48 h after AI) was affected (P<.01) by DPP (<60d-76.0%; 61-80d-80.7%; 81-100d-96.4%; 101-120d-94.4%; >120d-95.8%) and eCG+CR (G1-72.8%; G2-95.3%; G3-72.3%; G4-94.3%). Pregnancy rate was affected (P<.05) by eCG+CR (G1-40.7%; G2-52.8%; G3-34.2%; G4-47.6%), due to lower synchronization rate in G1 and G3. Conception of effectively synchronized cows (ovulation between AI and 48 h later) was not affected (G1-55.6%; G2-58.1%; G3-48.1%; G4-59.0%) by treatments. Cows that received eCG+CR had ovulation before AI (G2-14.9%; G4-22.0%) with lower conception rate (G2-40%; G4-19.1%) One more day of Norgestomet implant during CRESTAR protocol did not improve follicular diameter or pregnancy. The eCG+CR treatment had a positive effect on synchronization rate but not on pregnancy rate. These data suggest that cows that received eCG+CR should undergo AI before 46h.

Key Words: CRESTAR, TAI, Nellore

T152 Effects of post-insemination CIDR on embryonic loss associated with heat stress in dairy cattle. R. E. Carothers* and C. S. Whisnant, *North Carolina State University*, *Raleigh*.

The objective of this study was to determine the effects of post-insemination progesterone supplementation on heat stressed dairy cows. Previous research had indicated that treatment with GnRH on day 5 post-insemination could increase pregnancy rates in heat stressed dairy cows. This study was conducted in the summer of 2004 in an attempt to improve pregnancy rates of lactating dairy cows. Cows were synchronized with the OvSynch protocol, bred, and randomly assigned to control (CON) or treatment (TR). TR cows received a CIDR five days after breeding, which was removed seven days after insertion. Venous blood samples were collected every other day throughout the study and analyzed for progesterone via RIA. Cows not showing estrus after breeding were pregnancy checked by transrectal ultrasonography approximately thirty days after breeding. Mean Temperature Humidity Index (THI) was 72.5 with average daily maximum THI 79.7 and average daily minimum THI 65.3. These conditions indicate mild heat stress. Serum progesterone concentrations were higher during the time CIDR's were in place in cows treated with CIDR (3.7 ± 0.5 ng/ml) compared to control cows (2.4 ± 0.5 ng/ml) (P<.05). Pregnancy rates did not differ between groups (TR 18.2% versus CON 13.6%). Pregnancy rates were not improved by CIDR treatment of heat stressed dairy cows for seven days post-insemination despite an increase in serum progesterone concentrations.

Key Words: Progesterone, CIDR, Heat Stress

T153 Influence of reducing the interval between GnRH and $PGF_{2\alpha}$ to 5 days on reproductive performance of cows synchronized with GnRH-CIDR- $PGF_{2\alpha}$ programs. G. A. Bridges, C. L . Gasser*, D .E. Grum, M. L. Mussard, L. A. Helser, and M. L. Day, *The Ohio State University*, *Columbus*.

Three experiments were conducted to determine the influence of reducing the length of synchronization programs from 7 to 5 days on reproductive performance in lactating beef cows. In experiment 1, the standard, 7 d Select Synch + CIDR (7d-SS; n = 79) was compared to a 5 d Select Synch + CIDR (5d-SS; n = 77) protocol. Estrus response (87.2%), interval to estrus (57.3 ± 1.0 hr), conception rate (53.7%), and pregnancy rate (PR; 46.8%) did not differ between the programs, and did not vary relative to cycling status (cyclic, anestrous) or cow age (2-yr-old and mature). In experiment 2, the 7 d CO-Synch + CIDR (n = 112) was compared to a 5 d CO-Synch + CIDR (n = 111) protocol. All cows were timed-AI (TAI) concomitantly with GnRH at 60 h following CIDR removal. A significant (P = 0.05) treatment by age interaction was observed for TAI-PR. Timed-AI-PR was 44.4 vs. 60.0% in 2 yr old cows (P<0.05) and 54.3 vs. 53.8% in mature cows for the 7 d and 5 d protocols, respectively. Cycling status was not a significant source of variation in this experiment. In experiment 3, dominant follicle size and systemic estradiol concentrations at 60 hr after CIDR removal were compared between the 7d-SS (n = 16) and 5d-SS (n = 16) protocols. Estrus response was similar (68.8%) between treatments; however interval to estrus was greater (P < 0.05) in the 5 d (80.0 ± 1.7 hr) than 7 d (68.4 ± 3.6 hr) program. Dominant follicle size at 60 hr was nominally larger (P > 0.05) in the 7d-SS (13.3 ± 0.6 mm) than 5d-SS (12.2 ± 0.4 mm) treatment. Estradiol concentrations did not differ at 60 hr between treatments (8.6 ± 0.8 pg/ml). In conclusion, decreasing the duration of the Select Synch + CIDR protocol did not influence breeding performance, while PR was increased in 2 yr-old cows receiving the 5 d CO-SYNCH + CIDR protocol. At 60 hr after $PGF_{2\alpha}$ follicle diameter and estradiol concentrations did not differ between the 5 d and 7 d protocols.

Key Words: Cattle, Synchronization, CIDR

T154 Effects of supplemental progesterone administration on pregnancy rate and resynchronization in lactating dairy cattle during mild heat stress and non-heat stress conditions. A. Denson*, M. Jones, S . Bowers, A. Dos Santos, K. Graves, K. Moulton, and S. Willard, *Mississippi State University*, *Mississippi State*.

Administration of supplemental progesterone (P_4) post-breeding to improve pregnancy rates in cattle have been studied under a variety of production-management systems using various methods of P_4 administration. In the present investigation, studies were conducted to assess the use of the CIDR as a supplemental P_4 source during conditions of mild heat stress and non-heat stress in lactating dairy cows. All cows (n=44 summer; n=64 fall) were synchronized for 7 d using CIDR with administration of $PGF_{2\alpha}$ on d 6. Following CIDR withdrawal cows detected in estrus were bred by AI, with a timed insemination 54 h after $PGF_{2\alpha}$ for all cows not detected in estrus. Cows were balanced for production variables and assigned as Control (CON; no supplemental CIDR) or CIDR+, which received a second CIDR 11 d after the timed-AI. $PGF_{2\alpha}$ was not administered following second CIDR withdrawal. All cows were detected for estrus and bred AI throughout the remainder of the study. Summer study: Holstein (n=33) and Jersey (n=11) cows were managed under mild heat stress conditions (average daily THI=74 and average daily peak THI=80). Ultrasonography (US) at d 42 following the first AI post-CIDR revealed a pregnancy rate (PR) of 27% (6/22) for CIDR+, and 5% (1/22) for CON ($P<0.05$). US at d 65, combining first AI and resynchronized AI, revealed an overall PR of 45% (10/22) for CIDR+, and 18% (4/22) for CON ($P<0.05$). Fall study: Holstein (n=53) and Jersey (n=11) cows were managed under cool season conditions (average daily THI=51 and average daily peak THI=59). US at d 42 following the first AI post-CIDR revealed a PR of 31% (10/32) for CIDR+, 31% (10/32) for CON ($P>0.10$). US at d 65, combining first AI and resynchronized AI, revealed an overall PR of 44% (14/32) for CIDR+ and 41% (13/32) for CON ($P>0.10$). The use of the CIDR as a supplemental source of P_4 post-breeding increased pregnancy rate and accelerated rebreeding under mild heat stress conditions but not during the cool season in lactating dairy cows.

Acknowledgements: Funded by USDA-IFAFS #SC010306-1-2

Key Words: Progesterone, Heat Stress, Dairy Cattle

T155 Leptin gene polymorphisms and selection for milk yield in Holstein cows. S. H. Wu*[1], W. J. Weber[1], Y. Da[1], H. Chester-Jones[1], L. B. Hansen[1], Y. R. Boisclair[2], and B. A. Crooker[1], [1]*University of Minnesota*, *St. Paul*, [2]*Cornell University*, *Ithaca, NY*.

Cows from a breeding project that produced high-merit, contemporary cows (select line, SL) and low-merit cows that represent U.S. Holsteins in 1964 (control line, CL) were used to determine relationships of 2 single nucleotide polymorphisms (SNP) in the leptin gene with genetic merit for milk yield. Both SNP occur within exon 2 and result in amino acid substitutions. The first SNP (Lept1) is an A to T transition that leads to a Tyr7Phe change in the leptin signal peptide. The second SNP (Lept2) is a C to T transition that leads to an Arg25Cys change in the leptin peptide. DNA samples collected previously from 122 CL and 182 SL cows born between 1988 and 1992 (33 CL, 60 SL), 1993 and 1997 (35 CL, 73 SL), and 1998 and 2003 (54 CL, 49 SL) were analyzed. The PTA-milk difference between the lines increased with period (3134 ± 80, 3790 ± 77 and 4328 ± 62 kg, respectively). DNA was amplified with specific primers (Lept1: 5' GATTCCGCCGCACCTCTC 3' and 5' CCTGTGCAAG GCTGCACAGCC 3'; Lept2: 5' ATGCGCTGTGGACCCCTGTATC 3' and 5' TGGTGTCATCCTGGACCTTCC 3'). Amplified products were digested (Cla I for Lept1 and Acc III for Lept2) and digestion products separated by gel electrophoresis. For Lept1, overall AA, AT and TT genotypes represented 84.4, 14.8 and 0.8% for CL and 97.2, 2.8 and 0.0% for SL, respectively. Allelic frequency of T was greater in CL than SL cows during 1993 to 1997, 1998 to 2003, and overall (8.2 vs. 1.4%; χ^2, $P < 0.001$) and tended to decrease in SL cows with time. For Lept2, overall CC, CT and TT genotypes represented 50.8, 39.4 and 9.8% for CL and 37.9, 48.4 and 13.7% for SL, respectively. Overall allelic frequency of T was less in CL than SL cows (29.5 vs. 37.9%, χ^2, $P < 0.05$) but not for any individual time period. PTA-milk values were greater in SL than CL cows for each time period but did not differ among genotype within line for either SNP or their interactions. However, results indicate allelic frequencies for both leptin SNP have been altered by selection for contemporary Holsteins.

Key Words: Leptin, Polymorphisms, Milk Yield

T156 Efficacy and economic value of estrous synchronization. K. Evenson*, J. Johnson, S. Prien, and J. Blanton, *Texas Tech University*, *Lubbock*.

One hundred Angus-based beef cows and heifers were studied to determine the efficacy and economic value of four synchronization methods. Hormones were administered as follows: progesterone controlled internal drug-releasing insert, (CIDR), 1.9 g per animal; GnRH, 100µg i.m.; prostaglandin F2α (PGF2α), 25 mg i.m. HeatWatch estrous detection system was used on d0 until d22 to detect estrus. Artificial insemination was performed 12h after the onset of estrus. Four insemination protocols were utilized and consisted of 1) animals received PGF2α on d5 of the experiment (1-Shot; n=25); 2) animals received a CIDR insert and an injection of GnRH on d0, removal of the CIDR on d6 and were injected with PGF2α on d7 (CIDR; n= 25); 3) animals were injected with GnRH on d0 and PGF2α on d7 (Select Synch; n=25); 4) animals were injected on d0 and d11 with PGF2α (2-Shot; n=25). Animals were equally distributed into four treatment protocols by age, body condition score (BCS), and days postpartum (DPP). After artificial insemination, a clean-up bull was utilized and 100% conception occurred. Estrus response did not differ between treatments ([96%], 1-Shot; [96%], CIDR; [96%], Select Synch; [88%], 2-Shot); ($P > .5569$). Synchrony response of estrus is determined by the number of cows who demonstrated estrus in the predicted time divided by the number of cows who demonstrated estrus within each protocol. The synchrony responses are as follows: [83%], 1-Shot; [92%], CIDR; [96%], Select Synch; [96%], 2-Shot; ($P > .3898$). Protocols were evaluated on an economic basis by cost of semen, hormones, supplies, and fixed costs. Based on protocol cost, the CIDR protocol was the highest cost at $28.77/hd and 1-shot protocol was the lowest cost at $16.62/hd. The 1-shot protocol was the least effective protocol based upon effectiveness and economic value because only 83% were synchronized which resulted in a loss of $66.48 vs. Select Synch which properly synchronized 96% and only lost $19.92. Four synchronization protocols were evaluated with three protocols having a 96% estrous response rate, and one protocol with an 88% response. The CIDR protocol was the most expensive per head and the 1-shot protocol was least expensive per head.

Key Words: Estrus, Synchronization, Reproduction

T157 Effect of estradiol-17β supplementation before the last GnRH of the Ovsynch protocol in high producing dairy cows. A. H. Souza*, A. Gümen, E. P. B. Silva, A. P. Cunha, J. N. Guenther, C. M. Peto, D. Z. Caraviello, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

The aim of this study was to determine whether increasing circulating estradiol concentrations would increase conception rates (CR) in a TAI protocol for lactating dairy cows. Holstein cows (n=909) were assigned to two groups in a CRD design. Control cows received Ovsynch (GnRH-7d-PGF2α-58h-GnRH-16h-TAI). Treated cows had the same TAI protocol with the addition of 1 mg of estradiol-17β (E2) at 8 h before the second GnRH injection. Ovarian ultrasound and blood samples were taken just before E2 treatment for both groups. In a subset of cows (n=596), a Kamar® was used to assess expression of estrus. Ovulation was confirmed by ultrasound 7 d after TAI. Treatment with E2 increased circulating E2 (18.4±4.6, n=8 vs. 2.94±0.6, n=8; $P<0.01$) and increased expression of estrus (78.5%, n=302 vs. 42.4%, n=290, $P<0.001$). The overall CR did not differ ($P=0.57$) between E2 (45.2%, n=465) and control (43.5%, n=441) cows; however, in cooler seasons (<70F) there was a significant ($P<0.02$) greater CR in cows treated with E2 (50.9%, n=116) than controls (34.6%, n=108). In addition, E2-treated cows that showed estrus not only had better ($P<0.01$) CR (52.7%, n=237) than either E2-treated (21.5%, n=65) or control (37.7%, n=167) cows that did not show estrus, but also tended ($P=0.10$) to have better CR than control cows that showed estrus (45.5%, n=123). Moreover, cows with intermediate-sized ovulatory follicles (15-20 mm with single ovulation, n=416) tended to have an increase in CR ($P=0.06$) due to E2 treatment. In conclusion, any improvements in CR due to E2 treatment appear to depend on expression of estrus, season, cyclicity (data not shown), and size of ovulatory follicle.

Key Words: Estradiol, Estrus, Conception Rate

T158 Effect of GnRH after artificial insemination on conception rates in lactating dairy cows. A. P. Cunha*, A. H. Souza, A. Gümen, E. P. B. Silva, C. M. Peto, J. N. Guenther, D. Z. Caraviello, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

This study investigated the effect of multiple GnRH injections after timed artificial insemination (TAI) on conception rates (CR) in high producing dairy cows. Lactating Holstein cows (n=821) underwent the Ovsynch protocol (GnRH-7d-PGF2α-58h-GnRH-16h-TAI) and 7 days after TAI cows were assigned to one of two groups in a CRD design 1) treatment: received (i.m.) GnRH (100μg) injection on days 7 and 14 after TAI; 2) control: received no treatment. Ovarian ultrasound evaluations and BCS were performed on days 7, 14 and 20 after TAI for both groups. Cows without a CL on Day 7 were not used in the study. The macro GLIMMIX of SAS was used to evaluate the different models. The overall CR was not different (P>0.10) between GnRH-treated (43%, n=389) and control cows (42%, n=407). A greater (P<0.01) percentage of cows ovulated after GnRH on day 7 (78%, n=352) than after GnRH on day 14 (47%, n=311). Ovulation to the GnRH on day 14 did not have an effect (P>0.10) on CR. However, cows that ovulated after the GnRH on Day 7 had better CR (47%, n=352) than GnRH-treated cows that did not ovulate (27%; P<0.01) or control cows (42%, n=407; P<0.05). Control cows had higher CR than GnRH-treated cows that did not ovulate (P<0.03). The reason for a lack of ovulation in some cows treated with GnRH on Day 7 is unclear. Lack of ovulation was not related (P>0.10) to mastitis rate during the first 20 days after TAI or BCS. There were a greater (P<0.05) percentage of cows with follicles larger than 10mm on Day 7 in the GnRH-treated group that ovulated (99%, n=268) than GnRH-treated cows that did not ovulate (93%, n=72) or control cows (96%, n=397); however, this small difference is unlikely to explain the lack of ovulation in some GnRH-treated cows. In conclusion, ovulation to GnRH on Day 7 may increase CR in lactating dairy cows. An alternative explanation for our results is that lack of ovulation to GnRH on Day 7 has allowed selection of a group of less fertile cows.

Key Words: GnRH, Conception Rate, Dairy Cows

T159 Effect of GnRH between Pre-Synch injections and estradiol 17β during the Ovsynch protocol on conception rates in lactating dairy cows. A. Gümen*, A. H. Souza, A. P. Cunha, E. P. B. Silva, J. N. Guenther, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

Anovular cows have reduced conception rates (CR) during Ovsynch in spite of satisfactory ovulation rates. In order to improve CR in anovular cows, two modifications were made in a Presynch-Ovsynch protocol. First, cows were treated with Presynch (2 injections of prostaglandin F2α (PGF), 14 d apart, PGF1 initiated at 37-43 d postpartum) and half of the cows received a GnRH treatment at 7 d after PGF1 (PGP) or no treatment (PP). Second, cows that did not show estrus after Presynch were synchronized 11 d later with Ovsynch (GnRH-7d-PGF-58h-GnRH-16h-TAI) and half of the cows received 1 mg estradiol-17β (E2) at 8 h before the second GnRH treatment to increase E2 prior to ovulation. A total of 25% (163 of 654) of cows were anovular with no detectable luteal tissue by ultrasonography between PGF1 and 7 d later. More (P<0.001) anovular cows ovulated in PGP (80%) compared to PP (31% spontaneous ovulation). After the second PGF of Presynch 43% of cows (281/654) were detected in estrus and bred (57.4±0.2 d). Days to estrus were earlier (P<0.03) and less variable in anovular cows in PGP (2.9±0.1 d) compared to PP (3.6±0.3 d). However, there was no difference in ovular cows. In cows showing estrus, CR was numerically but not significantly greater in PGP than PP in anovular (18%; 3/17 vs. 33%; 8/24) but not ovular (36%; 40/110 vs. 38%; 48/128) cows. After Ovsynch, treatment with E2 increased expression of estrus in anovular (77% vs. 39%) and ovular (80% vs. 44%) cows. Interestingly, E2 treatment did not alter CR in ovular cows (45% vs. 45%) but increased (P<0.03) CR in anovular cows (18%; 10/56 vs. 36%; 24/66) regardless of GnRH treatment during Presynch. Thus, GnRH can be added to the Presynch protocol to induce ovulation in anovular cows and this increases synchrony in cows that show estrus. However, the largest increase in CR occurred in anovular cows that received E2 during Ovsynch suggesting that reduced CR to Ovsynch in anovular cows related to insufficient circulating E2.

Key Words: Presynch, Estradiol, CR

Production, Management and the Environment: Nutrition and Management

T160 Electronic identification of young lambs with mini-bolus and effects on intake and digestibility during fattening. J. J. Ghirardi[1], G. Caja*[1], C. Flores[1], and D. Garín[2], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*Universidad de la República*, *Montevideo, Uruguay*.

Three types of cylindrical ceramic mini-boluses (**B**) of different dimensions (o.d. × length; total weight): **B1** (10.5- × 51.0-mm; 13.8 g), **B2** (12.2- × 42.2-mm; 16.2 g), and **B3** (11.2- × 56.4-mm; 20.1 g) were produced. All B had a specific gravity greater than 3 and contained one 32 mm half-duplex ISO transponder. They were orally administrated by a trained operator, as early as possible, to a total of 513 newborn lambs of three sheep breeds used for different purposes: Manchega (dairy, n = 125), Lacaune (dairy, n = 116), and Ripollesa (local meat, n = 272). Lambs sucked from their mothers until wk 5 (dairy) or wk 6 (meat), and were intensively fattened (pelleted concentrate and barley straw ad libitum) thereafter. Growth rate, bolus retention and health status were recorded weekly. Retrieval and forestomachs location of B at slaughter (24 kg BW) were also recorded. Eight male Manchega lambs (45 d of age and 14 kg BW) in metabolic crates were randomly assigned to two experimental groups (**C**, control; and **BA**, mini-bolus applied) to evaluate the effects of B1 on feed intake and digestibility in four periods during fattening. On average, age at administration was lower ($P < 0.01$) in the dairy (B1, 21; B2, 29; and, B3, 20 d) than in the meat lambs (B1, 33; B2, 37; and, B3, 35 d). Body weight at application also differ ($P < 0.05$) between dairy (B1, 9.3; B2, 11.2; and, B3, 9.7 kg) and local meat lambs (B1, 8.9; B2, 11.0; and, B3, 9.1 d). Retention rate varied according to mini-bolus type (B1, 97.7; B2, 98.9%; and, B3, 100%). Lamb growth rate did not vary between B types. Recovery at slaughter was 100%, but three B1 (1.6 %) boluses were recovered from the abomasum. No differences in DM intake, average daily gain, feed conversion rate or nutrient digestibility were found between C and BA. In conclusion, B3 mini-bolus (20.1 g) proved to be an efficient device for the electronic identification of lambs, satisfying the ICAR requirement (>99% in 6 mo) and allowing the traceability of dairy (up to 21 d and 10 kg) and local meat lambs (up to 35 d and 10 kg) from suckling to slaughter.

Acknowledgements: EU project QLk1-2001-02229

Key Words: Electronic Identification, Rumen Bolus, Transponder

T161 Comparison of half- and full-duplex electronic ear tags and intraperitoneally injected transponders in the implementation of traceability under commercial conditions in pigs. C. Santamarina[1], M. Hernández-Jover[2], D. Babot[1,3], and G. Caja*[2], [1]*Universitat de Lleida*, *Lleida, Spain*, [2]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [3]*Centre UdL-IRTA*, *Lleida, Spain*.

A total of 790 Landrace × Large White ×× Pietrain pigs were used to study the traceability from weaning to the end of the slaughter line. Piglets were identified after weaning, reared under intensive conditions and harvested in a commercial slaughterhouse. All piglets were identified in triplicate with: a plastic button ear tag (**C**), in the right ear; an electronic button ear tag (**E**), in the left ear; and, an intraperitoneal (**I**) transponder. Transponders of the two radio frequency technologies complying with ISO 11789 (**H**, half-duplex; **F**, full-duplex B) were used. Treatments were: C (n = 790), EH (n = 369), EF (n = 397), IH (n = 392), and IF (n = 387). Readability of electronic devices was checked on the farm and in the slaughterhouse by using full-ISO handheld transceivers. No losses during the on-farm period and transportation were reported for C. Total of losses and electronic failures during the on-farm period and transportation were lower for IF (1.7%; $P < 0.05$) than EH (4.3%), but results for EF (2.3%)

and IH (2.1%) did not differ from the others. Losses during slaughtering did not differ between C (4.3%) and EH (2.9%), and were greater for EF (16.7%; $P < 0.05$). An additional 0.9% of electronic failures was recorded for EH, but no failures were observed in EF. Intraperitoneally injected transponders were not affected by the slaughter process, and 86.6% were recovered in the omentum at evisceration, the rest being lost on the floor. No transponders were left in the carcasses. The greatest values of traceability were obtained with the intraperitoneally injected transponders (98.1% on average), although no significant differences were found between IH (97.9%) and C (95.1%). Electronic ear tags reported the lowest traceability values (EF, 81.0%; and, EH, 91.9%; $P < 0.05$). In conclusion, good quality conventional ear tags and intraperitoneally injected transponders proved to be the most efficient systems for the traceability of pigs under commercial conditions.

Acknowledgements: CICYT AGL 2002-03960 (Spain) and EU QLk1-2001-02229 research projects

Key Words: Ear Tags, Transponders, Traceability

T162 Struvite crystallizer product as a phosphorus supplement for growing chicks. R. Kincaid*[1], J. Harrison[2], T. Benson[1], K. Bowers[3], and D. Davidson[2], [1]*Washington State University*, *Pullman*, [2]*Washington State University*, *Puyallup*, [3]*Multiform Harvest Inc.*, *Seattle, WA*.

One proposed treatment system for recovery of nutrients from dairy manure slurry involves the addition of Mg and ammonia to precipitate P as struvite ($NH_4MgPO_46H_2O$), which contains 12.7% P, 9.9% Mg and 5.7% N) from a slurry stream. Recovered product obtained by this method contained 10.4% P, 8.6% Mg, and 3.9% N, by analysis. A study was conducted to determine if the recovered product could be used as a source of inorganic P in diets of growing chicks. Day-old chicks (n=80) were assigned to dietary treatments of: 1) no P supplement; 2) 0.05% added P as KH_2PO_4; 3) 0.10% added P as KH_2PO_4; 4) 0.05% added P as product; and 5) 0.10% added P as product. The control diet contained 0.4% P, by analysis. The design was 4 replicates of 4 chicks per pen per dietary treatment (n=16 chicks/treatment). All chicks were fed a standard diet for 5 days, then their respective dietary treatment for 14 days. Feed intakes and growth rates were determined weekly for each group. On d 14, chicks were euthanized and the right tibia removed for bone ash determination. Feed intakes of chicks were increased ($P<0.05$) when P as KH_2PO_4 was supplemented but were depressed ($P<0.05$) by the added product. Similarly, growth rate of chicks fed added P as KH_2PO_4 increased ($P<0.05$) compared to control chicks but was depressed ($P<0.05$) by the product. In contrast, percent bone ash was greater for chicks fed product that those fed KH_2PO_4. The depressive effect of the product on feed intake and growth of chicks indicates that a component of the product was noxious to chicks, independent of P bioavailability. These results indicate that the product was not an acceptable ingredient in diets of young growing chicks.

Key Words: Phosphorus, Struvite, Chicks

T163 Multivariate factor analysis of electrical conductivity in dairy cattle. N. P. P. Macciotta*[1], M. Mele[2], R. Steri[1], and P. Secchiari[2], [1]*Università di Sassari*, *Sassari, Italia*, [2]*Università di Pisa*, *Pisa, Italia*.

Electrical conductivity (EC) of milk is an indicator trait for mastitis and it may be considered as a potential breeding goal for genetic programs, even if an accurate detection of affected animals still represents a problem. Several reasons can be found, one of which is the well known difficulty to quantify variations in multivariate phenotypes. In several research fields the need to copy with complex phenotypes has led to a widespread use of dimension-reduction techniques. The multivariate analysis of factor is a powerful technique able to reconstruct the structure of (co)variance of original variables by a few number of latent variables. Factor analysis was applied to a data set of 234 Holstein cows each having 28 EC traits, represented by the average of test day EC for 28 intervals of 10 days each, recorded by a commercial milk meter. Two factors able to explain 80% of the original variability were extracted. They were correlated with EC in the first part (FAC1) and in the second part (FAC2) of lactation respectively. Factor scores were analysed by a linear model that included the fixed effects of herd (3) parity (1 to 6) calving season (4), udder health status (no mastitis, mastitis within 150 days in milk, mastitis after 150 DIM). Both factors were affected by herd and parity, with heifers showing lowest values of both variables, and to a lesser extent, by season of calving. FAC1 was affected by the udder health status ($p=0.013$): cows that had mastitis in the first half of lactation shows values of FAC1 significantly higher than those of the other two groups. FAC2 was not clearly affected by the health status of the udder probably due to both the small number of animals with mastitis in the second half of lactation and to a confounding effect of the physiological rise of EC in this phase. Results of this study highlight the usefulness of dimension reduction technique in the analysis EC of cow milk during lactation and suggest further research for a possible implementation in automatic detection systems.

Key Words: Electrical Conductivity, Factor Analysis, Mastitis

T164 Effects of pre-weaning management on performance beef steers during a 30-d feedlot receiving period. R. Cooke*[1], X. Qiu[1], E. Pereira[3], G. Marquezini[3], J. Vendramini[1], C. Chase[2], S. Coleman[2], and J. Arthington[1], [1]*University of Florida, Range Cattle Research and Education Center*, *Ona*, [2]*USDA-ARS*, *Brooksville, FL*, [3]*Universidade Estadual Paulista*, *Botucatu, SP, Brazil*.

The objective of this experiment was to evaluate the effects of four pre-weaning management strategies on performance of weaned calves subjected to a 24 h transport. Sixty-four crossbred steers (Brahman x British) were randomly allocated to one of four pre-weaning management strategies (16 steers/treatment): 1) Negative control; weaned directly onto the truck, 2) Creep-fed; provided free-choice access to creep feed for 45 d prior to weaning, 3) Pre-weaned; weaned 45 d prior to shipping, and 4) Early-weaned; weaned at 80 d of age. On day 0, calves were loaded onto a commercial truck, hauled for 24 h, and delivered to the feedyard (d 1). Calves were penned within treatment (4 calves/pen; 4 pens/treatment) and provided free-choice access to hay and commercial grain starter for 30 d. Dry matter intake was measured daily, and BW was obtained on days 0, 1, 4, 8, 15, 22, 29 and 30. Data were analyzed using the MIXED procedure of SAS. Contrasts were made as follows: Control vs. Early-weaned, Creep-fed vs. Pre-weaned, and Control vs. Creep-fed and Pre-weaned. Average BW gain was greater ($P < 0.05$) for Early-weaned vs. Control calves. Average BW gain did not differ ($P = 0.49$, SEM = 0.25) among Pre-weaned and Creep-fed calves, but both tended to be greater ($P = 0.07$, SEM = 0.25) than Control (0.86, 1.08, 1.44, and 1.20 kg/d, for Control, Creep-fed, Early-weaned, and Pre-weaned calves, respectively; SEM = 0.25). Diet DMI was greater ($P < 0.01$) for Early-weaned vs. Control calves. Diet DMI did not differ among Creep-fed and Pre-weaned, but both were greater ($P = 0.02$) than Control calves (2.59, 2.77, 2.99, and 3.01 % BW for Control, Creep-fed, Early-weaned, and Pre-weaned calves, respectively; SEM = 0.09). Feed efficiency (F:G) was greater ($P = 0.01$) for Early-weaned compared to Control calves, but did not differ ($P = 0.13$) among Creep-fed and Pre-weaned vs. Control (average F:G = 9.55, 8.44, 6.25, and 7.90 for Control, Creep-fed, Early-weaned, and Pre-weaned calves, respectively; SEM = 0.69). The adoption of pre-weaning management strategies, as described in this study, may optimize calf performance following transport and entry into a feedyard.

Key Words: Weaning, Beef, Feedlot

T165 Effects of pre-weaning management on the acute phase protein response of transported beef steers during a 30-d feedlot receiving period. X. Qiu*[1], R. Cooke[1], E. Pereira[3], G. Marquezini[3], J. Vendramini[1], C. Chase[2], S. Coleman[2], and J. Arthington[1], [1]*University of Florida, Range Cattle Research and Education Center*, *Ona*, [2]*USDA-ARS*, *Brooksville*, [3]*Universidade Estadual Paulista*, *Botucatu, SP, Brazil*.

The objective of this experiment was to evaluate the effects of pre-weaning management on measures of inflammation in beef steers. Sixty-four crossbred steers (Brahman x British) were randomly allocated to one of four pre-weaning management strategies: 1) Control; weaned directly onto the truck, 2) Creep-

fed; provided free-choice access to feed for 45 d prior to weaning, 3) Pre-weaned; weaned 45 d prior to shipping, and 4) Early-weaned; weaned at 80 d of age. On day 0, calves were weaned and loaded onto a commercial truck, hauled for 24 h, and delivered into the feedyard. Calves were penned within treatment (4 pens/treatment) and provided free-choice access to hay and commercial grain starter for 30 d. Concentrations of acid soluble glycoprotein (ASG), haptoglobin, and ceruloplasmin were measured in blood samples collected on d 0, 1, 4, 8, 15, 22, and 29. Data were analyzed using the MIXED procedure of SAS. Contrasts were made as follows: Control vs. Early-weaned, Creep-fed vs. Pre-weaned, and Control vs. Creep-fed and Pre-weaned. Ceruloplasmin concentrations peaked on d 8 in Control calves and were greater ($P < 0.12$) than Early-weaned calves on day 8, 15, 22, and 29. Ceruloplasmin concentrations did not differ among Creep-fed, Pre-weaned, and Control calves; however, Pre-weaned calves had a lesser ($P < 0.12$) ceruloplasmin concentration on d 22 and 29, compared to Creep-fed calves. Haptoglobin concentrations peaked on d 1 in Control calves and were greater ($P < 0.13$) than Early-weaned calves on day 1, 8, and 22. Haptoglobin concentrations were similar among Creep-fed, Pre-weaned, and Control calves; however, Pre-weaned and Creep-fed calves had a lesser ($P < 0.12$) haptoglobin concentration on d 4, compared to Control calves. The greatest ASG concentration for Control calves was recorded on d 22 and was greater than Early-weaned calves ($P = 0.02$) and Creep-fed and Pre-weaned ($P = 0.02$) on this day. Control calves had a lesser ($P < 0.03$) ASG concentration than Early-weaned calves on d 0 and 1. Early calf weaning may be an effective practice for managing stress resulting from transportation and weaning.

Key Words: Weaning, Stress, Beef

T166 Fiber characteristics of U.S. Huacaya alpacas. C. J. Lupton[1], A. McColl[2], F. A. Pfeiffer*[1], and R. H. Stobart[3], [1]*Texas Agricultural Experiment Station*, *San Angelo*, [2]*Yocom-McColl Testing Labs*, *Denver, CO*, [3]*University of Wyoming*, *Laramie*.

Alpaca farming is a relatively new commercial enterprise in North America. A study was conducted to establish a comprehensive profile of U.S. Huacaya alpaca fiber characteristics that will be useful for educational, promotional, policy, selection, and breeding purposes. Specifically, the means and distributions of BW and all important fiber characteristics of a representative sample (n = 585) of U.S. alpacas were measured or calculated using internationally accepted objective test methods. Animals in specified age ranges and of known sex representing six geographical regions in the United States were weighed and sampled in approximate proportion to their population density in the respective regions. Fiber samples were shorn from the mid-side of the alpacas, representing female, male, and castrated male registered animals in the three age categories: one- and two-year-old and adult. Data were analyzed in terms of sex, age, region, color, and their interactions. Average BW (± SD) was 65.2 ± 12.5 kg. Fiber data that were measured included diameter (27.9 ± 5.4 µm), prickle factor (31.6 ± 25.1%) curvature (33.2 ± 7.0 deg/mm), medullation (white and light fawn samples only, 17.5 ± 11.0%), lab scoured yield (89.8 ± 4.5%), staple length (116.3 ± 40.0 mm), staple strength (50.2 ± 21.4 N/ktex), and resistance to compression (5.4 ± 0.8 kPa). In addition, yellowness and brightness were measured on the white samples and color differences were measured on the colored samples using a colorimeter. Compared to wool of similar fineness, alpaca was shown to be higher yielding, more heavily medullated (a distinctive feature of alpaca), longer, and considerably stronger. Resistance to compression was invariably lower for alpaca compared to wool of comparable fiber diameter, likely due to the lower levels of crimp in the alpaca fibers.

Acknowledgements: The authors express their appreciation to the Alpaca Research Foundation for financial support of this project.

Key Words: Alpaca, Huacaya, Objective Fiber Measurements

T167 Evaluation of the nutritive value of ensiled beet pulp for ruminant animals. C. W. Hunt*, J. C. Dalton, and N. R. Rimbey, *University of Idaho*, *Moscow*.

Beet pulp, which is the solid residue remaining after sugar is extracted from sugar beets, is an excellent source of digestible fiber for ruminant diets. Following sugar extraction the pulp is mechanically pressed to a DM content of approximately 25% and then the pulp is typically artificially dried for storage and feeding. Wet, ensiled beet pulp (WBP) is an alternative that would expend less fossil fuel and may have nutritive characteristics that are superior to dry pulp. Eight growing dairy heifer calves (approximate weight 210 kg) were used in a replicated 4 x 4 Latin square design (two heifers per square) to evaluate dietary treatments containing the following proportions of WBP and corn silage: 0:60, 15:45, 30:30, and 45:15. In addition to the WBP and corn silage, all diets had 40% alfalfa hay to provide adequate degradable protein. Each period of the Latin square consisted of 5 d of diet adaptation, 7 d of intake measurement, and 3 d of fecal sample collection to determine digestibility using AIA. In situ DM disappearance (20-h) of WBP was greater ($P < 0.01$) than corn silage when incubated in cows fed all forage (80.7 versus 65.2%, respectively) and in cows fed an early lactation diet (91.4 versus 71.1%, respectively). Digestibility of NDF increased linearly ($P < 0.01$), but DM intake decreased linearly ($P < 0.01$), as WBP was increased in the diet. Digestibility of DM and GE were not affected by treatment, therefore the DE content of the diets was equal across dietary treatments. These data suggest that WBP has equivalent energy value compared with corn silage as it has a more digestible fiber component. However, reduced intake may become a limiting factor for utilization of WBP for young calves.

Key Words: Energy, Digestion, Intake

T168 Evaluation of substitution value of barley grain for conventional forage on growth and reproductive performance of beef heifers. P. A. Szasz*, C. W. Hunt, A. Ahmadzadeh, R. Manzo, and J. I Szasz, *University of Idaho*, *Moscow*.

Metabolizable energy can often be supplied more economically from grain than from forages; however, grains are traditionally not included in wintering beef cattle rations. The purpose of this study was to evaluate the iso-caloric substitution value of barley for conventional forage on growth and reproductive performance of beef heifer calves. Forty crossbred heifers (initial BW 318 kg) were used in a completely randomized design and were allocated to four dietary treatments: a) conventional forage; b) forage with substituted barley provided in the AM; c) same as treatment b except that barley was fed in the PM; and d) barley fed in the AM as a pressed pellet. In all treatments, heifers were fed restricted amounts of their assigned diets to limit ADG to 0.72 kg/d. Following 105 d on these diets, heifers were commingled, fed a common diet, and were synchronized with two injections of prostaglandin F2α (PG) 14 d apart. Blood samples were collected on the day of 2nd PG injection. Estrus was observed 3 times daily and heifers received AI upon detection of estrus. Inclusion of barley in the diet reduced ($P < 0.05$) the total feed DM intake required to achieve the prescribed rate of gain; feed:gain was consequently lesser ($P < 0.05$) for barley-containing treatments. Body condition score was not different ($P <0.05$) across all dietary treatments at the time of AI. Although heifers fed conventional forage tended to have a greater ($P = 0.07$) number of corpus lutea at the time of 2nd PG injection, there was no difference in serum progesterone concentration among treatments. Moreover, estrus behavior was not different between treatments during 4 d following estrous synchronization. Pregnancy rates determined by ultrasound at d 35 and 71 post-breeding were not different among treatments. Results of these studies indicate that substituting barley for forage in limit-feeding regimes is a feasible means of meeting the metabolizable energy requirements without detrimental effect on reproduction.

Key Words: Metabolizable Energy, Beef Heifers, Reproduction

T169 Advantages of complex and chelated forms of zinc fed to bulls in a forage-fed bull test. R. C. Vann*[1], F. Holmes[2], H. Maxwell[3], C. G. Beyer[4], A. Denson[5], and S. T. Willard[5], [1]*MAFES-Brown Loam Experiment Station*, *Raymond, MS*, [2]*Mississippi Forage Bull Test*, *Tylertown, MS*, [3]*Columbia Animal Hospital*, *Columbia, MS*, [4]*Trouw Nutrition*, *Highland, IL*, [5]*Mississippi State University*, *Mississippi State*.

The objective was to compare three different mineral treatments provided to young growing bulls on forages in order to identify possible advantages of complex organic mineral (40% replacement of Zn) vs a chelated proteinate mineral (40% replacement of Zn) vs an inorganic control mineral. Angus bulls (n = 154) grazed ryegrass pastures and were offered free choice hay and water and were allotted to one of three mineral treatment groups balanced for age and weight: control (CT, n = 41), zinc-proteinate (ZP, n = 55) and zinc-complex (ZC, n = 58). Mineral treatments were offered at a target consumption of 0.11 kg/hd/d (4 oz). Bulls were weighed at the beginning (d 0), middle (d 70), and end (d 140) of the study to calculate ADG. Ultrasound measurements for ribeye area, intramuscular fat, back fat, rump fat and gluteus medius depth were taken on d 0 and d 140. On d 140, bulls underwent a breeding soundness exam and serum collected for determination of testosterone. Bull weights at d 0 and 140 were similar for all treatment groups. However, bulls in the CT group had the greatest ($P < 0.001$) ADG (1.21 ± 0.03), followed by the ZC group (1.14 ± 0.02) and the ZP group third (1.08 ± 0.02). There was no significant change (d 140 - d 0) in ultrasound body composition traits for ribeye area, back fat or intramuscular fat, however, the CT group had a greater ($P < 0.0002$) increase in rump fat and gluteus medius depth compared to ZP and ZC groups. There were no differences in scrotal circumference or testosterone concentrations among treatments. However, there were differences ($P < 0.03$) in percent semen motility with values as follows: CT:74.13 ± 2.60, ZC: 70.91 ± 2.60, and ZP: 64.81 ± 2.40. Bulls in the ZC group had the greatest ($P < 0.011$) number of percent normal cells and the least number of secondary abnormalities compared to the other two treatment groups. Although some advantages seemed apparent, our targeted Zn consumption, 440 mg total/180 mg organic, was not achieved. Actual average consumption was 80 mg total/32 mg organic in this research project. High quality ryegrass pastures contributed to the lack of mineral consumption in this research project.

Key Words: Zinc, Bulls, Forage

T170 Fate of *Fusarium graminearum* on barley grain during in vitro and in situ ruminal incubation. Y. Wang*[1], S. L. Scott[2], D. L. McLaren[2], Z. Matic[1], G. D. Inglis[1], and T. A. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Agriculture and Agri-Food Canada Research Centre*, *Brandon, MB, Canada*.

Survival of *Fusarium graminearum* (FG) in the ruminal environment was studied in vitro and in situ using infected whole barley kernels (WBK). Eight in vitro inocula were prepared using ruminal fluid from two barley grain/barley silage-fed steers. Strained ruminal fluid was autoclaved (ARF) or not (RF), then diluted with 0, 1, 2, or 3 volumes of mineral buffer. The WBK were incubated anaerobically for 6 h at 39°C in duplicate 125-mL serum vials (10 kernels per vial) with 50 mL of inoculum and 150 mg ground barley as substrate. Incubated WBK, as well as unincubated controls (± FG infection), were surface sterilized with 0.3% NaClO, transferred onto selective medium (10 kernels per plate), and incubated 5 d at 22°C. Growth of FG was observed on 2, 4, 16, and 14 of the 20 kernels plated from incubations in 0-, 1-, 2-, and 3-fold dilutions of RF, respectively, and on 6, 14, 10, and 14 kernels from the incubations in similarly diluted ARF. Ruminal fluid exerted a concentration-dependent, heat-resistant activity against FG that was enhanced in the presence of viable ruminal microorganisms. For the in situ study, WBK were processed five ways and ruminally incubated for 0, 6, 12 and 24 h in three barley grain/barley silage-fed steers (three bags per steer per time point). Randomly selected kernels (10 per bag) were plated as above. With no ruminal exposure (0 h), FG grew on 97, 37, 0, 70, and 77% of kernels that were incubated, respectively, as is (control, C), halved longitudinally (H), pressure-treated with steam (SPTW), tempered (2 h, 22°C; TW), or tempered with surfactant (TSW). After a 6-h incubation, FG grew on only 40, 20, and 6.7% of the C, TW and TSW kernels, respectively, all from the same steer. No growth was observed after 12 or 24 h. Steam treatment effectively inactivated FG, as did exposure to the ruminal environment. We conclude that the risk of excretion of viable FG by cattle consuming infected grain is negligible.

Key Words: Barley, *F. graminearum*, Rumen

T171 Effect of feed distribution frequency on intake, water consumption and ruminal pH in finishing beef heifers. V. Robles, L. González*, A. Ferret, X. Manteca, and S. Calsamiglia, *Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*.

Four rumen fistulated Holstein heifers (385 ± 6 Kg initial BW) were used in a 4 x 4 Latin square design to determine the effects of increasing feed distribution frequency on intake and ruminal pH. Treatments consisted of 1, 2, 3 and 4 times/day feedings (1D, 2D, 3D, and 4D). Concentrate (15.6% CP, 16.0% NDF, and 46.7% NSC, DM basis) was offered individually and ad libitum at 0800 for treatment 1D, at 0800 and 2000 for treatment 2D, at 0800, 1400 and 2000 for treatment 3D, and at 0800, 1200, 1600, and 2000 for treatment 4D. Barley straw was offered ad libitum at 0800. Each experimental period consisted of 14 d, and pH was measured at d 10, during 24 h, every 4 h. Data was analyzed with the MIXED procedure of SAS with animal and period considered as random effects, and orthogonal contrasts were used to test for linear, quadratic and cubic effects. Treatment effects at any given time were analyzed with the slice option. Barley straw to concentrate ratio (10:90) and total DMI (9.79 ± 0.33 Kg/d DM) were not affected by treatments. Water consumption tended ($P<0.10$) to increase linearly as the feed distribution frequency increased. Daily mean and lowest pH had a cubic tendency, values being 6.47, 6.69, 6.44, 6.67 for mean pH ($P=0.11$), and 5.88, 6.08, 5.81, 6.07 for lowest pH ($P=0.15$), for 1D, 2D, 3D and 4D treatments, respectively. Daily highest pH had an increasing linear tendency ($P<0.10$) when feeding frequency increase. Time in which ruminal pH remained under 5.8 was not affected by treatments, but while pH never fell under 5.8 for treatment 2D, it did for the remaining treatments (0 vs. 1.36 ± 0.71h). At any sampling time, pH was not affected by treatments except at 12 h after the first feeding, where a tendency ($P=0.06$) was detected, due to the higher pH for the treatment 2D. Preliminary data suggests that increasing the feeding frequency at twice a day allows to reduce the risk of ruminal acidosis without affecting feed consumption.

Key Words: Beef Heifers, Feeding Frequency, Ruminal pH

T172 The effect of feeding time on tympanic temperature of steer calves during winter. S. M. Holt* and R. H. Pritchard, *South Dakota State University*, *Brookings*.

The effect of feeding time on tympanic temperature during winter was investigated during a 55d feedlot growing study. Steers were limit-fed a high moisture ear corn diet (1.28 Mcal/kg NEg) at 0900h (AM), 1500h (PM) or 50% at 0900h and 50% at 1500h (SPLIT) to allow for 1.13kg ADG. Calculations of NEg required were derived using NRC equations and tabular values for ingredients. Climatic data were collected at 30 min intervals throughout the study via an on site automated weather station. Tympanic temperatures (TT) were collected every 30 min (5 steers/treatment) for 5d (d44 to d48). Ambient temperature (Ta) during the 55 d growing study ranged from -30.6 to 12.7^{0}C with a mean of -8.2^{0}C. Mean wind chill during the 5d TT collection period was -20.7^{0}C (-33.4 to -2.2^{0}C), while mean Ta was -21.4^{0}C (-30.6 to -12.7^{0}C). After 55d growing period, BW (364, 368 and 364kg), ADG (1.16, 1.21 and 1.14kg) and gain efficiency (215, 222 and 212g/kg) did not differ ($P>.10$) between AM, PM and SPLIT respectively, but followed rankings of previous research. Mean and maximum TT differed ($P<.05$) between treatments. Mean TT (39.0, 38.5, and 38.7^{0}C) and maximum TT (40.2, 39.1, and 39.6^{0}C) were higher for SPLIT than AM or PM, respectively. Diurnal TT patterns were assessed by separating the day into three periods based on mean hourly wind chills (6.8, -7.9, and -13.6^{0}C) for Period 1 (0800h to 1600h), Period 2 (1630 to 2100h) and Period 3 (2130 to 0730h) respectively. During period 3, mean TT (38.5, 38.7 and 39^{0}C) and maximum TT (40.2, 38.8, and 39.6^{0}C) were higher for SPLIT than AM or PM, respectively. During the warmest period of the day (Period 1), mean TT (38.9, 38.4, and 38.5^{0}C) and maximum TT (40.0, 38.9 and 39.0^{0}C) differed ($P>.05$) for all treatment groups (SPLIT, AM and PM). Elevated TT suggests that when SPLIT fed, steers increase metabolic rate to maintain normal TT during extreme cold. Additional research is needed to explain the changes in TT and how feeding times may impact energy partitioning.

Key Words: Tympanic Temperature, Feedlot Cattle, Cold Stress

T173 Performance of Holstein heifer calves fed three different concentrate grower diets with free-choice hay. J. Linn*[1], C. Soderholm[2], R. Larson[2], D. Ziegler[3], and H. Chester-Jones[3], [1]*University of Minnesota*, *St. Paul*, [2]*Hubbard Feeds*, *Mankato, MN*, [3]*University of Minnesota Southern Research and Outreach Center*, *Waseca*.

Heifer calves from 3 dairy farms were used in a 112-d study at SROC to evaluate feed intake and performance from 9 to 25 weeks of-age. Post weaned calves were randomly assigned by farm source and body weight (BW) to 4 replicate pens (6 calves/pen) of three 16% CP concentrates limit-fed up to 2.72 kg/heifer (as-fed) daily with free choice alfalfa hay. Heifers were housed in 7.62 x 3.66 m pens within a frame-steel curtain side-wall naturally ventilated grower barn. Average initial BW, hip height (HH) and body condition score (BCS) across treatments were 86.3 kg ± 0.68 kg, 93.5 ± 0.17 cm and 2.96 ± 0.01, respectively. Treatments were a complete grain-protein mix (GM); whole shelled corn (67.5%) mixed with base pellet (32.5%; WCP) and complete pellet (PEL). Total period and daily DMI of concentrate and hay did not differ across treatments (P >0.1), averaging 476, 2.44 and 1.81 kg/heifer, respectively. Total gain tended to be lower (P < 0.1) for heifers fed PEL (118.4 kg) than those fed WCP (124.7 kg) but similar (P > 0.1) to heifers fed GM (120.2 kg). Gain/DM feed was lower (P < 0.02) for heifers fed PEL (.246 kg) compared to those fed WCP (.263 kg) but not different (P > 0.1) from heifers fed GM (.255 kg). Final HH tended to be lower (P < 0.08) for heifers fed PEL (113.2 cm) compared to those fed WCP (114.6 cm) but similar (P > 0.2) to heifers fed GM (114.5 cm). Final BCS were similar (P > 0.3) across treatments averaging 3.98. Results indicated that heifers fed all the concentrate diets performed well. Heifers tended to utilize the PEL less effectively than the WCP diet.

Key Words: Dairy Calves, Grower Concentrates, Performance

T174 The effects of dietary antibiotics on growth performance and morbidity and mortality of pigs from primi-parous and multi-parous dams housed in a commercial wean-to-finish facility. B. A. Peterson*[1], M. Ellis[1], C. R. Bertelsen[1], J. M. DeDecker[1], M. J. Ritter[1], B. F. Wolter[2], J. Lowe[2], and R. Bowman[2], [1]*University of Illinois*, *Urbana*, [2]*The Maschhoffs, Inc.*, *Carlyle, IL*.

Research was conducted to evaluate the effect of dietary antibiotics on wean-to-finish performance of pigs from either primi-parous (PP) or mulit-parous (MP) dams. The PP and MP dams were kept on different farms, and their progeny were segregated during transport and placed in two separate identical wean-to-finish barns on the same site with strict bio-security maintained between the barns. Immediately post-weaning, pigs were allotted on the basis of weight to pens of 205 pigs (103 barrows and 102 gilts), and pens were randomly assigned to antibiotic treatments: 1) antibiotics [400 ppm tilmicosin (Elanco Animal Health, Indianapolis, IN) from weaning to 7 kg, 200 ppm tilmicosin from 7 to 11 kg, 27 ppm carbadox (Phibro Animal Health, Fairfield, NJ) from 11 to 27 kg, and 110 ppm lincomycin (Pfizer Animal Health, New York, NY) from 27 to 44 and from 73 to 84 kg] and 2) no antibiotics. A 12-phase dietary program formulated to meet or exceed NRC (1998) nutrient requirements was used. Pigs were individually weighed at weaning, and wks 2 and 22 post-weaning. Feeding antibiotics had no effect on growth performance, but morbidity and mortality was higher (P < 0.01) for pigs not receiving antibiotics. PP pigs were heavier (P < 0.01) at the beginning of the study, thus subsequent growth performance measures were adjusted by covariate analysis. MP pigs had less (P < 0.05) morbidity and mortality, were heavier (P < 0.05) at wk 22, and had higher (P < 0.05) ADG and ADFI, but poorer (P < 0.05) G:F than PP pigs. These results suggest that dietary antibiotics can effectively reduce morbidity and mortality in growing pigs and that dam parity may impact progeny growth performance and morbidity and mortality levels. However, this result needs to be viewed with caution because of the confounding of parity with the environment in which the pigs were reared.

Key Words: Antibiotics, Pigs, Dam Parity

T175 Performance of Holstein heifer calves fed texturized calf starters varying in molasses content. D. Ziegler*[1], H. Chester-Jones[1], B. Ziegler[2], R. Larson[2], and J. Linn[3], [1]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [2]*Hubbard Feeds*, *Mankato, MN*, [3]*University of Minnesota*, *St. Paul*.

Heifer calves from 3 dairy farms were used in a 56-d study at SROC to determine the effect of molasses concentration in calf starters (CS) on performance and health of calves. Upon arrival at SROC at two days of-age, calves were randomly assigned to one of three molasses starter treatments by farm source and body weight (BW). Calves were housed in 2.29 x 1.17 m individual calf pens within a frame-steel curtain side-wall naturally ventilated calf barn. Average BW across treatments at day 2 of-age was 40.5 kg Â± 0.47 kg. Treatments were grain, plant protein and processed grain byproduct based calf starters with 6, 9, or 12% molasses (as-fed basis). Calf starters were similar in nutrient content containing approximately 18% CP, 10% ADF, 2.7 Mcals ME/kg, 1.2% Ca, and 0.6% P. All calves were fed a 20% protein, 20% fat milk replacer (MR) at 0.28 kg (as-fed) in 1.96 L water (12.5% DM) twice daily for the first 35 days and then once daily from day 36 to weaning at 42 days. Calf starter and water were offered ad libitum throughout the 56 day study. Dry matter intake of MR (20.2 kg) and CS (49.4, 50.8, and 46.9 kg) were not different (P > 0.1) between the 6, 9, and 12% molasses treatments, respectively over the 56 days. Total gain for the 56 days was not different (P > 0.1) averaging 39.1, 38.1, and 35.8 kg for calves fed 6, 9, and 12% molasses treatments, respectively. Feed was utilized more efficiently (DM/gain) by calves fed 6% (1.79 kg) compared to those fed 9% (1.87 kg; P < 0.06) and 12% (1.89 kg; P < 0.03) molasses treatment. Calves were healthy throughout the study. Results indicate there are no feed intake benefits to increasing molasses levels in calf starters above a 6% inclusion rate.

Key Words: Dairy Calves, Growth, Calf Starter Molasses

T176 Effect of feed refusal amount on feeding behavior and production in Holstein cows. P. French*[1], J. Chamberlain[1], and J. Warntjes[2], [1]*Oregon State University*, *Corvallis*, [2]*University of California-Davis*.

The aim of this study was to determine the effects of amount of feed refusal on feed intake, feeding behavior, and milk production in Holstein cows. Fourteen multiparous Holstein cows (107±34 DIM) were assigned at random to one of two feedbunk management strategies: 2.5% (as-fed basis) feed refusal at 18 h post-feeding, designated as clean bunk (CB) or 5% feed refusal at 23 h post-feeding, designated as traditional bunk (TB). Cows were grouped housed in freestalls and fed individually via Calan gates. A TMR was offered twice daily at 0730 h and 1300 h. Feeding behavior was monitored continuously by a series of digital scales connected to a computer. Data were analyzed using the mixed procedure of SAS. Daily DMI (25.6 and 26.1 kg/d for CB and TB, respectively) and 3.5% FCM (41.5 and 42.7 kg/d for CB and TB, respectively) did not differ. Feed efficiency, calculated as kg 3.5% FCM per kg DM offered, did not differ (1.57 and 1.56 for CB and TB, respectively). Feed refusal at 18 h (4.4 vs 7.3% for CB and TB, respectively) and 23 h (3.4 vs 5.5% for CB and TB, respectively) post-feeding was less ($P < 0.01$) for CB compared to TB. Although feed disappearance was similar for CB and TB the first 18 h post-feeding, feed disappearance was greater ($P < 0.05$) for TB from 18 to 23 h post-feeding (1.3 vs 2.1 kg/d for CB and TB, respectively). Feedbunk management strategy did not affect number of meals per day (7.7 meals/d) or DMI per meal (3.4 kg DM/meal). However, daily meal-time (263 vs 375 min/d for CB and TB, respectively), meal duration (37 vs 49 min/meal for CB and TB, respectively), and eating time (212 vs 274 min/d for CB and TB, respectively) were less ($P < 0.01$) for CB compared to TB. In addition, eating rate was greater ($P < 0.01$) for CB (123 g DM/min) compared to TB (100 g DM/min). Although feedbunk management strategy altered feeding behavior with CB cows consuming a similar amount of total daily feed in a shorter amount of time, this change in feeding behavior did not affect milk production or milk composition.

Key Words: Feeding Behavior, Feed Refusals, Feedbunk Management

T177 Effects of OmniGen-AF on milk production and on lactation persistence in a commercial dairy setting. J. Chapman*[1], S. Puntenney[2], J. Verano[3], J. Heeg[4], Y. Wang[2], and N. Forsberg[2], [1]*Prince-Agri Products Inc., Quincy, IL*, [2]*Oregon State University, Corvallis*, [3]*Larson Dairy Inc., Okeechobee, FL*, [4]*Lakeland Animal Nutrition Inc., Lakeland, FL.*

The goal of this study was to evaluate effects of feeding OmniGen-AF, a commercially-available feed additive, on milk production and persistence of milk yield during a 60-day field trial. Holsteins cows (n=670), which included first, second and third lactation cows, were randomly assigned to a control treatment (n=342) or to a treatment which received OmniGen-AF (n=328) in the daily TMR. OmniGen-AF was fed at a rate of 56 g/hd/day for the first 30 days of the trial and at 28 g/hd/day for the second 30 days of the trial. Milk production records were collected throughout the study. Pre-experiment milk production levels of the control- and OmniGen-AF-fed groups were very similar (35.5 and 35.6 kg/hd/day, respectively). Effects of the two treatments on milk production were assessed statistically with a model which included pre-experiment milk production, days in milk, and lactation number as covariates. Addition of OmniGen-AF to the diet increased ($P<0.05$) absolute levels of milk production from 33.4 to 34.1 kg/hd/day during the 60-day feeding study. OmniGen-AF also significantly ($P<0.05$) increased persistence of milk production. Control-fed cows declined in production 2.42 kg/hd/day over the 60-day feeding study whereas milk production of OmniGen-AF-fed cows declined by only 1.08 kg/hd/day during the study. The benefit of the feed additive was more pronounced among multiparous cows. Specifically, control- and OmniGen-fed cows in first lactation lost similar amounts of milk (2.60 kg/hd/day and 2.22 kg/hd/day, respectively; $P>0.05$) during the 60-d study. Control-fed cows in third lactation lost 3.06 kg of milk/hd/day during the 60-day study whereas OmniGen-AF-fed third-lactation cows gained slightly ($P<0.05$) in production (+0.05 kg/hd/day) during the 60-day feeding study. These observations indicate potential for OmniGen-AF to increase milk production slightly and to improve persistence of milk production in multiparous cows.

Key Words: OmniGen-AF, Milk Production, Milk Persistence

T178 Principal component and multivariate analysis of milk fatty acid composition data from experiments designed to induce dietary milk fat depression in lactating cows. A. K. G. Kadegowda*, L. S. Piperova, and R. A. Erdman, *University of Maryland, College Park.*

The objective was to use principal component (PCA) and multivariate analysis (MA) to assess the relationship between milk fatty acid (FA) concentration (% of total FA methyl esters) and diet induced milk fat depression (MFD). Cow treatment observations (n=63) from 3 published feeding experiments with lactating dairy cows (Piperova et al. 2000, 2002, 2004 (J Nutr.130:2568, J Nutr.132:1235, and J. Dairy Sci. 87:3836, respectively) were used in the PCA. Principal component loading plots 1 and 2 described 55.9% of the total variation in milk FA and fat concentrations. Saturated FA (14:0, 16:0, 17:0) and milk fat showed negative loading for PC1 whereas trans t6-t15 18:1, along with t7c9, and t10c12 CLA showed positive (opposite) loading. Trans-16 18:1, 18:0, cis-18:1, cis 16:1, c11t13 CLA, and c9t11 CLA were associated with the PC2 axes (neutral), suggesting that they were not associated with changes in milk fat. Multivariate analysis using the SAS mixed procedure including experiment plus linear and quadratic terms for each of the PC1 positive loading variables showed significant regression coefficients ($P < 0.05$) for t6,7,8 (Fat % = $3.57 – 2.80X + 1.99X^2$) and t10 (Fat % = $3.55 – .292X + .0121X^2$) while all other trans-18:1 FA and CLA were nonsignificant. Subsequent MA was conducted on treatment means (n=33) from 9 independent literature experiments reporting milk t6-t11, c9t11 CLA, and t10c12 CLA. Significant effects of t9, t11 ($P < 0.05$), and t10 ($P< 0.06$), on milk fat percent were shown while t6,7,8 and c9t11 CLA and t10c12 CLA were nonsignificant. The PCA and MA analysis in the present study, confirms previous reports that t10 may be involved in MFD and suggest that t6,7,8 could also be important in MFD. Among the CLA isomers, the t10c12 CLA and t7c9 CLA isomer were consistently negatively correlated to milk fat. The analyses suggest that in addition to t10 18:1 and t10c12 CLA, the t6,7,8 18:1 and t7c9 CLA could be associated with MFD.

Key Words: Principal Component Analysis, Milk Fatty Acids, Milk Fat Depression

T179 In sacco forage fiber degradation in the rumen of lactating cows fed high- or low-forage diets supplemented with flaxseed or flaxseed oil. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Lennoxville, QC, Canada.*, [2]*Agriculture and Agri-Food Canada, Lethbridge, AB, Canada*, [3]*Laval University, Quebec, QC, Canada.*

The objective of this study was to examine the effect of flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on ruminal in sacco fiber degradation in dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four lactating cows (BW=647 kg; DIM=96 d) used in a 4x4 Latin square design (4 wk/period) were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Grass silage was ruminally incubated in duplicate nylon bags for 0, 2, 4, 8, 14, 24, 72, 48, and 96 h. Orthogonal contrasts (PROC MIXED, SAS) were used to determine the main effects of forage level, flaxseed source and their interaction. Significance was declared at $P\leq0.05$, and tendencies at $0.05<P\leq0.10$. The rapidly degradable fraction of ADF (a) was similar among treatments (9.98%). The slowly degradable fraction (b) of ADF tended to be reduced when cows were fed L compared to H diets (55.9 vs. 69.8%). The degradation rate (c) of ADF was not affected by forage level (2.12%/h) but the lag time value (L) was higher with L than with H diets (5.3 vs. 2.4 h). The effective degradability (ED) of ADF was lower with L than with H diets (24.5 vs. 31.6%). Neither degradation kinetic parameters (a, b, c, L) nor ED of ADF were different between FS and FO. The fraction (a) of NDF was not affected by forage level (8.12%). The fraction (b) of NDF was not changed by forage level; although it was numerically lower for cows fed L compared to cows fed H diets (61.1 vs. 70.8%; $P=0.18$). Parameters (c) and (L) of NDF were not affected by forage level (2.07%/h and 2.0 h; respectively). The ED of NDF was lower with L than with H diets (24.5 vs. 30.9%; respectively). Degradation kinetic parameters and ED of NDF were similar between FS and FO. This study suggests that ruminal fiber degradability of grass silage is reduced when cows are fed low compared to high forage diets, but that feeding either flaxseed or flaxseed oil has no effect.

Key Words: Flaxseed/Flaxseed Oil, Forage Fiber, Ruminal in Sacco Degradation

T180 Effects of flaxseed and flaxseed oil supplementation on ruminal fermentation characteristics, and ruminal ciliate protozoal populations in cows fed high- or low- forage diets. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Lennoxville, QC, Canada*, [2]*Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB, Canada*, [3]*Laval University, Quebec, QC, Canada.*

The objective of this study was to examine the effect of flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on ruminal fermentation characteristics and ruminal ciliate protozoal populations in dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four cows (BW=647 kg; DIM=96 d) used in a 4x4 Latin square design (4 wk/period) were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Effects of treatments were determined (PROC MIXED, SAS) by orthogonal contrasts: H vs. L, FO vs. FS and their interaction. Significance was declared at $P\leq0.05$, and tendencies at $0.05<P\leq0.10$. Ruminal pH was lower with L than with H (6.22 vs. 6.52) and was similar between FS and FO (6.35). Ruminal ammonia concentration was lower for cows fed L than for those fed H

(7.7 vs. 9.3 *mM*) but remained unchanged between FO and FS (8.5 *mM*). Ruminal total VFA concentration tended to be higher with L than with H (158. 7 vs. 148.1 *mM*), but did not differ between FO and FS (153.4 *mM*). Molar proportion of acetate was lower and that of propionate was higher for L than for H (57.2 vs. 65.5% and 27.1 vs. 19.4%; respectively). Molar proportions of these VFA were similar between FO and FS (61.3% and 23.3%; respectively). Acetate:propionate ratio was lower for cows fed L than for cows fed H (2.2 vs. 3.4) and it was similar between FO and FS (2.8). Total protozoa numbers were lower for cows fed L compared to cows fed H (2.6 vs. $5.3x10^5$/ml), but remained unchanged between FO and FS ($3.9x10^5$/ml). Only two genera of ruminal protozoa were detected. *Entodinium* numbers tended to be lower with L than with H (2.4 vs. 4.2 $x10^5$/ml) but were similar between FO and FS ($3.3x10^5$/ml). *Isotricha* numbers were similar among treatments ($0.14x10^5$/ml). This study suggests that ruminal fermentation characteristics and protozoa counts are not affected by FO and FS supplementation but they are influenced by forage level of the diet.

Key Words: Flaxseed/Flaxseed Oil, Ruminal Fermentation, Protozoa

T181 Effect of flaxseed and flaxseed oil supplementation on digestion, milk production, and milk composition in dairy cows fed diets with different forage levels. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [3]*Laval University*, *Quebec, QC, Canada.*

The objective of this study was to examine the effect of flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on digestion, milk production and milk composition in dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four lactating cows (BW=647 kg; DIM=96 d) used in a 4x4 Latin square design were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Diets were formulated to be isonitrogenous, isocaloric and isolipidic. Orthogonal contrasts (PROC MIXED, SAS) were used to test the main effects of forage level (F), flaxseed source (FLA) and their interaction. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. DMI was higher with L than with H (26.2 vs. 22.0 kg/d) and was similar between FS and FO (24.1 kg/d). DM digestibility was higher with L than with H (68.0 vs. 62.6%) and with FO than with FS (66.6 vs. 64.0%). N digestibility was similar for H and L diets, but it was lower for FS than for FO (59.4 vs. 63.3%). NDF digestibility was lower for HFS than for HFO (51.9 vs. 55.8%) and it was higher for LFS than for LFO (51.1 vs. 48.5%), which resulted in an interaction of FxFLA. Milk yield was higher with L than with H (48.1 vs. 39.2 kg/d) and with FO than with FS (45.3 vs. 42.0 kg/d). Milk fat content was lower with L than with H (3.01 vs. 3.74%) and with FO than with FS (3.20 vs. 3.55%). Milk protein content was higher with L than with H (3.12 vs. 2.92%) and tended to decrease with FO compared to FS (2.99 vs. 3.05%). Milk lactose content was higher with L than with H (4.70 vs. 4.50%) and tended to be greater with FO than with FS (4.64 vs. 4.55%). Fat yield was similar among treatments (1.46 kg/d). Protein yield was higher with L than with F (1.50 vs. 1.14 kg/d) and tended to decrease with FS compared to FO (1.29 vs. 1.36 kg/d). This study suggests that both forage level of the diet and the source of flaxseed (FO vs. FS) influence digestion, milk production and milk composition. However, no interaction was observed between forage level and flaxseed source (whole seed vs. oil).

Key Words: Flaxseed/Flaxseed Oil, Digestion/Milk, Dairy Cows

T182 Effect of increasing oil from distillers grains or corn oil on lactation performance. C. Leonardi*, S. Bertics, and L. Armentano, *University of Wisconsin*, *Madison*.

The objective of this study was to evaluate lactation production response of dairy cows fed distillers dried grains with added solubles (DDGS). It was hypothesized that the oil present in DDGS would decrease milk fat yield. In four diets DDGS (0%, 5%, 10% and 15% of dietary DM) replaced a mixture of soy bean meal and soy hulls. A fifth diet contained 1.5% (DM basis) corn oil (OIL), but no DDGS. All diets contained 27.0% corn silage, 18.0% alfalfa silage, 1.4% blood meal and 1.0% fish meal (DM basis). Diets were formulated to be about 16.9% CP and have 28% NDF, but fatty acid content increased with increasing DDGS. In addition 15% DDGS and OIL were approximately equal in fatty acid content. The DDGS fed contained (± SD) 28.7 ± 0.9% CP, 25.9 ± 2.3% NDF, and 10.8 ± 0.5% fatty acids (DM basis). Twenty multiparous lactating Holstein cows were assigned to a replicated 5 x 5 Latin Square design, with periods of 21 days. Comparisons tested were: linear and quadratic effect of DDGS, and OIL vs. 0% DDGS. Increasing DDGS linearly increased milk production and milk true protein yield. Although increasing DDGS decreased milk fat percentage, it did not affect milk fat yield. Feeding OIL increased milk yield and tended to increase milk true protein yield despite decreased true protein percentage. In diets containing approximately 28% NDF, blood and fish meal, feeding DDGS or corn oil to a level that raised total dietary fatty acid to 5% increased milk and milk protein yield, without decreasing milk fat yield.

	Diet[1]					Contrast		
	0%	5%	10%	15%	Oil	Linear	Quadratic	0% vs. Oil
DMI, kg/d	26.7	26.4	27.1	26.6	26.9	0.66	0.75	0.65
Milk, kg/d	44.6	43.8	46.4	46.2	47.2	0.009	0.62	0.005
True Protein,%	3.08	3.05	3.10	3.09	3.01	0.35	0.58	0.006
True Protein,g/d	1363	1329	1431	1416	1408	0.002	0.60	0.09
Fat, %	3.38	3.35	3.33	3.24	3.28	0.05	0.52	0.14
Fat, g/d	1491	1446	1530	1488	1531	0.57	0.95	0.34

[1]Diet: diets contained 0, 5, 10 or 15% distillers dried grains with solubles (DDGS, DM basis). Oil = diet containing corn oil but no DDGS.

Key Words: Distillers Dried Grains with Solubles, Milk Fat Yield

T183 Effects of forage and oil supplementation on milk fatty acid composition in ewes. C. Reynolds*, V. Cannon, S. Loerch, G. Lowe, D. Clevenger, and P. Tirabasso, *The Ohio State University*, *Wooster*.

In a previous study, the positive effect of dietary oil on milk conjugated linoleic acid (CLA) level was greater in ewes fed diets based on corn silage compared to alfalfa meal. In the present study, our objective was to measure the response of milk fatty acid (FA) composition to dietary oil (3% of ration DM, 2:1 respectively, soybean oil:marine algal oil [Martek Biosciences]) in Hampshire x Dorset ewes (78.6 kg BW) fed alfalfa haylage (AH) compared to corn silage (CS). Ewes (48) were assigned to one of 4 treatments and 12 pens in a 2 X 2 factorial randomized block design on the basis of lambing date and number of lambs. Control rations (60:40 forage:concentrate, DM basis) based on AH or CS were each fed to 6 pens for 3 wk after lambing, then 3 pens each fed AH or CS were switched to oil supplemented rations (AHO and CSO). Milk yield over 3 h and composition were measured at 42 d postpartum. DMI was decreased ($P < 0.05$) by oil, but not affected by forage. Milk yield was decreased by oil for AH, but increased by oil for CS ($P < 0.03$). Milk fat content was increased by oil for AH, but decreased by oil for CS ($P < 0.08$). Total CLA (g/100 g FA) was increased ($P < 0.01$) for AH vs. CS and by oil, and the response to oil was greater for AH ($P < 0.01$). In contrast, total trans-C18:1 was higher for CS vs. AH, with a greater response to oil for CS ($P < 0.01$). Feeding marine oil increased C22:6 ($P < 0.01$), and the response was greater for AH ($P < 0.09$). Milk fatty acid responses to feeding vegetable and marine oils were affected by forage source, but responses to AH were not the same as we observed previously for alfalfa meal.

	AH	AHO	CS	CSO	SEM
DMI, kg/d	4.1	3.3	3.5	3.2	0.1
Milk yield, kg/d	2.1	1.2	2.1	2.4	0.2
Milk fat, %	8.42	9.80	8.96	7.79	0.60
Milk protein, %	5.02	5.72	4.95	4.73	0.11
Total CLA	0.74	3.31	0.70	1.44	0.25
Total *trans*-C18:1	3.53	19.29	4.96	25.68	1.04
C22:6 (n-3)	0.07	2.18	0.07	1.70	0.14

Key Words: Ewes, Forage, Fatty Acids

T184 Effect of supplemental fat source on production, immunity, and reproduction of periparturient Holstein cows in summer. B. C. do Amaral*, C. R . Staples, O. Sa Filho, T. R. Bilby, J. Block, F. Silvestre, F. M. Cullens, C. E. Alosilla, Jr., L. Badinga, and W. W. Thatcher, *University of Florida*, *Gainesville*.

Objective was to evaluate how dietary fat sources of oleic, trans-octadecenoic, linoleic, or linolenic acids affected the performance of periparturient Holstein heifers (n = 22) and cows (n = 32) during the summer season. Fat supplements were the following: 1) sunflower oil (Trisun, Humko Oil, 80% oleic acid), 2) Ca salt of trans-octadecenoic acids (EnerG TR, Bioproducts Inc, 57% trans 6-12), 3) Ca salt of vegetable oils (Megalac-R, Church & Dwight Co, 30% linoleic acid), and 4) linseed oil (Archer Daniels Midland, 56% linolenic acid and 16% linoleic acid). Supplemental fats were fed at 1.35% of dietary DM beginning at 29 d prior to expected calving date. After calving, fats were fed at 1.5% (oils) and 1.75% (Ca salts) of dietary DM for 15 wk. The mean DMI prepartum (8.8, 9.2, 8.7, and 9.4 kg/d; SE = 0.5) and postpartum (16.6, 16.2, 15.8, and 16.6 kg/d; SE = 0.6), mean milk yield (34.5, 34.7, 32.2, and 34.0 kg/d; SE=1.4), mean true protein concentration (2.75, 2.78, 2.75, and 2.78%; SE=0.06), and mean BW (586, 575, 555, and 558 kg; SE = 15) for treatments 1, 2, 3, and 4, respectively were not different among treatments groups. Milk from cows fed linseed oil had greater fat% (3.57%) than that from cows fed Ca salts of vegetable oils (3.22%) or trans-octadecenoic acids (3.15%). At 40 ± 2 d postpartum, the previously pregnant uterine horn was flushed with 25 ml of saline, flushing collected, and measured for neutrophils using a hemocytometer. Log of total neutrophils was lowest for heifers fed supplemental linseed oil (7.3, 6.7, 6.5, and 3.1; SE = 0.8) but not for cows (5.6, 5.0, 5.2, and 5.0; SE = 0.8) on treatments 1 to 4, respectively (treatment by parity interaction, P=0.047). Feeding linseed oil increased milk fat % and reduced neutrophils in uterine flushings.

Key Words: Fat, Reproduction, Immune Function

T185 Effect of feeding different levels of lauric acid on ruminal protozoa, and milk production in dairy cows. A. Faciola*[1], G. Broderick[2,1], A. Hristov[3], and M. Leão[4], [1]*University of Wisconsin*, *Madison*, [2]*U. S. Dairy Forage Research Center*, *Madison, WI*, [3]*University of Idaho*, *Moscow*, [4]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

Reducing ruminal protozoa may improve N utilization. Medium-chain saturated fatty acids such as lauric acid (C12:0) have been shown to suppress protozoa. Fifty-two Holstein cows (eight fitted with ruminal cannulae) averaging 607 kg were used to test the effectiveness of different levels of lauric acid (LA) for suppressing protozoal population in the rumen; milk production and ruminal parameters were measured. Cows were randomly assigned to four treatments: A) control, B) 80, C) 160, or D) 240 g/d of LA that was incorporated into the TMR, which was fed once a day for 8-wk. Prior to feeding the LA, all cows were fed the same diet (control) for a 2-wk covariate period and production of milk and protozoal counts were determined for use in statistical analysis. The TMR contained (DM basis): 29% alfalfa silage, 35% corn silage, 14% rolled high moisture corn, 8% soybean meal, 12% ground dry corn grain, 15.5% CP and 29% NDF. Cows were fed ad libitum, protozoal counts, pH measurement, and ruminal sampling were done every two weeks. Data were analyzed using proc mixed in SAS. Least square means are reported in the table below. Feeding LA in the diet at 80, 160, and 240 g/d did not reduce DMI, or affect ruminal parameters and milk production. LA fed at 160 and 240 g/d reduced ruminal protozoal population by only 25 and 30%, respectively, showing that these levels, or method of administration, were not effective for obtaining a ruminal LA concentration that suppressed protozoa.

Item/Treatment	A	B	C	D		
Dietary LA, g/d	0	80	160	240	SEM	P>F
DMI, kg/d	26.6	25.5	25.3	25.0	0.6	0.10
Milk, kg/d	35.3	36.1	35.8	36.5	0.8	0.73
Ruminal ammonia, mM	6.1	6.2	6.6	7.5	0.6	0.40
Ruminal total free AA, mM	11.6	9.5	12.4	9.4	1.0	0.23
Ruminal pH	6.6	6.6	6.5	6.4	0.1	0.23
Ruminal protozoa (x 10^6) cells/ml	5.0[a]	5.1[a]	3.8[b]	3.4[b]	3.8	0.05

Key Words: Lauric Acid, Protozoa, Dairy Cows

T186 Effect of feeding ground versus whole safflower seed and safflower oil on milk fatty acid composition in cows. R. Mohammed, D. Lee, E. Tong, S. Parmley, G. Khorasani, and L. Doepel*, *University of Alberta*, *Edmonton, Alberta, Canada*.

A key step in the formation of conjugated linoleic acid (CLA) in milk is the biohydrogenation of unsaturated fatty acids in the rumen. With this in mind, we conducted an experiment to determine the effect of altering lipid availability to the rumen microbes on milk CLA yield. Forty lactating Holstein cows, blocked by parity, days in milk, and milk production were assigned to one of four dietary treatments: 1) no added fat (CTL), 2) ground safflower seed (GSS), 3) whole safflower seed (WSS) and 4) safflower oil (SO). The safflower seed and oil were incorporated into the TMR in amounts supplying 3% lipid on a DM basis. Dry matter intake in the animals on GSS diets was significantly higher than those on SO and WSS diets (P=0.04). Milk yield, and milk fat and protein yields were not affected by treatment. Milk fat and protein percentage were significantly higher with CTL compared to GSS, WSS and SO (P=0.03 and 0.01 respectively). The concentrations of cis-9, trans-11 CLA and trans-11 C18:1 in milk were higher with SO than with GSS, but were not different between GSS and WSS. The milk concentration of trans-10, cis-12 CLA was significantly higher with GSS, WSS and SO compared to CTL (P=0.005). The results suggest that WSS is as effective as GSS in increasing milk CLA levels.

Effect of treatments on DMI, yield and composition of milk

	CTL	GSS	SO	WSS	SEM
DMI (kg/d)	21.2[ab]	22.2[a]	19.5[bc]	18.6[c]	1.00
Milk yield (kg/d)	27.6	30.3	27.3	26.3	1.22
Fat yield (kg/d)	1.0	1.0	0.9	0.9	0.05
Protein (kg/d)	0.9	0.9	0.9	0.8	0.04
Lactose yield (kg/d)	1.3	1.4	1.2	1.2	0.06
Fat %	3.7[a]	3.2[b]	3.4[b]	3.4[b]	0.12
Protein %	3.4[a]	3.1[b]	3.2[b]	3.2[b]	0.07
Lactose %	4.6	4.6	4.5	4.5	0.04
CLA c_9t_{11}	0.4[a]	0.7[b]	1.0[c]	0.9[bc]	0.08
$CLAt_{10}c_{12}$	0.01[a]	0.02[b]	0.02[b]	0.02[b]	0.003
$C_{18:1}$ t_{11}	1.29[a]	2.64[b]	3.81[c]	3.30[bc]	0.34

Within a row, means with different superscripts differ significantly (P<0.05)

Key Words: Safflower Seed, Milk Fatty Acid Composition, CLA

T187 Effects of bST and dietary fat in early lactation on lactational performance of Holstein cows. M. Carriquiry*, W. J. Weber, C. R. Dahlen, G. C. Lamb, and B. A. Crooker, *University of Minnesota*, *St. Paul*.

Multiparous cows (n = 59) in a 2 x 2 factorial design were used to determine effects of bST (POSILAC®) and supplemental dietary fat (Alifet-High Energy®

and Alifet-Repro®; AF) during the first 17 wks of lactation (WOL). Cows were blocked by expected calving date and previous 305ME and assigned randomly to consume fat (0 or 4% of dietary DM) from calving and/or receive bST (0 or 500 mg) every 10 d from 12 to 70 d in milk (DIM) and at 14 d-intervals thereafter. Diets contained 1.68 Mcal NEL, 185 g CP, and 200 g ADF per kg DM. Isocaloric diets were created by including whole, high-oil sunflower seeds (0 vs 10%) in the non-AF diet. Means from a repeated measures analysis differed when P < 0.05. Milk yield was not affected by AF but there was an interaction of bST and WOL as bST increased milk yield after 6 WOL (47.9, 50.3 ± 1.0 kg/d). Milk fat content increased (4.23, 4.56 ± 0.12%) and 4% FCM yield (45.5, 48.3 ± 1.2 kg/d) tended (P=0.06) to increase with bST during the first 17 WOL. Milk protein and lactose yield and dry matter and energy intake were similar among treatments. Body condition score was not affected by treatments. Postpartum body weight of bST cows was less than non-bST cows (641, 626 ± 7.6 kg). Backfat thickness was increased by AF (3.5, 4.1 ± 0.2 mm) and tended (P = 0.08) to decrease with bST (4.2, 3.6 ± 0.2 mm). Energy balance nadir (-15.1 ± 1 Mcal/d at 2 WOL) did not differ among treatments but energy balance decreased with bST (-4.2, -7.6 ± 0.7 Mcal NEL/d) during the first 17 WOL. There was a trend (P = 0.06) for an interaction of bST and AF as AF decreased the impact of bST on energy balance. Positive energy balance occurred at 15 WOL for bST cows fed no AF and at 13 WOL for the other treatments. Gross efficiency was greater for bST cows (2.07, 2.29 ± 0.05 kg FCM/kg DMI). Initiation of bST administration at 12 DIM increased milk yield after 6 WOL and prolonged the period of negative energy balance but did not cause cows to reach a lower energy balance nadir.

Key Words: Somatotropin, Fat, Lactation

T188 Effect of varying levels of free fatty acids from palm oil on milk production and feed intake in Holstein cows. S. Mosley*[1], E. Mosley[1], B. Hatch[1], J. Szasz[1], A. Corato[2], N. Zacharias[1], D. Howes[3], and M. McGuire[1], [1]*University of Idaho*, *Moscow*, [2]*University of Padova*, *Padova, Italy*, [3]*Howes Management Services*, *Nampa, ID*.

To determine the optimum feeding level for free fatty acids of palm oil (PALM) (Energizer RP10; 92% palmitic acid), lactating cows (n =18) were randomly assigned to a treatment sequence in replicated 4 x 4 Latin squares. Animals were assigned to squares by parity (3 multiparous and 1 primiparous with primiparous in the incomplete square). The four diets were designed to provide 0, 500, 1000 and 1500 g of PALM per day. The amount of free fatty acids was adjusted on a daily basis to be 0, 1, 2 or 3% of the total mixed ration based upon the ration dry matter. Cows were fed individually with feed intake determined daily. Each period lasted 16 d with milk production and composition determined the final 2 d. Milk production, milk composition and feed intake data were analyzed using the MIXED procedure of SAS. Milk yields were 30.9, 34.0, 34.2 and 34.2 kg/d (SEM = 1.9) for the 0, 500, 1000 and 1500 g levels, respectively. Milk yield was increased (P<0.001) by the addition of PALM; however, there were no differences among the levels of PALM. Fat percent was also increased (P<0.01) by the addition of PALM from 3.44% for 0 g to 3.93% for 500 g (SEM = 0.17) but there were no differences among the PALM treatment levels. Dry matter intakes were 23.4, 26.3, 24.4 and 23.4 kg/d (SEM = 1.4) for the 0, 500, 1000 and 1500 g levels, respectively. The addition of PALM increased milk yield, fat percentage and feed intake, while no adverse effects on milk protein concentration were observed. Feeding 500 g/d of PALM maximized milk yield, milk fat percentage, and feed intake.

Key Words: Dietary Lipid, Palmitic Acid, Milk Yield

T189 Effects of intravenous infusion of tallow emulsion on responses to glucose and insulin challenges of Holstein cows. J. A. A. Pires*, A. H. Souza, and R. R. Grummer, *University of Wisconsin*, *Madison*.

The objective was to test whether the induction of elevated blood NEFA by intravenous infusion of tallow emulsion alters glucose tolerance and insulin responsiveness in Holstein cows. Six non-lactating, non-gestating Holstein cows were assigned to a cross-over design. One cow was excluded from experiment due to complications from mastitis. Treatments consisted of 11 h intravenous infusions of saline (**S**) or 20% (w/v) triacylglycerol (**TAG**) emulsion derived from tallow (**T**) to elevate plasma NEFA. Each period consisted of 2 d of infusions (**I1** and **I2**), separated by 1 d in which cows were not infused. Bilateral jugular catheters were inserted 1 d before the first infusion and were maintained for the 3 d period. Treatments were administered continuously via drip infusion, at a targeted a rate of 0.1g TAG/kg BW /h for the T treatment. On I1 of each period, a glucose tolerance test (**GTT**) was performed (0.25g dextrose i.v. bolus/kg BW), starting 8 h after initiation of T or S infusions. On I2, an insulin challenge (**IC**) was performed (0.1 IU insulin i.v. bolus/kg BW). Blood samples were collected every 2 h during the first 8 h of infusion, and 16 samples from -15 to 180 min relative to GTT and IC. The infusion of S or T continued during the GTT and IC sampling period. Cows were fed every 4 h at a rate to meet energy requirements for 5 days prior to each period, and every 2 h during the first 8 h of infusions. Infusion of T increased nonesterified fatty acids (**NEFA**; $P < 0.001$) relative to S, during the first 8 h of infusions (303 vs. 86 µEq/L), during the GTT (306 vs.76 µEq/L) and during the IC (357 vs. 187 µEq/L). During GTT, neither glucose clearance rate (**CR**) nor glucose half life ($\mathbf{T^{1/2}}$) differed between T and S (1.7 vs. 2.4 %/min, and 48 vs. 31 min, respectively). After IC, CR was lower ($P < 0.05$) for T than S (1.5 vs. 2.5 %/min). Accordingly, $T^{1/2}$ was 46 min for T and 29 min for S ($P < 0.05$). These results suggest that elevated levels of NEFA cause a reduction in insulin responsiveness.

Key Words: Insulin Challenge, Glucose Tolerance, Dairy Cows

T190 Intake, duodenal flow and ruminal biohydrogenation of fatty acids in Holstein steers fed canola supplemented dairy lactation diets. S. E. Bedgar*, J. W. Schroeder, M. L. Bauer, and W. L. Keller, *North Dakota State University*, *Fargo*.

Fifteen cannulated Holstein steers (399 ± 21.7 kg initial body weight (BW)) were stratified by BW and assigned to treatments in a completely randomized design to evaluate the effects of feeding ground canola seed on change in fatty acid flow. Diets containing 0, 6.1, and 12.2% of the total ration dry matter (DM) as ground canola seed were offered ad libitum. Rations were formulated to represent high production lactation diets and to contain 20.5, 19.7, and 18.6% CP with 1.61, 1.65, and 1.71 Mcal of net energy per kg of DM, for the 0, 6.1, and 12.2% canola diets, respectively. The control diet was composed of corn silage, ground corn, alfalfa, soybeans, canola and blood meal, vitamins, minerals, and chromic oxide as an external marker. Ground canola seed (39.6% lipid, DM basis) replaced corn grain and canola meal in the diets. Steers were acclimated to treatment for 25 d prior to collections. Duodenal and ileal samples were taken to represent every 1.5 h in a 12 h period from d 29 through 31. Rumen fluid samples were taken at 0, 2, 4, 6, 8, 10, and 12 h post-feeding. Inclusion of ground canola seed did not affect DM intake. Intake of total fatty acids and long-chain fatty acids increased linearly ($P < 0.001$) with dietary canola. Flow of fatty acids increased ($P = 0.04$) to the duodenum and ileum as canola was added to the diet. Percentage biohydrogenation of C_{18} fatty acids increased linearly ($P = 0.02$) with canola. These data suggest that ground canola can be used as an ingredient to increase the flow of fatty acids to the small intestine without negatively affecting digestion and ruminal fermentation. While saturated C_{18} fatty acid flow to the small intestine increased because of increased ruminal biohydrogenation, delivery of $C_{18:1}$ and $C_{18:3}$ to small intestine also increased with increasing dietary canola.

Key Words: Canola, Dairy, Fatty Acid

T191 Effect of supplementation with Ca-salts of fish oil on omega-3 fatty acids in milk fat. E. Castaneda-Gutierrez*[1], W. R. Butler[1], M. J. de Veth[1], A. L. Lock[1], D. A. Dwyer[1], D. Luchini[2], and D. E. Bauman[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Bioproducts Inc.*, *Fairlawn, OH*.

Omega-3 fatty acids play an important role in reproductive processes in dairy cows and are associated with beneficial health effects in humans; thus, en-

hancement of their intake and content in milk is desirable. The objective of this study was to evaluate the effect of rumen protection of fish oil at two doses on the transfer of EPA, DPA and DHA into milk fat. Four lactating Holstein cows (143 ± 31 DIM) were randomly assigned in a Latin square design to the following treatments: 1) rumen infusion of Ca-salts of fish oil and palm fatty acid distillate, low dose (CaFO-1), 2) rumen infusion of Ca-salts of fish oil and palm fatty acid distillate, high dose (CaFO-2), 3) rumen infusion of fish oil (RFO), and 4) abomasal infusion of fish oil (AFO). CaFO-1 provided 146 g/d of fat containing 8.3, 1.8 and 10.6 g/d of EPA, DPA and DHA, respectively; CaFO-2 provided twice these amounts. RFO and AFO supplied 145 g/d of fat which provided 16.2, 3.8, and 22.0 g/d of EPA, DPA and DHA, respectively. A 10 d pre-treatment period was used as a baseline, followed by 10 d treatment periods with intervals of 10 d in between. Supplements were infused every 6 hr and milk samples taken the last 3 d of baseline and treatment periods. Milk and milk protein yield were unaffected by treatment. RFO reduced DMI by 15% and milk fat yield by 20% ($P < 0.02$). Milk fat yield was increased by CaFO-2 compared with AFO and RFO ($P < 0.01$). Milk secretion of EPA, DPA and DHA was increased by all treatments as compared to pretreatment baseline values (Table 1). Fat content and transfer percent of EPA, DPA and DHA to milk fat were significantly higher with AFO ($P < 0.01$), but did not differ among other treatments. Ca-salts did not increase output of omega-3 fatty acids in milk fat compared with rumen infusion of unprotected oil; however, the milk fat content of these fatty acids was increased over pretreatment values without the negative effects on DMI and milk fat yield observed with the unprotected fish oil supplement.

FA in milk, g/d [1]	CaFO-1	CaFO-2	RFO	AFO	SEM	*P*-value
EPA	0.68[b]	0.83[b]	0.63[b]	3.76[a]	0.32	0.001
DPA	0.83[b]	0.94[b]	1.06[b]	2.31[a]	0.18	0.003
DHA	0.78[b]	1.06[b]	0.95[b]	4.30[a]	0.41	0.002

[1] Baseline values (unsupplemented) for EPA, DPA and DHA were 0.31, 0.57 and 0.14 g/d, respectively.

Key Words: Fish Oil, Omega-3 Fatty Acids, Ca-Salts of Fatty Acids

T192 Rumen vs. abomasal infusion of fish oil as a novel approach to determine the extent of rumen biohydrogenation of omega-3 fatty acids and their transfer into milk fat. C. McConnell, A. L. Lock, and D. E. Bauman*, *Cornell University*, *Ithaca, NY*.

Fish oils are rich in the omega-3 fatty acids, eicosapentaenoic (20:5 n-3; EPA) and docosahexaenoic acid (22:6 n-3; DHA). These fatty acids are of interest in human health, particularly for their beneficial effects in reducing the risk of atherosclerosis. Thus, current research is pursuing opportunities to enhance omega-3 fatty acids in many foods. The milk fat of dairy cows is very low in EPA and DHA, with their transfer from fish oil and fish meal being poor (~<1 to 4%). The objective of the current study was to compare the effects of supplying fish oil to the rumen vs. the abomasum on milk fatty acid composition and the transfer efficiencies of EPA and DHA to milk fat. The two methods provide a comparison of the extent to which ruminal biohydrogenation may reduce EPA and DHA transfer to milk fat. Three rumen fistulated lactating Holstein cows (235±73 DIM) were randomly assigned in a 3 X 3 Latin square experiment. Treatments were: 1) no supplement (control), 2) rumen infusion of fish oil (RFO; 150 g/d), and 3) abomasal infusion of fish oil (AFO; 150 g/d). Treatment periods were 7 d with a 9 d interval between periods. The concentrated fish oil contained 26% EPA and 28% DHA; daily infusions supplying 39 and 42 g/d of EPA and DHA, respectively. Milk fat content of EPA was 0.18, 0.18 and 1.36 and DHA content was 0.11, 0.08, and 1.13 g/100 g of fatty acids for the control, RFO and AFO treatments, respectively ($P < 0.01$). Transfer efficiencies were 30 and 25% for EPA and DHA, respectively on the AFO treatment, and <1% for EPA and DHA on the RFO treatment. Results indicate extensive biohydrogenation of fish oil fatty acids occurs in the rumen, which is supported by the fact that during RFO supplementation, the concentration of 20:0 in milk fat increased above that found in the control and AFO treatments (($P < 0.05$). In conclusion, the AFO treatment increased the EPA and DHA content of milk fat relative to RFO, and, thus, the major limitation to using an unprotected dietary supplement to increase omega-3 fatty acids is due to biohydrogenation of these fatty acids in the rumen.

Key Words: Milk Fat, Fish Oil

T193 The effect of docosahexaenoic acid on the production of vaccenic acid and conjugated linoleic acid from unsaturated C18 fatty acids in rumen cultures. A. AbuGhazaleh*, G. Apgar, and B. Jacobson, *Southern Illinois University*, *Carbondale*.

Previously, combining docosahexaenoic acid (DHA) with soybean oil in rumen cultures enhanced vaccenic acid accumulation. The objective of this experiment was to examine the effect of combining DHA along with oleic, linoleic, and linolenic acids to determine which combination would lead to maximum vaccenic acid and conjugated linoleic acid (cis-9, trans-11 CLA) accumulations. Treatments consisted of 1) 10 mg DHA (control), 2) control plus 20 mg oleic acid (DHAO), 3) control plus 20 mg linoleic acid (DHAL), and 4) control plus 20 mg linolenic acid (DHALN). Treatments were incubated in triplicate in 125 ml flasks containing 500 mg finely ground TMR, 10 ml of the strained ruminal fluid, 40 ml of media, and 2 ml of reducing solution. A 5-ml sample of culture contents was taken at 0 and 24 h for fatty acid analysis by gas liquid chromatography. After 24 h of incubation, the concentration of vaccenic acid (5.8, 6.0, 20.9, and 9.3 mg/culture, for treatments 1-4, respectively) was highest ($P < 0.05$) with the DHAL, intermediate with the DHALN, and least with the DHAO. The concentration of cis-9, trans-11 CLA (0.1, 0.1, 0.7, and 0.1 mg/culture) in cultures increased ($P < 0.05$) only with the DHAL. Addition of linolenic acid to cultures caused a dramatic increase ($P < 0.05$) in the concentration of cis-15, trans-11C18:2 (0.2, 0.3, 0.5, and 9.8 mg/culture). Concentration of hydroxy stearic fatty acid (0.2, 1.1, 0.2, and 0.2 mg/culture) increased ($P < 0.05$) only in cultures containing added oleic acid. Combining DHA with linoleic acid most effectively increased concentrations of vaccenic acid and cis-9, trans-11 CLA in rumen cultures.

Key Words: Docosahexaenoic Acid, Conjugated Linoleic Acid, Vaccenic Acid

T194 The effect of low pH on the production of trans monoenes and conjugated linoleic acid in rumen cultures containing docosahexaenoic acid and unsaturated 18 carbons fatty acids. A. AbuGhazaleh*, G. Apgar, and B. Jacobson, *Southern Illinois University*, *Carbondale*.

Previously, combining docosahexaenoic acid (DHA) with linoleic acid in rumen cultures at pH 6.9 enhanced vaccenic acid and c9, t11 conjugated linoleic acid (CLA) accumulations. The objective of this experiment was to examine the effect of low pH on trans monoenes and CLA accumulations in rumen cultures incubated with DHA and oleic, linoleic, and linolenic acids. Treatments consisted of 1) 10 mg DHA (control), 2) control plus 20 mg oleic acid (DHAO), 3) control plus 20 mg linoleic acid (DHAL), and 4) control plus 20 mg linolenic acid (DHALN). Treatments were incubated in triplicate in 125 ml flasks containing 500 mg finely ground TMR, 10 ml of the strained ruminal fluid, 40 ml of media, and 2 ml of reducing solution. Ruminal fluid was collected from fermenters fed high grain diet. The pH of cultures averaged 6.1 and 5.5 at 0 and 24 h, respectively. A 5-ml sample of culture contents was taken at 0 and 24 h for fatty acid analysis by gas liquid chromatography. Data were analyzed using the GLM procedure of SAS. Results are expressed by their least square means. After 24 h of incubation, t10 C18:1 (4.8, 5.0, 12.8, and 4.5 mg/culture, for treatments 1-4, respectively) was the main trans monoene isomer in cultures and was highest ($P < 0.05$) with the DHAL. Similarly, t10, c12 CLA (0.1, 0.1, 1.5, and 0.2 mg/culture, for treatments 1-4, respectively) was the main CLA isomer in cultures and was highest ($P < 0.05$) with the DHAL. Additions of linolenic acid to rumen cultures caused a dramatic increase ($P < 0.05$) in the concentration of t11, c15 C18:2 (0.5, 0.5, 0.5, and 8.5 mg/culture, for treatments 1-4, respectively) and t11, t13 CLA (0.1, 0.1, 0.1, 1.0 mg/culture for treatments 1-4, respectively). Hydroxy stearic fatty acid concentration (0.4, 2.6, 0.3, and 0.2 mg/culture, for treatments 1-4, respectively) increased ($P < 0.05$)

only with the DHAO. Lowering culture pH increased accumulations of t10 C18:1 and t10, c12 CLA and the increase was highest when DHA was combined with linoleic acid.

Key Words: Docosahexaenoic Acid, Trans Monoenes, pH

T195 Production of trans monoenes and conjugated linoleic acid in continuous cultures fed diets containing fish oil and sunflower oil with decreasing levels of forage. A. AbuGhazaleh*[1], B. Jacobson[1], R. Buckles[1], and K. Kalscheur[2], [1]*Southern Illinois University*, *Carbondale*, [2]*South Dakota State University*, *Brookings*.

Previously, feeding fish oil (FO) and sunflower seeds to dairy cows resulted in the greatest increases in the concentrations of vaccenic acid and conjugated linoleic acid (CLA) in milk fat. The objective of this study was to evaluate the effects of forage level in diets containing FO and sunflower oil (SFO) on the production of trans monoenes and CLA by mixed ruminal microbes. A dual-flow continuous culture system consisting of 3 fermenters was used in a 3 x 3 Latin square design. Treatments were 1) 75% forage, 25% concentrate mix containing 1% FO and 2% SFO; 2) 50% forage, 50% concentrate mix containing 1% FO and 2% SFO; 3) 25% forage, 75% concentrate mix containing 1% FO and 2% SFO. The forage source was alfalfa pellets. Corn, soybean meal, limestone, vitamins and minerals made up the concentrate mix. During 10-d incubations, fermenters were fed treatment diets three times daily (150g/d, divided equally between three feedings) as TMR diet. Effluents from the last 3 d of incubation were composited for analysis. The concentrations of t10 C18:1 (0.0, 10.5, 33.5 mg/g DM overflow for treatments 1 to 3, respectively) and t10, c12 CLA (0.08, 0.18, 0.35 mg/g DM overflow) increased linearly ($P < 0.05$) as dietary forage levels decreased. The concentrations of vaccenic acid (14.7, 12.9, 0.0 mg/g DM overflow) and c9, t11 CLA (1.78, 1.52, 0.03 mg/g DM overflow) decreased ($P < 0.05$) in a linear manner as dietary forage levels decreased. The concentration of hydroxy stearic fatty acid (1.1, 3.3, 1.4 mg/g DM) showed a quadratic ($P < 0.05$) response to dietary forage levels. The biohydrogenation of oleic (78.8, 85.2, and 80.7), linoleic (92.9, 93.7, and 88.4) and linolenic (92.6, 94.6, and 87.0) acids were not affected ($P > 0.05$) by forage levels. Decreasing dietary forage levels resulted in t10 C18:1 and t10, c12 CLA replacing vaccenic acid and c9, t11 CLA, respectively, in fermenters fed FO and SFO.

Key Words: Fish Oil, Forage Level, Trans Fatty Acids

T196 Conjugated linoleic acid (CLA) content of milk and meat products and its intake in humans. T. R. Dhiman*, A. L. Ure, and S. Nam, *Utah State University*, *Logan*.

Conjugated linoleic acid (CLA) has been shown to have potential health benefits in animal models. A review of published research was conducted on factors affecting the CLA content of milk and meat and its influence on CLA intake in humans. The *cis*-9, *trans*-11 $C_{18:2}$ isomer is the principle dietary form of CLA found in ruminant products and is produced by partial ruminal biohydrogenation of linoleic and linolenic fatty acids or by endogenous synthesis in the tissues themselves. Increasing the CLA contents of milk and meat has the potential to raise the nutritive and therapeutic values of dairy and meat products. The CLA contents in milk and meat are heavily influenced by the diet fed to the animal. Dairy cows grazing on pasture produced milk fat containing 0.59-2.21% CLA. Cows fed plant oils at 3-5% of the diet produced milk containing 0.71-2.13% CLA as a proportion of fat. Beef from cattle grazing on pasture had 0.48-1.35% CLA as a proportion of fat. Beef from cattle supplemented with feed sources rich in linoleic or linolenic fatty acids had similar or slightly higher CLA compared to control beef. The CLA content in milk or dairy products available on the market ranges from 0.34 to 1.07% of fat (Mean = 0.53%). The CLA content in raw or processed beef available on the market ranges from 0.12 to 0.68% of fat (Mean = 0.37%). The mean CLA content of meat from chicken, pork, and rabbit is 0.12% of fat (range = 0.06-0.17). The CLA in turkey meat ranged from 0.16-0.25% of fat. It is currently estimated that the average human adult consumes only one third to one half of the amount of CLA that has been shown to reduce cancer in animal studies. A person consuming one serving of standard whole milk, cheese, and beef, daily, would have a CLA intake of 114 mg/d. However, a person consuming one serving each of CLA-enriched whole milk, cheese, and beef would have an average CLA intake of 428 mg/d. The greatest potential to increase CLA intake of humans is through the consumption of CLA-enriched milk and cheese. While beef raised on pasture may have higher CLA content as a proportion of fat, the total fat content is reduced.

Key Words: Conjugated Linoleic Acid, Milk, Meat

T197 Conjugated linoleic acid from water buffaloes milk fat in tropical region. S. Fernandes[1,2], W. Mattos[1,2], S. Matarazzo[1,2], D. Lanna*[1,2], and M. Gama[1,2], [1]*Universidade Estadual do Sudoeste da Bahia*, *Itapetinga, Bahia, Brazil*, [2]*Universidade de São Paulo*, *Piracicaba, São Paulo, Brazil*.

The intake of milk will be enhancing with natural properties with the potential benefit human health, such as conjugated linoleic acid (CLA) an anticarcinogenic agent. The CLA research has been demonstrated almost exclusively with bovines in temperate environment. Few data are available in the literature regarding the effects of tropical feeds on the CLA contents in water buffaloes milk fat. A trial was carried out to verify the CLA contents in water buffaloes milk (mid and late lactation) fed pasture or feedlot in Sao Paulo state, Brazil. Eight animals at each farm were randomly allocated to five farms. All data were used to evaluate the effects of season in same farm ($P \leq 0.05$) by Student t test. The samples were collected in July (dry) and November (rainy) 2002. In Farm 1 (F1) animals were housed in feedlot and were fed corn silage plus wet brewers grain (WBG); Farm 2 (F2): corn silage (dry) and chopped Pennisetum purpureum (rainy) plus WBG all the year; Farm 3 (F3): pasture of Brachiaria decumbens (rainy) and B. decumbens plus chopped sugar cane (dry). Animals in this farm were supplemented with WBG all the year; Farm 4 (F4): B. decumbens and corn silage (dry) and B. decumbens supplemented with WBG (rainy); Farm 5 (F5): pasture of B. ruziziensis supplemented with grass silage of B. ruziziensis (dry) and pasture (rainy). The animals in F5 were supplemented with TMR all the year. The highest CLA contents in milk (Table 1) were observed in November, when animals grazed lush pasture in two farms (F2 and F3). In F2 (feedlot) in November, the roughage was fresh grass (highest C18:3) and in July was corn silage. In F3 (pasture), the availability of pasture was lower in dry season and increased in rainy season, when C18:3 availability (metabolic precursor of CLA) was highest. It can be concluded that in water buffaloes under tropical conditions the CLA contents in milk fat was larger in rainy season.

CLA (C18:2c9t11) contents from water buffaloes milk fat in tropical region

Farm	Fat (average, %)	July (%)	November (%)
F1	7.5±0.16	1.12±0.10a	0.98±0.30a
F2	7.2±0.15	0.73±0.10b	1.32±0.24a
F3	6.8±0.16	1.40±0.10b	2.10±0.23a
F4	6.6±0.17	1.16±0.14a	1.57±0.26a
F5	6.6±0.15	1.10±0.10a	1.46±0.24a

* – standard error; Different letter in the same row, represent different means (P£0,05) by Student t test.

Acknowledgements: Thanks to Otavio Bernardes, Jeremias Cruz, Angelo Carvalho, Jose Proenca, Carlos Bianchi, Paulo Machado, Umberto Tonhati and Fealq

Key Words: Fat Acid, Tropical Pasture, Wet Brewers Grain

T198 1^3C studies on glucose metabolism in dairy cows fed a fat-enriched diet. P. Junghans*[1], K. Gaafar[1], F. Schneider[2], C. C. Metges[1], G. Gäbel[3], J. R. Aschenbach[3], and J. Voigt[1], [1]*Research Institute for the Biology of Farm Animals (FBN), Research Unit Nutritional Physiology*, *Dummerstorf, Germany*, [2]*Research Unit Reproductive Biology*, *Dummerstorf, Germany*, [3]*University Leipzig*, *Leipzig, Germany*.

This study explores whole body glucose metabolism in lactating cows fed a fat-enriched diet. The experiment was carried out on eight Holstein-Friesian cows (591 ± 28 kg BW) during the first 6 to 10 wk of their first or second lactation. The experimental design was a 2 x 2 cross-over design using two 2-wk periods. The cows were fed isoenergetic and isonitrogenous diets based on corn silage. In the diet of the fat group about 1.8 kg of tapioca starch was substituted by about 0.7 kg of rumen-protected fat (Ca salts of palm oil). To determine the glucose turnover 0.8 mg/kg BW D-[U-$^{13}C_6$]glucose (99 atom % ^{13}C) was given i.v. as single bolus. Blood samples were collected at -5, 5, 10, 15, 20, 30, 45, 60, 90, 120, 150, 240 min after tracer administration. Isotope ratios between [U-$^{13}C_6$]glucose and [U-$^{12}C_6$]glucose as aldonitrile pentaacetate derivative were measured by selected ion monitoring GC-MS at m/z 334 and 328. Whole body glucose flux, glucose pool, and mean transit time were calculated by a noncompartmental approach. The whole body flux of glucose was not different between the diets (Table 1). Glucose turnover was 1.5 times in cows fed a fat diet, because the body pool of glucose was decreased. The lower body glucose pool corresponds with lower plasma glucose (n. s.) and insulin concentrations. The data suggest that the higher starch intake explains the increased glucose pool. Possible changes of gluconeogenesis, glycogenolysis and/or glucose oxidation by dietary fat remain to be investigated.

Table 1. Milk yield and glucose metabolism in lactating dairy cows

Item	Diet Starch (n = 8)	Diet Fat (n = 8)
FCM	34.3 ± 2.6	36.2 ± 3.5
Glucose, mmol/l blood	3.38 ± 0.22	2.93 ± 0.20
Insulin, mU/l blood plasma	17.2 ± 2.5[a]	10.4 ± 1.1[b]
Glucose pool, g	100.3 ± 8.7[a]	67.0 ± 6.3[b]
Glucose flux, kg/d	2.86 ± 0.21	2.98 ± 0.16
Mean transit time, min	51.5 ± 4.5[a]	33.7 ± 4.6[b]

Values represent mean ± SE. Different superscripts denote significant differences between diets (P<0.05)

Key Words: Lactating Cow, Glucose Metabolism, Stable Isotope

T199 Glucose rate of appearance (Ra) responses to isoenergetic infusions of glucose (GLC), propionic acid (C3) and non essential amino acids (NEAA) in dairy cows. S. Lemosquet*[1], E. Delamaire[1], J. Guinard-Flament[1], and H. Lapierre[2], [1]*UMR INRA Agrocampus Rennes Production du Lait*, *St-Gilles, France*, [2]*AAC*, *Lennoxville, Canada*.

The effects of GLC, C3 and a mixture of glucogenic NEAA on Ra and milk lactose yield were determined in four mid-lactation Holstein cows, fitted with both duodenum and rumen cannulas, used in a 4 × 4 Latin square design with 14 d-periods. Cows were fed a grass silage-based diet (Ctrl) that provided almost no by-pass starch. Ctrl cows received 93.5% of net energy of lactation and 114% of protein requirements. Isoenergetic infusions (5.15 Mcal/d of gross energy) of GLC in the duodenum (7.65 mol/d), C3 in the rumen (14.1 mol/d) or a mixture of 5 NEAA in the duodenum (in mol/d; Asp: 0.60; Ala: 1.59; Glu: 5.92; Ser: 2.44; Gly: 1.21) were given in supplement to the Ctrl diet. For each period, on d 13, [6,6-$^2H_2$]glucose (40 µmol/kg/h for 2 h) was infused into one jugular vein. Four blood samples were taken from the other jugular vein to measure glucose enrichments in the last 30 min of infusion. Ra averaged 12.1, 17.9, 14.4, 13.8 ± 0.4 mol/d for Ctrl, GLC, C3 and NEAA, respectively. Ra increased with energy supply (Ctrl *vs.* infusions, $P < 0.01$) but differently according to the nutrients infused. GLC increased Ra more than both glucogenic precursors (GLC *vs.* C3 + NEAA, $P < 0.01$). Ra was not different between C3 and NEAA ($P = 0.4$), but the amount of glucogenic NEAA infused was very high with NEAA plus diet covering 186% of protein requirements. The variations of Ra were not related to plasma jugular concentrations of glucagon (97, 94, 91 and 362 ± 42 ng/L, for Ctrl, GLC, C3 and NEAA, respectively). Milk lactose yield averaging 3.46, 3.55, 3.58 and 3.27 ± 0.07 mol/d was not modified by the energy supply (Ctrl *vs.* infusions, $P = 0.9$), but was lower with NEAA compared to C3 ($P < 0.02$). Changes in Ra were not paralleled by changes in lactose yield. On an energetic basis, intestinal GLC was the most efficient nutrient to increase Ra. However, there was no direct link between increase in whole body glucose availability and milk lactose yield.

Key Words: Dairy Cow, Glucose, Isotope

T200 Effect of casein (Cas) and propionate (C3) supply on whole body protein kinetics in lactating dairy cows. G. Raggio*[1], G. E. Lobley[2], S. Lemosquet[3], H. Rulquin[3], and H. Lapierre[4], [1]*Laval University*, *Quebec, QC, Canada*, [2]*Rowett Research Institute*, *Aberdeen, UK*, [3]*INRA*, *Saint Gilles, France*, [4]*Agriculture and Agri-Food Canada*, *Lennoxville, QC, Canada*.

The effects of Cas and C3 and their interaction on whole body leucine (Leu) metabolism were determined in three multiparous Holstein cows, fitted with both duodenum and rumen cannulas, used in a Youden replicated square with 14 d-periods. All cows were fed a grass silage-based diet estimated to supply 29.7 Mcal d^{-1} of NEL and 1593 g d^{-1} of protein digested in intestine (PDI-INRA, 1989). Cas (743 g d^{-1} in the duodenum) and C3 (1041 g d^{-1} in the rumen) infusions were tested in a factorial arrangement. For each period, on d 11, L[1-^{13}C]Leu (4.5 mmol h^{-1} for 7.5 h) and on d 13, [^{13}C]sodium bicarbonate (4.05 mmol h^{-1} for 5 h) were infused into a jugular vein. Blood samples were taken from the carotid artery to measure enrichments of $^{13}CO_2$ (d 11 and 13) and of ^{13}C[4-methyl 2-oxopentanoate] (MOP, d 11), used as representative of Leu precursor pool. Only Cas treatments increased milk yield, but both Cas and C3 treatments increased milk protein concentration. Increases in Leu whole body (WB) irreversible loss rate (ILR) with Cas treatments exceeded (P = 0.10) the extra Leu from abomasal infusion and the overall increments in Leu ILR, oxidation, protein synthesis, and in milk (all P < 0.001) suggest a general response in protein turnover. C3 treatments tended to increase Leu WB ILR, protein synthesis and in milk but with a tendency for a Cas x C3 interaction on WB Leu oxidation. The latter suggests that the impact of energy on protein metabolism depends of the level of protein supply.

	Treatment					P values		
	Ctrl	Cas	C3	Cas+C3	SEM	Cas	C3	CasxC3
Milk yield, g d^{-1}	26.9	31.4	27.1	32.1	0.71	0.001	0.51	0.74
True Protein, g kg^{-1}	29.6	30.7	30.9	32.8	0.43	0.009	0.005	0.32
Leu WB kinetics, mmol h^{-1}								
- Duodenal infusion		20.9		20.9				
- ILR	95.2	119.9	100.1	126.1	2.77	0.001	0.07	0.79
- Oxidation	7.2	21.2	8.8	18.2	1.13	0.001	0.57	0.09
- Protein synthesis	87.9	98.7	91.3	107.9	3.5	0.001	0.08	0.44
- Milk	23.1	27.8	24.4	29.6	0.66	0.001	0.03	0.66
CER	14.5	15.3	15.5	16.1	0.19	0.006	0.003	0.61

WB: whole body; ILR: irreversible loss rate; CER: carbon dioxide entry rate.

Key Words: Kinetics, Leucine, Dairy

T201 See Abstract 48.

T202 Effect of rumen energy and nitrogen balance on milk urea nitrogen in Chinese Holstein cows. S. W. Zhai*[1] and Y. Ma[2], [1]*Zhejiang University*, *Hangzhou, Zhejiang, China*, [2]*Northwest Sci-Tech University of Agriculture and Forestry*, *Yangling, Shaanxi, China*.

Nutrient requirement of Chinese dairy cattle emphases the importance of rumen energy and nitrogen balance (RENB) on production performance. RENB is the balance between the amount of microbial protein that is potentially pos-

sible from the available energy extracted during fermentation in the rumen and the amount of microbial protein that is potentially synthesized from the available rumen-degradable protein. There was no information of effect of RENB on milk urea nitrogen (MUN) in Chinese Holstein Cows. The objective of this study was to investigate the response of milk production performance and MUN concentration in Chinese Holstein lactating cows to different RENB levels diets. Eighteen multiparous lactating cows were divided by days in milk and milk yield into six groups. Diets were formulated to have three RENB levels (-153, 5 and 150 g/d). Experiment was conducted according to a replicated 3 × 3 Latin Square design with six replicates and each period consisted of 21 days, with d 1 to 14 for adjustment and d 15 to 21 for data and sample collection. All data were analyzed using the SPSS analysis program (SPSS, 1999). Effects were considered significant at P<0.05. Dry matter intake (kg/d), milk yield (kg/d), milk protein (%), milk fat (%), and milk lactose (%) for -153, 5, and 150 RENB g/d group were not affected by treatment (P>0.05) and were: 20.1, 19.9, and 19.6; 23.9, 24.5, and 24.5; 3.28, 3.31, and 3.35; 4.67, 4.70 and 4.72. However, significant difference was found in MUN concentration between treatments (P<0.01) and MUN for -153, 5, and 150 RENB g/d group were 10.8, 9.3 and 7.6. Urea nitrogen in milk was mainly from the excess protein in rumen, the result of this study indicated MUN might be used as an indicator of ration RENB for Chinese dairy cows.

Key Words: Milk Urea Nitrogen, Rumen Energy and Protein Balance, Dairy Cows

T203 Effects of monensin on diurnal rhythmicity of blood metabolites in dairy cows at different stages of lactation. J. C. Plaizier*[1], A. Fairfield[2], P. A. Azevedo[1], T. F. Duffield[2], G. H. Crow[1], R. Bagg[3], P. Dick[3], and B. W. McBride[2], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*University of Guelph*, *Guelph, ON, Canada*, [3]*Provel, A Dvision of Eli Lilly, Inc.*, *Guelph, ON, Canada*.

Effects of a prepartum administration of a monensin Controlled Release Capsule (M) or a placebo (C) and stage of lactation (LS) on diurnal variation of blood metabolites were determined in 16 Holstein dairy cows. Cows were fed a total mixed ration ad-libitum twice daily at 0700 h and 1300 h. At calving, cows were switched from a close up dry cow diet to a lactating cow diet. Cows were blood sampled every three hours for 24 h at three stages of lactation, including 1 Wk before calving (Wk -1), 1 Wk after calving (Wk 1) and six weeks after calving (Wk 6). Average dry matter intakes were 11.2, 16.0 and 20.5 kg/d at Wk -1, Wk 1 and Wk 6, respectively. Average milk yields were 26.8 and 38.0 kg/d at Wk 1 and Wk 6, respectively. Serum concentrations of glucose, β hydroxybutyrate (BHBA), non-esterified fatty acids (NEFA), and urea exhibited significant diurnal variation. Glucose and NEFA were on average 0.09 mmol/L and 0.08 mmol/L lower between 1030 h and 2230 h than between 2230 h and 1030 h, respectively. The BHBA and urea were on average 95.1 µmol/L and 0.49 mmol/L higher between 1030 h and 2230 h than between 2230 h and 1030 h, respectively. The diurnal variations in glucose, BHBA and NEFA were not affected by monensin and by stage of lactation. Diurnal variation in urea was affected by stage of lactation, but not by monensin. Monensin did not significantly affect urea and NEFA in this study. At Wk 1, monensin numerically increased glucose and reduced BHBA, but not at Wk -1 and Wk 6. Glucose was lower and BHBA and NEFA were higher at Wk 1 compared to Wk -1 and Wk 6. Urea was higher in Wk 6 compared to Wk -1.

	Wk -1		LS Wk 1		Wk 6		*P value*		
	M	C	M	C	M	C	SE	M	LS
Glucose, mmol/L	3.64	3.53	3.10	2.63	3.56	3.55	0.28	NS	<0.0001
BHBA, mmol/L	568	525	1122^{b}	1459^{a}	639	612	250	NS	<0.0001
NEFA, mEq/L	0.32	0.24	0.68	0.81	0.19	0.19	0.07	NS	<0.0001
Urea, mmol/L	5.28	4.93	5.81	5.27	6.08	5.80	0.48	NS	0.13

Key Words: Blood Metabolites, Diurnal Variation, Monensin

T204 Effects of monensin and dietary soy oil on milk fat percentage in lactating cows. O. Alzahal*[1], N. E. Odongo[1], T. Mutsvangwa[2], T. F. Duffield[1], R. Bagg[3], P. Dick[3], G. Vessie[3], and B. W. McBride[1], [1]*University of Guelph*, *Guelph, Ontario*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan*, [3]*Elanco Animal Health, Division Eli Lilly Canada Inc.*, *Guelph, Ontario, Canada.*

Seventy-two lactating Holstein dairy cows (100-150 DIM) were used in a 2 X 3 factorial experiment to investigate the effects of monensin and dietary soy oil inclusion on milk fat percentage. Treatments were (DM basis) 1) Control TMR (no monensin, no soy oil); 2) Treated TMR (Rumensin Premix®, 22 ppm; no soy oil); 3) Control TMR + 1.7% soy oil; 4) Treated TMR + 1.7% soy oil; 5) Control TMR + 3.5% soy oil; and 6) Treated TMR + 3.5% soy oil. The TMR (% DM; corn silage, 34%; haylage, 22.7%; hay, 4.5%; high moisture corn, 20% and protein supplement, 18.8 %) was offered *ad-libitum*. The trial consisted of a 2-week baseline period (data used as a covariate), a 3-week adaptation period, a 2-week treatment period, and a 4-week wash-out period. Feed and milk samples were taken three times per week and composited over each experimental period. Monensin reduced milk fat percentage and milk fat yield ($P < 0.05$). Soy oil linearly ($P < 0.05$) increased milk yield and milk protein yield and linearly ($P < 0.05$) reduced milk fat yield. Monensin reduced milk fat percentage by 11 % at 1.7 % soy oil inclusion and by 23 % at 3.5 % soy oil inclusion. Monensin and soy oil had no effect ($P > 0.05$) on DMI. These results show that monensin depresses milk fat percentage and that the depression of milk fat percentage is dependent on the level of dietary soy oil inclusion.

	Control			Monensin			*P*value		
Item/Soy Oil, DM%	0	1.7	3.5	0	1.7	3.5	A	B	C
DMI, kg/d	21.3	20.8	20.9	20.6	21.0	21.5	0.85	0.82	0.42
Milk yield, kg/d	27.5	29.5	29.4	26.9	28.9	30.1	0.92	<0.01	0.56
Fat, %	3.76	3.59	3.14	3.74	3.21	2.43	<0.01	<0.01	0.07
Fat yield, kg/d	1.03	1.05	0.91	0.99	0.91	0.73	<0.01	<0.01	0.28
Protein, %	3.35	3.26	3.27	3.31	3.24	3.23	0.22	0.06	0.93
Protein yield, kg/d	0.92	0.96	0.95	0.88	0.93	0.97	0.51	0.04	0.26

A=main effect of monensin, B=main effect of soy oil, C=monensin X soy oil.

Key Words: Monensin, Soy Oil, Fat Percentage

T205 Monensin and oil can have additive and synergistic effects on performance and milk fatty acid profiles. E. da Costa Eifert[2], R. de Paula Lana[3], D. P. D. Lanna*[2], M. I. Leão[3], and P. B. Arcuri[4], [1]*Supported by*, *CNPq, Brasil*, [2]*LCNA-ESALQ/USP*, *Piracicaba, Brasil*, [3]*DZO-UFV*, *Viçosa, Brasil*, [4]*Embrapa*, *Dairy Cattle*.

Four 7/8 Holstein-Zebu cows in early lactation were used in a 4x4 Latin Square design to determine the effects of monensin (0 and 33 ppm, MN) and soybean oil (0 or 4%, SBO) on performance and milk fatty acid profile. Corn silage and concentrate (53:47 % DM) were fed twice a day, with oil mixed to the concentrate. No interaction between oil and MN effects were observed for DMI and MY, however SBO decreased DMI (18.2^{a}vs 16.5^{b}kg/d; ^{a,b}, P<0.05) and MY (24.2^{a}vs 22.8^{b}kg/d). This decrease could be explained by the diet high oil content. Lactose and milk protein content were not influenced by treatments, but MN (3.48^{a}vs 2.95^{b}%) and SBO (3.51^{a}vs 2.93^{b}%) reduced milk fat content. Effects on DMI, MY and milk fat content were greater for MN+SBO combination, suggesting an additive effect. MN had no effect on short and medium-chain FA (SCFA), but increased unsaturated FA (32.7^{a}vs 34.7^{b}%). SBO reduced SCFA (10.4^{a}vs 6.5^{b}%), MCFA (52.4^{a}vs 34.9^{b}%) and increased UFA (27.7^{a}vs 39.6^{b}%). All trans-C18:1 isomers were increased by SBO (2.5^{a}vs 5.8^{b}%) and MN (3.4^{a} vs 4.9^{b}%), except t11-C18:1, which was altered only by SBO (1.10^{a}vs 1.64^{b}%). SBO and MN increased t6-8, t9 and t10-C18:1 concentrations, but the combination had a synergistic effect (interaction MN+SBO, P<0.05). Value of t10 (control=0.26; Mn=0.59; SBO=1.53; MN x SBO=2.67%) followed t10,c12 CLA concentrations (control=0.002; MN=0.008; SBO=0.033; MN+SBO=0.048 %). MN and SBO had additive effects for t10,c12 CLA. C9,t11 CLA was not influenced by treatment (control=0.54; MN=0.66; SBO=0.55;

MN+SBO=0.73%) and Δ^9-desaturase activity was reduced in SBO diets. Effects of MN and SBO on performance were mainly additive. However, changes in milk fat composition and FA profile were greater when MN and SBO were supplied together, with additive and synergistic effects on lipid bio-hydrogenation.

Key Words: Biohydrogenation, Ionophore, Soybean Oil

T206 Diet composition determines the type of response of cows fed monensin. K. McGuffey* and J. Wilkinson, *Elanco Animal Health Research*.

Quadrant analysis (QA) is a method of examining the importance of two traits that may respond independently but taken together indicate a degree of the desired state. QA was applied to the 9 Trial North American Monensin Dose-titration study after discovering that trials could be grouped in one of three outcomes based on milk fat and milk protein yields. Yield groupings for monensin (M) treatments compared to control (C) were: higher fat-higher protein (HFHP), lower fat-higher protein (LFHP), and lower fat-lower protein (LFLP). Cows fed M compared to C at HFHP sites averaged 1.2 to 2.1 kg/d more milk with small differences in milk fat percent (<0.1%) and milk protein percent (<0.05 %). Dry matter intake was similar for M and C. Cows fed M compared to C at LFLP sites averaged 0.7 to 1.6 kg/d more milk but a large difference in milk fat percent (Î”= 0.1 to 0.4%) and small differences in milk protein percent (<0.05 %). Dry matter intake was similar for M and C. At LFLP sites, milk was similar for cows fed M compared to C. Milk fat percent decreased linearly from C (3.63%) to 24 ppm M (3.40%). Milk protein percent was similar. Dry matter intake for 8, 16 and 24 g M per kg averaged 0.2, 1.0 and 1.2 kg/d less than C. Average feed composition of TMR and the nutrient analysis for each feed at each site were entered into the Cornell Net Carbohydrate Net Protein model (CNCPS), and output used to identify diet components related to each type of response to M. At HF sites, diets were higher (P<0.01) in NDF (32.9 v 29.8 and 28.4) and lower (P<0.05) in NFC than LF sites. At HP sites, diets delivered more (P<0.05) total metabolizable protein (MP) with MP of bacterial origin greater (P<0.05) than LP sites. Dietary concentrations (% of DM) of crude protein, fat and linoleic acid were not different across outcome groupings. Diets that promote ruminal fermentation of fiber and microbial growth optimize the lactation response of cows fed monensin.

Key Words: Monensin, Lactation, Ration

T207 Performance of dairy cows fed ensiled high moisture corn of a flint or a dent hybrid. F. M. J. Costa, J. F. dos Santos, and M. N. Pereira*, *Universidade Federal de Lavras*, *Lavras, Minas Gerais, Brazil*.

Corn grown in Brazil is mainly flint type. Flint corn has lower ruminal digestibility than soft texture, dent grain. The texture effect on grain digestibility is accentuated in plants approaching the black layer stage of maturity. We evaluated the effect of corn texture on the performance of lactating cows fed high moisture, black layer stage grain silage. Treatments were: Flint (Tork) or dent (AG 4051) corn factorialized with 9% or 18% of corn grain in diet DM. Pellets of citrus pulp replaced corn in the low starch diet, citrus pulp inclusions were 16.2 or 25.6% of diet DM. Other feed ingredients as a % of diet DM were 33.9% corn silage (47.7% NDF), 15.6% tifton hay (73.6% NDF), 13.6% soybean meal and 0.85% urea. The TMR contained 50% forage, 15.3% CP and 27.7% forage NDF. Twelve Holsteins in mid lactation received a sequence of the four treatments in three, 21-day period, 4x4 Latin Squares. Data was analyzed with the GLM procedure of SAS with a model containing the effects of square, period, cow within square, texture, starch and interaction. There was no treatment effect on milk urea content (P>0.28), mean value was 15.3 mg dl $^{-1}$. The high starch diets decreased milk fat content from 3.38 to 3.26% (P=0.04) and increased protein content from 2.99 to 3.03% (P=0.05). There was no detectable grain texture effect on milk solids content (P>0.35). Daily production of milk was 27.9 kg for flint corn and 28.8 kg for dent (P=0.19) and protein production was 0.84 and 0.87 kg (P=0.17), respectively. Intake of digestible organic matter was 11.7 kg for flint and 12.3 kg for dent corn (P=0.05). Total tract apparent digestibility of the non-NDF organic matter was 82.4% for flint and 83.6% for dent corn (P=0.10). The high dietary starch content decreased the 12-hour post feeding, single point ruminal pH more in the dent corn diet than it did in the flint corn diet (P=0.06 for the interaction between texture and starch content). Dent corn numerically increased milk production, although P values were high, however some digestion parameters suggest that high moisture dent corn silage was more fermented in the rumen than flint corn silage.

Acknowledgements: Funded by FAPEMIG

Key Words: Corn Texture, Citrus Pulp, Brazil

T208 Balancing grass silage based rations to dairy cows with regards to rumen degradable fiber. M. Murphy[1], T. Andersson*[1], and I. Andersson[2], [1]*Lantmännen Animal Feeds*, *Stockholm, Sweden*, [2]*Swedish University of Agricultural Sciences*, *Uppsala, Sweden*.

To exploit differences in the nutrient composition of grasses, dairy cow diets were based on substrate rumen degradation characteristics rather than energy. Total Mixed Rations (TMR) were computed to contain the same amounts of rumen degradable NDF, protein and starch, and equally balanced for other nutrients. Thirty-two multiparous dairy cows were used in a balanced change-over trial with two treatments and an extra period to account for residual effects. Two grass silages were cut at different stages (Early, 38.5% NDF, and Normal, 46.2% NDF) and complemented with barley, oats, beet fiber and protein sources. Feed ingredients of the TMR differed. The Early TMR contained 34% silage, DM-basis, and the Normal TMR contained 43% silage. TMR were formulated to contain 34% NDF of which 51% was rumen degradable. TMR were fed ad lib and intake was recorded using gate maneuvered feeding bins. Indigestible fiber (INDF) was used as a marker in fecal grab samples from eight cows. Milk yield was recorded. Degradation characteristics for NDF and protein were determined in sacco for all feeds. Data were statistically analyzed using the PROC MIXED procedure of SAS. Intake and production with the TMR based on Early (20 kg DM and 30 kg milk) were greater (P<0.01, DMI SEM=0.67, milk SEM= 0.81) than for the Normal TMR (19 kg DM and 29 kg milk). Milk fat content was the same but milk protein was higher with Early TMR, 3.51 % compared to Normal, 3.46 % (P<0.001, SEM=0.05). NDF total tract digestibility did not differ between diets. Degradation characteristics of silage NDF differed from the computed characteristics based on harvest samples and the rumen digestible NDF content in Normal TMR was 42 % of NDF compared to 50 % in Early TMR. Cows ate more than expected but the intake of INDF was the same for both TMR, 1.5 kg d-1. The INDF might have been limiting intake. Economic benefits of the increased production and intake with Early TMR were offset by a higher feed cost due to lower harvest yields. Formulating diets based on average degradation characteristics is a feasible alternative to energy systems but accurate assessment of the characteristics is necessary.

Key Words: NDF, Grass, Rumen Degradation

T209 Effects of physically effective NDF on ruminal pH and nutrient digestion of dairy cows fed diets based on corn silage. W. Z. Yang* and K. A. Beauchemin, *Research Center, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

A study was conducted to investigate the effects of physically effective fiber (peNDF) content of dairy cow diets on ruminal pH and feed digestion in the total digestive tract. Corn silage, chopped fine, medium and coarse, was used in the study designed as a replicated 3 x 3 Latin square using six lactating dairy cows with ruminal cannulas. The fine, medium and coarse silages were combined with a corn-based concentrate to provide three levels of peNDF (forage:concentrate ratio of 45:55). Particle distribution of the diets was determined using the Penn State Particle Separator with a top sieve (19-mm), middle sieve (8-mm) and pan. The peNDF contents of the diets were 10.4, 14.0 and 17.0% for low, medium and high peNDF diets, respectively. Cows were offered ad libitum access to a TMR. Dry matter intake ranged from 23.5 to 24.8 kg/d for the treatments and was not affected by dietary peNDF levels. Although digestibility of DM (range of 62.6 to 64.5%) in the total tract was not significantly different among the treatments, digestibility of NDF (43.5, 46.9 and 47.4%

for low, medium and high peNDF, respectively) tended (P<0.15) to be linearly increased, and in contrast, digestibility of starch (85.0, 80.1 and 80.4% for low, medium and high peNDF, respectively) tended (P<0.12) to be linearly decreased with increasing peNDF content of the diets. In addition, altering dietary peNDF contents did not affect mean ruminal pH (6.01, 5.95 and 6.06 for low, medium and high peNDF, respectively), area between the pH curve and pH 5.8 or 5.5, and time that pH was below 5.8 or 5.5. The results indicate that manipulation of the peNDF content of corn-based diets can improve fiber digestion in the total tract, but has limited effects on ruminal pH in cows not experiencing subacute acidosis.

Key Words: Physically Effective NDF, Ruminal pH, Digestion

T210 Evaluation of kernel hardness parameters and degradabilities of Zimbabwean commercial and research corn hybrids. D. Ngonyamo-Majee*[1], R. Shaver[1], J. Coors[1], D. Sapienza[2], J. Lauer[1], and X. Mhike[3], [1]*University of Wisconisn*, *Madison*, [2]*Sapienza, Analytica*, *Johnston, IA*, [3]*Crop Breeding Institute, AREX*, *Zimbabwe*.

Our objective was to characterize kernel hardness parameters related to degradability in selected Zimbabwean commercial and research corn hybrids. Fifteen hybrids comprising germplasm from six seed companies selected to cover the diverse genetic background of the region were evaluated. Hybrids were grown at three locations in Zimbabwe; two in Harare and one at Gwebi Research Station during summer 2003-2004 in 2*5 m row plots in a split-plot design with two replicates. Harvest was at two maturities (HS1=½ milk line; HS2=black layer). Dried kernels were transported to UW-Madison for all analyses. A 100 g sample of whole kernels was used for near infrared transmittance (NIT) prediction of density (D), starch and protein contents using Pioneer Hi-Bred Int. calibrations. Laboratory data included pycnometer D, visual vitreousness (V), and degradabilities (in-situ ruminal DM degradability (RDMD) and total DM degradability (TDMD) using Pioneer Hi-bred Int. in vitro enzymatic method on ruminal residue) on samples ground to pass a 6mm Wiley mill screen. Correlations between degradabilities and kernel hardness parameters were evaluated, and r-values are presented in the table. Variation in kernel hardness parameters and degradabilities among the Zimbabwean hybrids evaluated was high. All kernel hardness parameters were correlated (P<0.0001) with degradability measurements. Ruminal DMD was highly correlated with TDMD (r=0.933).

Variable	n	Range	Mean	STDEV	NITD	PYCD	0-hr	RDMD	TDMD
Vitreousness	168	10-100	75.6	21.2	0.79	0.78	-0.58	-0.71	-0.58
NIT Density	166	1.23-1.35	1.31	0.03		0.89	-0.68	-0.82	-0.71
Pycnometer Den	167	1.02-1.29	1.20	0.06				-0.75	-0.62
0-hr	166	8.3-24.5	14.9	2.7				0.76	0.69
RDMD	166	36.2-66.0	50.1	6.5					0.93
TDMD	166	64.2-85.2	74.4	4.2					

Key Words: Corn, Vtreousness, Degradability

T211 The effect of silage additives and delayed filling on the fermentation of ryegrass silage. R. Schmidt*, D. Kleinschmit, R. Teller, and L. Kung, *University of Delaware*, *Newark*.

Annual ryegrass (28% DM) was chopped (late boot) and immediately treated and packed (direct filling) in laboratory silos, or left in the forage wagon overnight (10 h), and then treated and packed (delayed filled). The treatments added to the forages were: a) nothing or control (C); b) *Lactobacillus buchneri* 40788 (400,000 cfu/g of wet forage) and *Pediococcus pentosaceus* (100,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (LBC); c) *P. cerevisiae* and *P. acidilactici* (100,000 cfu/g, Lallemand Animal Nutrition) (P2); d) Silage Savor (SS), 0.5 kg/t of wet forage (Kemin Industries, Des Moines, IA), a buffered propionic/acetic acid based product; and e) SS, 1 kg/t. A 2 × 5 factorial design was used to determine the effects of delayed filling, treatments, and their interactions. After 90 d of ensiling, delayed filling caused silages to undergo a clostridial fermentation regardless of added treatment. These silages had the highest pH (> 5.8 vs. about 4.7), greatest concentrations of butyric acid (> 0.2% vs. 0) and ammonia-N (> 0.9% vs. about 0.35%), and lowest concentrations of lactic acid (< 1.5% vs. about 7%), compared to silages that were directly filled ($P < 0.05$). After 7 d, direct filled silages treated with P2 and LBC had lower pH and higher ratios of lactic:acetic acids (L:A) (about 10:1) when compared to silage that was untreated (about 8:1) ($P < 0.05$). After 60 and 90 d, silages treated with LBC had a L:A of about 1:2 indicating a major conversion of lactate to acetic acid ($P < 0.05$). At these openings, the L:A decreased for silage treated with P2 but to a lesser extent (about 2:1). After 90 d of ensiling the concentrations of propionic acid from direct filled silages were 0.21, 1.84, 0.85, 0.83, and 0.81% for treatments a, b, c, d, and e, respectively. Treatment with SS had minor effects on the fermentation of direct filled silages. Delayed filling of silage is an unacceptable practice that cannot be overcome by the use of additives.

Key Words: Ensiling, Ryegrass, Inoculant

T212 Effect of corn silage harvest method on intake and production by mid lactation dairy cows. G. I. Zanton*, M. J. Vassallo, D. R. Buckmaster, and A. J. Heinrichs, *Pennsylvania State University*, *University Park*.

The objective of this research was to elucidate the effects of different corn silage harvest methods on rumen parameters, dry matter intake, feed sorting, and milk production in mid lactation Holstein cows. Corn silage was harvested with different methods (CS = chopped short; CL = chopped long and processed; SH = shredded) yielding very different particle size distributions at harvest and fed as the sole forage source in a TMR (60% of dietary DM). The largest differences in corn silage particle size distribution, as assessed by the Penn State Particle Separator, were in mass of particles larger than 30 mm (5.59, 14.14, and 36.96% AF basis for CS, CL, and SH, respectively; P<0.05). In a replicated 3x3 Latin square design experiment, 6 cows (3 rumen-cannulated) were fed treatment rations for 21 days per period. Cows fed CS and CL consumed less particle mass larger than 30 mm than did cows fed SH (1.8, 3.8, and 9.7 kg/d; AF basis; P<0.05). Also, cows fed CS and CL consumed less feed with particles smaller than 2.75 mm than cows fed SH (6.9, 7.3, and 8.6 kg/d; AF basis; P<0.05). Dry matter intake, however, did not differ between treatments (P>0.05), averaging 28.35 (+0.26) kg/d. Cows fed CS selectively refused particles larger than 30 mm to a larger extent than those fed CL or SH, but no differences between treatments were noted for other particle sizes. Mean rumen pH and minimum pH, VFA, and ammonia concentrations did not differ between treatments and diurnal pH variation was also not different between treatments (P>0.05). Production of 4% fat corrected milk was maximized with CS or CL (43.1, 42.7, and 40.2 kg 4%FCM/d for CS, CL, and SH; P<0.05). Milk fat percentage was greatest for the cows fed SH and lowest for CS and CL, though generally low (3.1, 3.1, and 3.2 %; P<0.05 for SH versus CS and CL). It is concluded that particle length of corn silage, produced by different harvest methods, can affect the FCM production independent of changes in DMI or rumen parameters.

Key Words: Corn Silage Harvest Methods, Particle Size, Sorting

T213 Adding value to corn through the use of a corn grazing system on dairy farms. T. R. Smith*[1], M. Boyd[1], G. Triplett[1], A. Chapa[1], C. Herndon[1], J. Murphy[2], and B. J. McClenton[1], [1]*Mississippi State University*, *Starkville*, [2]*Coastal Plain Branch Experiment Station*, *Newton, MS*.

Corn silage is the basis of dairy rations throughout the US. But, due to the labor, expense and specialized equipment needed to prepare and feed corn silage, its use has limitations, particularly on small dairies. Grazing dairy cows on corn could add value to the crop and flexibility to dairy management practices. A lactation trial was conducted to evaluate the impact of corn grazing on milk production, animal well being and dairy profitability. Two groups of 18 lactating Holsteins were randomly selected and balanced for DIM, production and weight. Control cows were fed a TMR, ad libitum throughout the study.

Cows in the Grazing group were allowed access to a 1.62-ha plot, of Terral TV2140RR corn planted March 23rd. The 2-wk adaptation period began July 10th, with corn at the late roasting-ear stage, and a 10-week trial followed. In the first 4 wks of the trial, grazing cows were restricted to 70% of the TMR fed to controls and they consumed 80% of the available forage DM. The savings in TMR averaged 8.5 kg/hd/d or $351 over the 26-d interval. As the forage matured, cows began removing just the grain off the ears and grazing cows consumed 7.9 kg/hd/d of corn, removing 83.6% of the available corn after 1 wk of grazing and 95% after 3 wks. During this time, grazing cows were full-fed, but all corn grain (6.80 kg/hd/d) was removed from their TMR and at $7/45 kg, this saved $794 over the next 42-d interval. Milk production averaged 25.1 ± 1.19 kg/d, but neither milk production nor composition differed between groups. Similarly, there were no differences in body weight or condition score change between groups. The total savings in feed costs for grazing cows was $1,145 over 10 wks. The grain yield averaged 49.9±6.5 bu/ha and at $2.47/bu, the value of corn on 1.33 ha used in the trial was $744.80. Thus, in this study, grazing added 53% to the value of the crop over other potential uses. Further, corn provides an excellent forage in the summer when other high-quality forages are limiting and dairy cows can graze corn with no detrimental impact to production. Supported by the Mississippi Agricultural and Forestry Experiment Station.

Key Words: Corn Grazing, Dairy Nutrition, Dairy Management

T214 Ruminal and intestinal digestibility of distillers grains with solubles varies by source. D. H. Kleinschmit, J. M. Ladd*, D. J. Schingoethe, K. F. Kalscheur, and A. R. Hippen, *South Dakota State University*, *Brookings*.

Two ruminally cannulated Holstein cows (263 DIM) producing 32 kg/d of milk were used to determine the ruminal degradability of DM and CP in soybean meal (SBM), dried distillers grains with solubles (DGS) from five sources (A, B, C, D, and E) and one source of wet DGS (W). Feeds were incubated in the rumen for 3, 6, 12, 18, 24, and 36 h on three consecutive days. Intestinal CP digestibility was measured on feeds at 12 h. The MIXED procedure of SAS was performed and the statistical model was y = treatment + cow + time + day + time × treatment with cow being random. Other interactions were not significant. Significance was declared at $P < 0.05$. Ruminal DM and CP degradation rates were greater in SBM compared with DGS. W had a greater ruminal DM degradation rate compared with A, B, and D and a greater ruminal rate of CP degradation compared with A, B, C, and D, but not E. The rates of NDF digestibility among DGS ranged from 0.0253 to 0.0315/h. Ruminal undegradability of DM (RUDM) was less in SBM compared with DGS. A and D had more RUDM compared with B, C, and E and W. In addition B was greater for RUDM compared with W. Ruminally undegradable protein (RUP) for SBM was less than for DGS. W had less RUP than in dried DGS. The RUP of C and E was lower than in A, B, and D with A having more RUP than B and D. Intestinal digestibility (ID) of SBM was greater than in all DGS. B and C had greater ID compared with A, D, and E. The ID in W was similar to all other DGS, except for A, which was lower. In conclusion, the RUP in SBM was lower than in DGS. Wet DGS had less RUP than dried DGS, but among the dried DGS, RUP varied considerably. Processing differences between ethanol plants may significantly affect DGS quality.

Treatment	SBM	A	B	C	D	E	W
Ruminal DM degradation/h	0.0858^{a}	0.0209^{c}	0.0237^{c}	0.0261^{bc}	0.0232^{c}	0.0274^{bc}	0.0334^{b}
Ruminal CP degradation/h	0.0852^{a}	0.0134^{c}	0.186^{c}	0.0214^{c}	0.0161^{c}	0.0256^{bc}	0.0340^{b}
RUDM, %	29.4^{d}	57.0^{a}	53.8^{b}	52.0^{bc}	56.6^{a}	51.1^{bc}	50.8^{c}
RUP, %	38.9^{e}	78.0^{a}	67.8^{b}	63.6^{c}	71.0^{b}	63.5^{c}	56.5^{d}
ID, %	87.5^{a}	62.5^{d}	77.4^{b}	77.4^{b}	66.1^{cd}	65.9^{cd}	71.7^{bc}

^{a,b,c,d,e}Means in rows with unlike superscripts differ ($P < 0.05$).

Key Words: Distillers Grains, Protein, Dairy Cattle

T215 Feedstuff stability, intake, and performance of dairy cows fed wet distillers grains treated with a preservative. K. F. Kalscheur*, J. Baez, and D. R. Henning, *South Dakota State University*, *Brookings*.

The objective of this study was to determine the impact of adding a preservative to wet distillers grains (WDG) on feedstuff stability, intake, and performance of lactating dairy cows. Fifteen primiparous and fifteen multiparous Holstein cows were assigned to one of three diets, each which contained 15% distillers grains but of different types: 1) dried distillers grains (DDG); 2) untreated-WDG (UWDG); and 3) treated-WDG (TWDG). All distillers grains were produced by the same ethanol plant. The preservative (CakeGuard™; Alltech, Inc.) was applied at a rate of 1 kg/t and mixed thoroughly to make TWDG. The WDG arrived the day before the start of the experiment and was stored outside in replicated, uncovered boxes for the duration of the experiment. The WDG averaged 31.5% DM, 29.3% CP, 23.1% NDF, 13.9% ADF, 3.8% starch, 14.2% fat, 3.53 pH, and 8.3% lactic acid. Dry matter loss attributed to visual spoilage was greater ($P < 0.01$) in UWDG (3.1%) than in TWDG (1.3%). Dry matter loss not attributed to visual spoilage was greater ($P < 0.01$) for TWDG (5.4%) than for UWDG (3.5%). Total DM loss was not different between UWDG and TWDG. All cows were fed the DDG diet the week prior to the start of the experiment, which was used as the covariate period. Cows fed WDG had lower DMI than cows fed DDG (22.7 and 26.4 kg/d; $P < 0.02$). Dry matter intake decreased in cows fed UWDG, but increased in cows fed the DDG and TWDG over the course of the study (treatment by week interaction; $P < 0.01$). Milk production was not affected by diet (37.9, 37.7, and 38.1 kg/d for DDG, UWDG, and TWDG). Feed efficiency (energy-corrected milk/DMI) tended to be greater for cows fed WDG compared to DDG diets (1.65 and 1.46; $P < 0.10$). Milk fat % (3.48, 3.29, and 3.41) and protein % (3.13, 3.17, and 3.10) did not differ across diets. In addition, fat and protein yield, milk urea nitrogen, body condition score, and body weight did not differ across diets. Although total DM loss was similar for both WDG diets, intakes of cows fed TWDG did not decline as did cows fed UWDG.

Key Words: Wet Distillers Grains, Preservative, Dairy Cows

T216 See Abstract 46.

T217 Effects of time of feeding and forage to concentrate ratio on rumen fermentation and productivity of lactating dairy cows. A. Nikkhah*, J. C. Plaizier, C. Furedi, and A. D. Kennedy, *University of Manitoba*, *Winnipeg, MB, Canada*.

Effects of time of feeding and dietary forage to concentrate ratio (F:C) on feed intake, rumen fermentation and milk production were determined in 8 cows using a 4 × 4 Latin square design. Cows received a higher concentrate total mixed ration (TMR) with a F:C of 38:62 or a lower concentrate TMR with a F:C of 49:51. Fresh TMR was provided either at 9 am or at 9 pm. Rumen fluid was sampled at 0100 and 1300 h using an oral probe. Animals were not heat stressed during any time of the day. Time of feeding and F:C did not affect dry matter intake and milk yield. Changing time of feeding from 9 am to 9 pm did not affect average rumen pH, acetate to propionate ratio, milk protein and body condition score, tended to increase milk fat percentage from 2.57 to 2.76% ($P = 0.10$) and increased body weight change from -0.32 to 0.29 kg/d ($P < 0.05$). The differences in ruminal fluid pH, VFA and ammonia levels between 4 h and 16 h after feeding were greater ($P < 0.01$) for cows fed at 9 pm compared to cows fed at 9 am. Reducing F:C reduced rumen pH from 6.33 to 6.19 ($P = 0.009$), acetate to propionate ratio from 2.79 to 2.05 ($P < 0.0001$) and milk fat percentage from 2.88 to 2.55% ($P = 0.001$), and increased milk protein percentage from 3.36 to 3.53% ($P < 0.001$), body weight change from -0.37 to 0.32 kg d-1 ($P = 0.02$), and body condition score from 3.01 to 3.16 ($P = 0.03$). Interactions between time of feeding and F:C on production and rumen parameters were not significant. Results suggest that evening feeding improved the energy balance of the cows without negatively affecting milk production.

Acknowledgements: This study was supported by grants from Dairy Farmers of Canada and Dairy Farmers of Manitoba

Key Words: Time of Feeding, Forage to Concentrate Ratio, Milk Production

T218 Effect of free stall pen design on feeding behavior. R. Mentink*, K. Nordlund, T. Bennett, and N. Cook, *University of Wisconsin*, *Madison*.

The purpose of this study was to determine if a difference exists in group feeding behavior in dairy cows housed in free stall pens with either 2-rows or 3-rows of stalls. The high yielding, mature cow pens in 12 herds were filmed for a 24 hour period. 6 herds had 2-row pen designs (mean 1.52 cows per feed space) and 6 had 3-row pen designs (mean 2.07 cows per feed space). Video tapes were scanned at 10 minute intervals to produce charts of feed bunk utilization, recording the proportion of feed spaces (24 inches wide) occupied by cows at each time interval. Cows in the feed alley were continuously monitored for physical and non-physical aggressive displacements. Herd feeding behavior data were aligned according to peak feed bunk utilization following fresh feed delivery (primary peaks) and following return from milking without fresh feed delivery (secondary peaks). Comparisons between feeding behavior patterns were made using an autoregressive (AR-1) repeated measures model in SAS (SAS, 1999). There was no difference in feed bunk utilization by pen design for the 90 minute period after primary peaks (P=0.24). Feed bunk utilization for 90 minutes following secondary peaks did significantly differ between 2-row and 3-row pens (P=0.008). Peak feed bunk utilization did not reach 100% in either pen design, but was greater in 3-row pens and took longer to decline to baseline levels. Although no significant difference in the rate of aggressive displacements was observed after primary peaks between pen designs, cows in 3-row pens experienced significantly more aggressive displacements during the day (0.246 per cow per hour) than cows in 2-row pens (0.128 per cow per hour), (P=0.008). Feed bunk utilization is a function of several competing drives, namely; hunger and desire to access fresh feed, allelomimetic drive, and social issues of rank and a desire to maintain space and separation between herdmates. Differences in feeding behavior in pens with varying feed space allowances may require different management approaches to feeding, in order to ameliorate potential negative effects on health and productivity.

Key Words: Free Stall Design, Feeding Behavior, Dairy Cattle

T219 Effect of feed intake variation on the performance of dairy cows in early lactation. M. A. Shah*[1], K. S. Schwartzkopf-Genswein[1], P. S. Mir[1], and M. R. Murphy[2], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [2]*University of Illinois*, *Urbana*.

Data from 86 cows in early lactation from three locations (Alberta, Illinois, and New Hampshire) were compiled to study the effect of dry matter intake (DMI) variation on feed consumption and production in a completely randomized design. Variation in daily DMI for 6 to 70 d in milk was calculated for individual cows. Data for wk 1 of lactation were excluded because of abnormal variation associated with parturition. Based on DMI variations, cows at each location were divided into low (LV, 22% of cows), medium (MV, 61%), and high (HV, 17%) variation groups. Average milk fat and lactose contents were highest for MV (3.67 and 4.62; $P < 0.09$) compared to LV (3.44 and 4.52; $P < 0.02$) and HV (3.54 and 4.33) cows. There was no ($P > 0.10$) difference in DMI, milk, milk fat, milk protein, and milk lactose yields (21.6, 42.4, 1.51, 1.30, and 1.73 kg/d, respectively) among the three groups. However, evaluation of the first 5 wk of lactation revealed that LV and MV cows consumed more DM (20.6 and 20.2 kg/d, $P < 0.05$) than HV cows (17.6 kg/d). Greater intakes for LV and MV cows resulted in higher milk yields (41.3 and 41.6 kg/d, $P < 0.05$) compared to HV cows (36.9 kg/d). Milk yield was closely correlated with DMI ($r = 0.81$, $P < 0.0001$) for the LV and MV groups during the first 5 wk of lactation, but correlation for the HV group was low ($r = 0.40$). More than 80% of cows lost body weight (BW) during the first 5 wk of lactation. A higher percentage of HV cows (78%) lost ≥40 kg of BW compared to the LV (29%) and MV (37%) groups. Cows in the HV group likely mobilized more body stores to maintain milk yield and composition during early lactation, potentially increasing the risk of metabolic disorders and reducing subsequent reproduction efficiency.

Key Words: Feed Intake Variation, Dairy Cow, Early Lactation

T220 Effect of forage particle size on sorting dietary particles by dairy cows. W. Z. Yang* and K. A. Beauchemin, *Research Center, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

Three studies were conducted to determine whether particle size of forage affects sorting of feed by dairy cows fed diets varying in types of forages and grains. Corn silage, chopped fine, medium or coarse, was combined with barley grain (CS-B, study 1), or with corn grain (CS-C, study 2), and barley silage, chopped fine, medium or coarse, was combined with barley grain (BS-B, study 3). Each study was designed as a replicated 3 x 3 Latin square. Particle distribution of the diets was determined using the Penn State Particle Separator with a top sieve (0.75"), middle sieve (0.31") and pan. The physically effectiveness factor (pef), calculated as the sum of the particles retained on the two sieves, was 0.35, 0.32 and 0.29 of DM for CS-B diets, 0.56, 0.49, and 0.32 for CS-C diets, and 0.41, 0.37 and 0.33 for BS-B diets, for coarse, medium and fine silages, respectively. Data were analyzed using the mixed model of SAS to account for effects of treatment (fixed) and square, period within square, cow within square (random). For cows fed CS-B diets, proportion of long particles (0.75") left in the orts 24 h after feeding was reduced by 29, 78, and 97% for coarse, medium and fine diets, respectively. Therefore, the pef of the diets was always greater than the pef of the orts (0.23, 0.20 and 0.16, for coarse, medium and fine, respectively). For cows fed BS-B diets, proportion of long particles and pef in the orts (0.33, 0.31 and 0.28, for coarse, medium and fine, respectively) were also smaller than in the original diets. In contrast, for cows fed CS-C diets, the proportion of long particles was greater in the orts (13.6, 10.6 and 3.7%) than in the original diets (7.6, 4.8 and 2.3%) for coarse, medium and fine, respectively. The results suggest that dairy cows fed highly fermentable barley grain intentionally select long particles to meet their need for physically effective fiber. Inversely, cows select small particles over long particles when a less fermentable grain source, such as corn, is fed.

Key Words: Forage Particle Size, Sorting, Dairy

T221 Effects of corn grain endosperm type and conservation method on milk production and feeding behavior of lactating dairy cows. Y. Ying*, M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of endosperm type and conservation method of corn grain on milk yield, DMI, and feeding behavior of cows were evaluated. Eight ruminally and duodenally cannulated Holstein cows (73 ± 39 DIM; mean ± SD) were used in a duplicated 4 x 4 Latin square design with 21-d periods. A 2 x 2 factorial arrangement of treatments was used with main effects of corn grain endosperm type (floury or vitreous) and conservation method (dry or high-moisture, HM). Diets were formulated to 26.6% neutral detergent fiber and 16.5% crude protein. Treatment corn grain supplied 86.6% of dietary starch. No differences were detected for yields of milk, 3.5 % FCM, milk fat, protein, lactose or SNF; mean yield of 3.5% FCM across treatments was 47.5 kg/d. However, an interaction was observed for efficiency of production (3.5% FCM/ DMI). Floury endosperm increased efficiency 0.05 kg 3.5% FCM per kg DMI in dry corn diets but decreased it by 0.14 kg 3.5% FCM per kg DMI in HM corn diets ($P = 0.09$). An interaction was observed for effect of treatment on milk protein concentration ($P = 0.06$). Milk protein concentration was increased by vitreous endosperm when fed as dry corn (2.68 vs. 2.62%) but not in HM corn diet. Solids not fat concentration was increased by dry corn compared to HM corn (8.45 vs. 8.37%, $P = 0.01$) from combined effects of treatment on milk protein and milk lactose concentrations. DMI was increased 1.3 kg/d by dry corn treatments compared to HM treatments ($P = 0.03$). The increase in DMI by dry corn was from a shorter intermeal interval (104.4 vs. 118.2 min/day, $P = 0.04$) because meal size was not affected by treatment. Body weight was not affected by treatment but vitreous endosperm tended to increase body condition loss($P = 0.07$). Dry corn decreased ruminating bout length and number of chews per bout. Corn endosperm type and conservation method interact to affect efficiency of milk production and milk protein concentration in high producing dairy cows.

Key Words: Corn Grain Endosperm Type, Conservation Method, Milk Production

T222 Effects of feeding time and forage to concentrate ratio on water intake and drinking behavior of dairy cows. J. Plaizier*, D. Fulawka, A. Nikkhah, and A. Kennedy, *University of Manitoba*, *Winnipeg, MB, Canada*.

Effects of time of feeding (TF) and forage to concentrate ratio (F:C) on drinking behavior were determined in eight lactating Holstein cows housed in individual tie stalls. Cows had unlimited access to fresh water only through their own water bowl. A four by four Latin square with experimental periods of 2 wk adaptation and 1 wk of data collection was used. Data were analyzed using the SAS Mixed procedure with TF and diet as fixed factors. Cow and period were random factors. Cows received a total mixed ration (TMR) with a F:C of 38:62 or a TMR with a F:C of 49:51. Fresh TMR was provided either at 9 am or at 9 pm. Water consumption was determined by continuous measurement of the flow of water through each water bowl. Drinking bouts were defined as the combination of drinking events that were less that 4 min apart. The number of drinking bouts and water consumption during each 3 h period were determined. Dry matter intake and milk yield were not affected by diet and TF and were 20.6 kg/d and 37.0 kg/d across treatments, respectively. Both diet and TF did not affect total water consumption, the water consumption per bout, the duration of drinking bouts and the drinking rate. Averages for these parameters across treatments were 73.7 L/d, 2.9 L, 3.3 min, and 1.07 L/min, respectively. Drinking behavior varied significantly among cows. Diet did not affect the number of drinking bouts per day, the total time spent drinking, and the distribution of drinking throughout the day. Cows fed at 9 am had more drinking bouts per day (28.3 vs. 25.6) and spent more time drinking (94.4 vs. 81.7 min/d) than cows fed at 9 pm. More drinking bouts and more water consumption were found for cows fed at 9 am during all 3 h periods from 9 am to 9 pm. Thereafter, the number of drinking bouts and water consumption were greater in cows fed at 9 pm (9 pm to 12 pm; 6 am to 9 am) or similar (12 pm to 3 am; 3 am to 6 am) for the two TF treatments. Results show that TF affects distribution of drinking bouts throughout the day.

Acknowledgements: This study was supported by grants from Dairy Farmers of Canada and Dairy Farmers of Manitoba

Key Words: Drinking Behavior, Time of Feeding, Dairy Cows

Ruminant Nutrition: Methodology and Modeling

T223 Influence of fermentation method on NDF degradation parameter estimates. D. Bossen[1], D. R. Mertens*[2], and M. R. Weisbjerg[1], [1]*Danish Institute of Agricultural Sciences*, *Foulum, Denmark*, [2]*US Dairy Forage Reseach Center*, *Madison, WI*.

Effect of three methods of fermentation on degradation parameters was studied using feeds ground to different sizes. Corn silage (CS), grass silage (GS), barley grain (B), sugar beet pulp (BP), and rape seed cake (RSC) were ground using a shear mill. Silages were ground through 8, 4, 2 or 1-mm screens (G8, G4, G2, G1, respectively) and concentrates through 4, 2 or 1-mm screens, except RSC that was ground through 2 or 1-mm screens. Materials were incubated twice for 0, 6, 12, 24, 48 and 96 h either in situ (IS) in four lactating cows, in vitro (IVn) with media pH of 6.8, or in vitro (IVa) with media pH adjusted to 6.0 using citric acid. Inoculum for IVn and IVa was prepared as a composite from the same four cows used for IS. Feeds and residues were analysed using the amylase-treated NDF method. Potentially degradable aNDF (D_0, g kg^{-1} DM), indegradable aNDF (I, g kg^{-1} DM), discrete lag time (L, h) and fractional rate of aNDF degradation (k_d, h^{-1}) were estimated using NLIN in SAS. Differences within each feed were determined using GLM in SAS. Initial aNDF was 399, 431, 197, 480 and 251 g kg^{-1} DM for CS, GS, B, BP, and RSC, respectively, for G1, but increased with increasing screen size. Grinding screen size affected k_d for CS and B, and D_0 for B, possibly due to incomplete extraction of starch for G4 and G8. Fermentation method affected all degradation parameters for all feeds except RSC, where method only affected D_0 and k_d. Higher D_0 were obtained using IVn compared to IVa, but the difference was significant only for CS. The D_0 was higher for IVn than IS for B, CS and GS, but not BP. Method IVa gave highest I for all feeds except RSC. Method IVn obtained higher k_d than IVa, and especially IS. Average k_d were .06, .10, and .17 for G1 and G2 of all feeds, using methods IS, IVa and IVn, respectively. However, the differences were much larger for BP than for CS. Method IVa gave markedly higher L compared to IVn and IS for all feeds except B. The results demonstrate a marked effect of method on parameter estimates, and indicate that low pH increases lag time and decreases fractional rate of aNDF degradation.

Key Words: Degradation, NDF, Kinetics

T224 The application of a novel, wireless, automated system for determining the fermentation gas production kinetics of feeds. A. Adesogan*[1], S. Kim[1,2], and N. Krueger[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, South Korea*.

This study describes a novel automated method of measuring the fermentation gas production kinetics of feeds that intermittently measures and relays the pressure arising from the fermentation of feeds in culture bottles to a server using a wireless, radio frequency (RF) signal. The fermentation parameters of three ground (1 mm) feeds (corn, citrus pulp and Pensacola bahiagrass hay, Experiment 1) or esterase enzyme-treated (0, 1 and 2 g/100 g DM) bermudagrass hay (Experiment 2) were determined using the RF sensors and compared to those determined with a digital manometer. Feed samples were incubated in buffered, rumen fluid in quadruplicate (Experiment 1) or triplicate (Experiment 2) in 250 ml, gas-tight, culture bottles at 39 °C. Pressure sensors mounted on each culture bottle were set to take hourly pressure measurements for 96 h and a digital manometer was used to take pressure readings after 0, 2, 4, 6, 8, 12, 24, 48, 60, 72 and 96 h of incubation. An exponential model was fitted to the fermentation gas production data from the sensors and the digital manometer. The fermentation parameters were compared using a 3 x 2 factorial (Experiment 1) and a completely randomized design (Experiment 2). In both experiments, the method of gas pressure measurement did not affect ($P>0.05$) fermentation parameters and there was no method x feed interaction ($P>0.05$). In Experiment 1 the concentrates had greater ($P<0.001$) gas pool size, a faster fermentation rate and a slower lag phase than the hay; and the corn had a longer ($P<0.05$) lag phase, a similar ($P>0.05$) fermentation rate and a greater ($P<0.01$) gas pool size than the citrus pulp. In Experiment 2, increasing esterase enzyme application did not affect the fermentation rate ($P>0.05$), but increased the lag phase ($P<0.05$) and tended ($P=0.063$) to increase the gas pool size. There was a good relationship between RF sensor and manometer-based estimates of gas pool size ($r^2 = 92$), fermentation rate ($r^2 = 83$), and lag phase ($r^2 = 60$). This study demonstrates the potential of the new RF sensor technique for differentiating between the fermentation kinetics of feeds.

Key Words: Gas Production, Kinetics, Fermentation

T225 Comparison of two molecular methods to assess the shift in bacterial population in continuous culture receiving fresh alfalfa or hay with different concentrations of sucrose. C. Ribeiro*, S. Karnati, J. Sylvester, Z. Yu, and M. Eastridge, *The Ohio State University*, *Columbus*.

Identifying shifts in rumen bacterial populations while also measuring nutrient digestibility and the disappearance of unsaturated fatty acids will improve our understanding of the contribution of specific bacterial species to the overall biohydrogenation (BH) process. Denaturing gradient gel electrophoresis (DGGE) and ribosomal intergenic spacer length polymorphism (RIS-LP) were used to determine the effect of forage conservation and sucrose addition on bacterial populations. Four continuous culture fermenters were used in a 4 X 4 Latin square design. The treatments were: 1) fresh alfalfa, 2) alfalfa hay, 3) alfalfa hay plus 4% sucrose, and 4) alfalfa hay plus 8% sucrose. Effluent and bacterial

samples were frozen, lyophilized, and stored at -20 °C. For DGGE, the V3 hypervariable region of the 16S rRNA gene was amplified from extracted DNA using PCR with a universal bacterial primer set. Amplicons were separated on a 6.5% acrylamide gel with a 40 to 60% denaturing gradient. For RIS-LP, extracted DNA was amplified using PCR with primers S926f and L189r. Amplicons containing the complete RIS and parts of the flanking rRNA genes were separated on a 4% polyacrylamide gel. Banding profiles of DGGE and RIS-LP were analyzed using Bionumerics. Digestibility data were analyzed by PROC MIXED of SAS. Cluster analysis of the banding profiles grouped the sucrose treatments together for both methods suggesting that sucrose altered the bacterial populations. As reported previously [J. Dairy Sci. 87(Suppl. 1):38], addition of sucrose linearly ($P < 0.05$) decreased BH. Alfalfa hay with 8% sucrose resulted in 14% lower NDF digestibility than alfalfa hay alone. Digestibilities of fiber fractions were higher ($P < 0.05$) for fresh alfalfa than hay. Future research will identify individual bands and try to identify the bacteria that may be responsible for treatment-induced changes in BH.

Key Words: Fresh Alfalfa, Biohydrogenation, RIS Analysis

T226 Measurement of volatile fatty acid interconversion as a means to study the role of thermodynamics in the control of fermentation. E. Ungerfeld*, B. Bequette, S. Owens, and R. Kohn, *University of Maryland*, *College Park*.

The molar ratios of volatile fatty acids (VFA) observed in the rumen may result in part from thermodynamic constraints on rumen fermentation. If certain pathway branches become infeasible because of the buildup of end products, fermentation may shift momentarily to other pathways, keeping the profile of end products in equilibrium. Because similar bidirectional pathways are used for VFA interconversion as for VFA production, thermodynamic control of VFA production would result in a similar rate of conversion from one VFA to another as the reverse rate of conversion. A method was developed to measure VFA interconversion under different fermentation conditions to determine when thermodynamics may play a role in the control of VFA and gas profiles. VFA interconversion flows were measured by infusing ^{13}C-labeled VFA into ruminal batch cultures that had been incubated for 2 or 8 h with alfalfa hay. VFA were infused in a 73:16:11 molar ratio mixture of acetate, propionate and butyrate, a different one of which was ^{13}C-labeled in each incubation. Samples were taken over 10 h for the incubations that were dosed after 2 h of the fermentation, and over 13 h for the incubations dosed after 8 h of fermentation. VFA production rates increased initially and then declined over the course of the incubation. Rates of conversion of the different VFA into other VFA increased and decreased in parallel with fermentation rates, as expected because the same enzymes are involved. On average throughout the incubation period, rate of conversion of acetate to propionate was similar to the reverse conversion rate, suggesting flows were close to equilibrium. Rate of conversion of two acetate to butyrate was greater than the reverse rate in the first half hour of measurement, but later the forward and reverse rates were similar. The method enabled us to measure non-steady state VFA interconversion rates, and can be used to study the return to equilibrium when fermentation is perturbed under different conditions.

Key Words: Rumen, Thermodynamics, Fermentation

T227 Dry matter determination by conventional oven drying and by semi-automatic halogen moisture analyzer methods. C. T. Kadzere*, Z. Liu, and H. Krebs, *North Carolina A&T State University*, *Greensboro*.

Determining dry matter (DM) is a basic analytical procedure that facilitates the comparison of nutrient content in feed, food, fecal, and other samples on a common denominator. Therefore, an accurate DM is important in compositional analysis of feed samples and is pivotal to ration formulation for precise animal nutrition. The DM of 43 fecal samples from two digestibility studies DSI and DSII were determined in duplicate by the conventional oven drying (OD) method and also by the semi-automatic halogen moisture analyzer (HMA) method. Samples were pre-dried at 55°C for 66 hrs and ground through a 1 mm sieve for DSI. DSII samples were pre-dried as for DSI and ground through a 2 mm sieve. In the OD method, 2 g of the samples were weighed into an aluminum dish and oven dried at 102°C for 24 hrs. The dried residue was cooled in a dessicator and weighed again to determine DM. In the HMA method, a 0.5-1 g sample was weighed into an aluminum sample pan and heated by the internal halogen dryer unit. The HMA determined DM to a constant value. DM was determined by the two methods for DSI and DSII samples. The two-sample t-significance test was used to compare DM data generated from the OD and that from the HMA methods. In DSI, there was no difference ($p \geq 0.05$) in 11 out of the 12 samples between DM determined by the OD and that by the HMA methods. However, in DSII 20 out of 31 samples had higher ($p \leq 0.05$) DM by 0.4 to 2.8 percentage points when DM determined by the HMA method was compared to that determined by the OD method. The variation in these data sets suggests the need to carefully evaluate basic analytical procedures as modern electronic methods are adopted and replace conventional analytical methods in animal nutrition labs. This is important if accurate compositional analysis of feed, food, fecal, and other samples is to be achieved, and if data generated from different analytical procedures are to be interpreted and comparatively used.

Key Words: Dry Matter, Oven Dry, Moisture Anlyzer

T228 A cordless system for continuous ruminal pH recording in dairy cows. O. Alzahal*, B. Rustomo, T. F. Duffield, and B. W. McBride, *University of Guelph*, *Guelph, Ontario, Canada.*

The use of continuous pH recording in dairy cows provides more accurate measurements than spot-sampling technique and better explains the daily diurnal variation in ruminal pH. The existing system, however, uses an indwelling pH sensor that is connected to a remote personal computer via a cable, thus, restricting the movement of the cow. The use of a cordless system has numerous advantages. It provides researchers with a tool to record pH in a free-stall setting as well as during the grazing season. It also allows the experimental animal an access to exercise. The cordless system is compromised of three major components: a sensor, a data logger, and software. The sensor (PHE-7352, Omega Engineering Inc., Stamford, Connecticut, USA) is a heavy-duty sensor designed to assure low maintenance and has the capability of measuring pH under any angle orientation. The sensor connects to a light-weight portable data logger (pHTemp101, Monarch Instrument, Amherst, NH, USA) that is situated in a water-proof box mounted on the animal back. The software (Monarch Instruments Data Recording Software v 2.0) loaded to a personal computer or a PDA allows users to collect, display, analyze, and synchronize data from different loggers. The new system was used to monitor ruminal pH of a dry cow fed *ad-libitum* alfalfa hay for three days. Rumen fluid was sampled and measured using a hand-held pH meter (pH 310, Oakton Instruments, Vernon Hills, IL, USA) four times per day and pH readings were compared against the pH readings obtained at the same time from the continuous system. Readings obtained by the continuous system were not significantly different from those obtained by point-sampling, but tended to be numerically lower. This technique will expand the ability of researchers to study ruminal pH of dairy cows under practical management circumstances such as free-stall housing or during grazing.

	Technique Continuous	Spot-Sampling	SE	*P* value
pH	6.59	6.64	0.03	0.09

Key Words: Dairy Cattle, Ruminal pH, Continuous Recording.

T229 Effect of sampling time on blood metabolites to dairy cows given amino acids, starch and glucose infusions. I. Schei*[1,2], I. A. Boman[1], L. T. Mydland[1], and H. Volden[1,2], [1]*Norwegian University of Life Sciences*, *Aas, Norway*, [2]*TINE BA*, *Aas, Norway*.

Eight multiparous lactating dairy cows were used to evaluate diurnal variation related to time of feeding on blood metabolites to abomasal or intravenous infusion of a mixture of amino acids, wheat starch and glucose. Each cow was assigned to an uncompleted replicated run 4x4 Latin square with 14 d periods, where the last 7 days were for infusions. Infusions were: 1) starch in the abomasum (SP), 2) glucose in the blood (GB), 3) amino acids in the abomasum (AP), 4) amino acids in the blood (AB). The experiment was conducted in early lactation (start 56 ± 7 d postpartum; milk yield 33.4 ± 1.7 kg) and repeated with the same animals and treatments in late lactation (start 159 ± 4 d postpartum; milk yield 22.5 ± 1.1 kg). Daily amounts infused were 400, 446 and 400 g in early lactation and 300, 335 and 300 g in late lactation for starch, glucose and amino acids, respectively. Cows were fed a basal diet of a concentrate mixture and grass silage at a ratio of 55:45 on DM basis and fixed to 95% of the energy requirement receiving 18.6 and 14.0 kg DM d^{-1} in early and late lactation, respectively. Feed was offered three times daily, at 0600, 1400 and 2200. Blood samples from the jugular vein were drawn at 0500, 0800 and 1200. Sampling time showed an effect on glucose, NEFA, urea, insulin and growth hormone ($P < 0.05$), but not on glucagon and IGF-1. Interactions between sampling time, infusions and lactation stage were observed for urea, glucose and insulin. In early lactation, highest glucose concentrations were observed for SP and GB at 0500 and 0800 and for AB at all sampling times in late lactation. In early lactation, insulin were elevated in GB at 0800. However, in late lactation, AB showed the highest post-feeding insulin concentration. From this study it is concluded that glucose and insulin concentrations are not only dependent of time after feeding, but also to substrate supplementation and stage of lactation.

Key Words: Dairy Cows, Insulin, Glucose

T230 Estimating methane emissions from grazing dairy cattle using the SF6 tracer technique. S. Cooper*[1], M. Main[1], C. Benchaar[1,2], D. Lynch[3], and A. H. Fredeen[1], [1]*Nova Scotia Agricultural College*, *Truro, Nova Scotia, Canada*, [2]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, Quebec, Canada*, [3]*Organic Agriculture Centre of Canada*, *Truro, Nova Scotia, Canada*.

The SF6 tracer method for measuring CH_4 emission from lactating dairy cows was compared to that of a respiration chamber under real and simulated grazing conditions. Four Holstein cows were used in a 2 x 2 cross-over design. The cattle were housed under either confinement conditions (respiration chamber) or grazing pasture throughout the study. The chambers (n=2) were 3.5 m deep x 2.6 m wide x 2.6 m tall. In order to simulate grazing within the chamber, fresh pasture was clipped and hand fed twice daily. Additionally, the SF6 collection devices were attached to the cows within chambers to more accurately compare the chamber and the tracer technique in terms of CH_4 emissions. Gas samples were taken for four consecutive days and CH_4 concentration was analyzed using Fournier transformed infrared spectroscopy. SF6 concentration in gas samples was analyzed by gas chromatography. Data were analyzed using the GLM procedure of SAS. The respiration chambers accounted for a higher level of total CH_4 production than the SF6 tracer technique under simulated grazing (347.6 vs. 275 g/d; $P< 0.01$) . However, no difference in total CH_4 emission was observed between the chambers and SF6 method on pasture (349.4 g/d; $P>0.05$) . Results from this study indicate that the SF6 tracer technique can be used to qauntify CH_4 emissions from lactating dairy cows grazing pasture.

Key Words: Dairy Cattle, Methane, Measurment Techniques

T231 Development and evaluation of empirical equations to predict feed passage rate in cattle. S. Seo*[1], L. O. Tedeschi[1], C. G. Schwab[2], and D. G. Fox[1], [1]*Cornell University*, *Ithaca, NY*, [2]*University of New Hampshire*, *Durham*.

The 2001 Dairy NRC database was used to develop empirical equations that can more accurately predict feed passage rate (Kp) in cattle, using a meta-analysis technique. The database was comprised of studies that used external markers, and included wide ranges in BW, DMI and physiological stages (post weaning growth, lactating and dry) of cattle. The selection of significant input variables was done using a random coefficients model that used each study effect as a random variable. The equations developed are: kp forage = 2.365 + 0.214 FpBW + 0.734 CpBW + 0.069 FDMI (n = 553); kp concentrate = 1.169 + 1.375 FpBW + 1.721 CpBW (n = 195); and kp liquid = 4.524 + 0.223 FpBW + 2.046 CpBW + 0.344 FDMI (n = 766), where kp is passage rate, %/h; FpBW is forage DMI as a percentage of BW, %; CpBW is concentrate DMI as a percentage of BW, %; and FDMI is forage DMI, kg. These passage rate equations for forage, concentrate and liquid explained 87%, 95% and 94%, respectively of the variation in passage rates in the data base used in equation development after adjustment for random study effect. These equations and other published equations (2001 dairy NRC, CNCPS cattle, Cannas and Van Soest, Lescoat and Sauvant, Owens and Goetsch and Evans) were evaluated with an independent database. The present equations predicted more accurately than the published equations. The increase in R squared between observed and model-predicted values ranged from 1 to 19%, 1 to 14%, and 4 to 16% and the decrease in the mean square error of prediction varied from 6.7 to 39.2%, 3.3 to 54.4%, and 8.1 to 52.7% in the prediction of kp of forage, concentrate and liquid, respectively. When the present equations were implemented, the CNCPS cattle prediction resulted in up to 1.5 kg lower MP allowable milk. We concluded these empirical equations are suitable for predicting passage rate in cattle. However, because more than half of the variation resulted from the random effect, which was unaccounted for, the development of a mechanistic model that accounts for more of the biologically important variables and their interactions is required to predict passage rate more accurately.

Key Words: Cattle, Passage Rate, CNCPS

T232 Potential of NIR spectroscopy to predict grain vitreousness using whole-plant corn samples. J. Goeser*[1,2], B. A. L. Justen[3], J. Coors[1], and R. Shaver[1], [1]*University of Wisconsin*, *Madison*, [2]*U.S. Dairy Forage Research Center*, *Madison, WI*.

Vitreousness, a measure of corn grain hardness, is an indirect measure of starch degradability in the rumen. Vitreousness can be predicted using near infrared spectroscopy (NIRS) from grain samples. Our objective was to determine whether vitreousness can be determined from whole-plant samples using NIRS, which would simplify evaluating starch degradability in silage trials by eliminating the need for a separate grain evaluation. Nearly 300 whole-plant corn samples were collected from silage evaluation trials from the University of Wisconsin silage breeding program. The trial involved 50 hybrids planted in two-row plots in six replications, with one row harvested for whole-plant silage, and one for grain vitreousness. Vitreousness was determined using a light box technique on ears from 10 plants. Samples ranged in vitreousness from approximately 70-95%, a typical range for commercial hybrid varieties. Vitreousness, based on grain samples, varied significantly (p=.05) among hybrids. Whole-plant silage samples were scanned using a FOSS NIR system Model 6500 scanning monochrometer with a spectral range between 400-2498 nm. Approximately 2 g of ground sample was used for scanning. The Infrasoft International NIRS version 3.0 software program CALIBRATE with the modified partial least squares regression option was used for analysis. Thirty-one NIRS math treatments were applied to the data, and 20% of the samples were randomly selected for cross validation. The highest R^2-value relating predicted to observed data points was 0.22 when using a 4,1,2,1 math treatment, which was not satisfactory. The poor NIRS predictions are likely the result of dilution of the grain portion by the stover. Determination of grain vitreousness by NIRS should be limited to using ground grain samples as opposed to whole-plant samples.

Key Words: Corn, Starch, Vitreousness

T233 A comparison of three techniques for determining the physical effectiveness factor for use in calculating physically effective NDF. K. W. Cotanch*[1], J. W. Darrah[1], H. M. Dann[1], R. J. Grant[1], and J. Audy[2], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Feed Commodities International*, *Vergennes, VT*.

The physically effective NDF content of a feed is determined by multiplying the NDF content of the feed by a physical effectiveness factor (pef). The pef is determined analytically as the proportion of dry matter greater than 1.18-mm using dry sieving with a Ro-Tap Sieve Shaker (Ro-Tap). The Penn State Particle Separator (PSPS) has been proposed as a method to determine pef on farm quickly and inexpensively. The objective of this study was to compare pef values from the Ro-Tap method to pef values from 2 PSPS methods. Samples of corn silage (n=20) and hay crop silage (n=21) were collected from 15 commercial dairy farms in Vermont. Particle size distribution was determined for all samples using the Ro-Tap and the PSPS. The pef was determined as 1) the proportion of dry forage greater than 1.18-mm using a Ro-Tap ($pef_{Ro\text{-}Tap}$), 2) the proportion of as-fed forage greater than 1.18-mm PSPS (pef_{PSPS}), and 3) the proportion of as-fed forage remaining on the 19 and 8-mm sieves plus 50% of the amount remaining on the 1.18-mm sieve and pan using the PSPS ($pef_{PSPSmod}$). Data were analyzed using the CORR and REG procedures of SAS. For corn silage, there were positive correlations between $pef_{Ro\text{-}Tap}$ and pef_{PSPS} (r=0.82; $P<0.001$) and $pef_{Ro\text{-}Tap}$ and $pef_{PSPSmod}$ (r=0.82; $P<0.001$). Compared to Ro-Tap (x), PSPS (y_1) over predicted pef ($y_1=0.31x+0.71$) and PSPSmod (y_2) under predicted pef ($y_2=1.71x-0.68$). For hay crop silage, there was no correlation between $pef_{Ro\text{-}Tap}$ and pef_{PSPS} (r=0.17; $P=0.45$) and a weak correlation between $pef_{Ro\text{-}Tap}$ and $pef_{PSPSmod}$ (r=0.45; $P=0.04$). Compared to Ro-Tap (x), PSPSmod (y_3) over predicted pef ($y_3=0.26x + 0.65$). Though a limited sample set and range of pef values, the PSPS and modified PSPS systems did not accurately measure pef as defined by standard dry sieving. If on-farm measurement of pef is needed, then a new method or sieving tool needs to be developed.

Key Words: peNDF, Dry Sieving, Penn State Particle Separator

T234 Pool size and flux of vaccenic acid during in vitro incubation of fresh alfalfa modeled by SAAM II. C. Ribeiro*, M. Eastridge, and D. Palmquist, *The Ohio State University*, *Columbus*.

The concentration of vaccenic acid (VA) during ruminal biohydrogenation (BH) is important because it is the major source of conjugated linoleic acid in milk from cows. We developed multicompartmental models to estimate pool size and flux of VA during BH of FA in fresh alfalfa. Alfalfa was harvested and immersed immediately in liquid nitrogen. Approximately 0.5 g of the frozen alfalfa was inoculated with rumen fluid using two buffers: a strong buffer (SB; 0.4 *M* $NaHCO_3$) and a weak buffer (WB, 0.2 *M*; 50:50 $NaHCO_3$/NaCl, wt/wt). Samples were incubated for 0, 1, 2, 3, 4, 6, 9, and 12 h. At each sample time, pH was measured and the tubes were immediately put in ice and stored at -20 °C until freeze-drying. Fatty acids (FA) were transesterified and measured using GLC. Average concentration of VA during incubation was estimated by PROC MIXED of SAS. The temporal change in the size of the VA pool and BH of VA were estimated by SAAM II. Precision of measuring the VA pool size was estimated from the CV for each time point in each buffer solution. There was no difference ($P > 0.05$) in the rate of BH of VA between SB (13.0%/h) and WB (11.7%/h). The VA concentration did not differ ($P > 0.05$) between buffers; however, the CV for pool size for SB and WB were 2.5% and 3.45%, respectively. Appearance of VA was greater than disappearance until ca. 6 and 9 h for SB and WB, respectively (see table). These represent the times that VA concentration peaked for each buffer. Because SAAM II estimates fluxes, as well as mass of the VA pools, it generates more information from the data than using SAS alone and is therefore a useful tool to model ruminal BH.

Flux (mg/h) of vaccenic acid appearance and disappearance

Time (h)	SB App.	SB Disapp.	WB App.	WB Disapp.
0	0.000	0.056	0.000	0.043
1	0.202	0.070	0.146	0.051
2	0.278	0.098	0.219	0.070
3	0.286	0.126	0.247	0.091
4	0.264	0.150	0.247	0.112
6	0.191	0.175	0.209	0.142
9	0.098	0.173	0.134	0.156
12	0.047	0.146	0.077	0.146

Key Words: Vaccenic Acid, Biohydrogenation, Fresh Alfalfa

T235 Rate of disappearance of linoleic and linolenic acids from fresh alfalfa during in vitro incubations estimated by SAAM II. C. Ribeiro*, M. Eastridge, and D. Palmquist, *The Ohio State University*, *Columbus*.

We used kinetic analysis (SAAM II) of disappearance rates (DR) of unsaturated fatty acids (FA) to study dietary and ruminal factors affecting biohydrogenation (BH) and formation of *trans* FA in fresh alfalfa. Alfalfa samples were harvested and immersed immediately in liquid N, then freeze-dried, ground to 1 mm, and stored at -20 °C. Approximately 0.5 g of frozen alfalfa was inoculated with rumen fluid using two buffers: a strong buffer (SB; 0.4 *M* $NaHCO_3$) and a weak buffer (WB, 0.2 *M*; 50:50 $NaHCO_3$/NaCl, wt/wt). Samples were incubated for 0, 1, 2, 3, 4, 6, 9, and 12 h; pH was measured and tubes were put in ice and stored at -20 °C until freeze-drying. The FA were transmethylated and measured by GLC. The DR (h^{-1}) of 18:2 and 18:3 were estimated by PROC NLIN of SAS and by SAAM II. Comparison of the two methods was performed by paired *t*-Test of the DR from each FA in each buffer. The average pH for the SB and WB were 6.7 and 6.2, respectively. The DR was lower ($P < 0.05$) for 18:2 and 18:3 in WB and did not differ ($P > 0.05$) between methods of estimation. The SE of the DR were very similar between methods. SAAM II is a superior approach to model the dynamics of FA metabolism in BH.

Disappearance rates (h^{-1}) of 18:2 and 18:3

Methods	18:2 SB	18:2 WB	18:3 SB	18:3 WB
SAS	0.281	0.245	0.440	0.308
SAAM II	0.275	0.236	0.438	0.303
Probability (*t*-Test)	0.27	0.27	0.41	0.24

Key Words: Biohydrogenation, Fresh Alfalfa, Kinetics

T236 Modeling nutrient supply to ruminants using NRC-2001 with inputs based on in situ and mobile bag techniques measurements. P. Yu*, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objectives of this study were to use the NRC-2001 model with inputs based on in situ and mobile bag techniques measurements to predict the potential nutrient supply to dairy cows using an exampled feedstuff - lupin seeds that were systematically pressure-toasted and to determine how pressure-toasting effects (which shifted degradation of protein from rumen to small intestine without changing intestinal digestion) could be quantitatively measured by the model. The quantitative predictions were made in terms of: 1) rumen undegraded (RUP)

and 2) degraded rumen protein (RDP), 3) truly absorbed undegraded protein (ARUP), 4) microbial protein (MCP) synthesized in the rumen from rumen available protein or 5) from total digestible nutrients (TDN), 6) truly absorbed rumen synthesized microbial protein (AMCP), 7) truly absorbed rumen endogenous protein (AECP), 8) total metabolizable protein (MP), as well as 9) the protein degradation balance (PDB). The results show using NRC-2001 with inputs based on in situ and mobile bag techniques measurements, the protein degradation balance and total metabolizable protein supply to dairy cattle could be quantifiably predicted. However, the results differed from that published with the DVE/OEB system (which is a non-TDN based model) although the two models had significant correlations with high R square (> 0.99) values. Using the NRC model, the overall mean for the total absorbed protein in the small intestine was higher (+10 g/kg DM), but the protein degradation protein balance values were lower (-12 g/kg DM) in comparison to that predicted by the non-TDN based model. These differences are due to considerably different factors used in calculations in the two models, although both are based on similar principles. This indicates that a further refinement is needed for a modern protein evaluation and prediction system

Key Words: Modeling Nutrient Supply, Ruminants, NRC and DVE/OEB

T237 Comparison between nylon bag method and gas production method in determination of feedstuff nutritive value. A. Nikkhah* and A. Mahdavi, *University of Tehran*, *Karaj, Tehran, Iran*.

This investigation was conducted to determine dry matter digestibility (DMD), crude protein degradability (CPD), neutral detergent fiber (NDF), acid detergent fiber (ADF) and gas production of some feedstuffs with different methods. Six cannulated bulls (Holstein and Sistani bulls) in a complete randomized design with two replicates were used. The amounts of gas production at 0, 2, 4, 6, 8, 12, 24, 48, 72 and 96 hours and feedstuffs degradation by nylon bag at 0, 4, 8, 16, 24, 48, 72 and 96 hours were measured. The feedstuffs that were used in this study included: alfalfa hay, wheat straw, corn silage, concentrate and cottonseed, which consumed at maintenance level by experimental animals. Dry matter degradability at 96 hours for alfalfa hay, wheat straw and corn silage were 71.52%, 51.02% and 77.89% and at 48 hours for concentrate and cottonseed were 80.59% and 53.51% and the dry matter degradability for these feedstuffs at 24 hours were 66.93%, 33.57%, 68.24%, 79.83% and 48.71%, respectively. The amount of gas production at 96 hours of incubation for alfalfa hay, wheat straw and corn silage were 51, 45, and 75.5 mL/h and for concentrate and cottonseed at 48 hours of incubation were 81 and 58.5 mL/h, respectively. Correlation coefficient between dry matter degradation and gas production for these feedstuffs were 0.99, 0.99, 0.99, 0.96 and 0.99, and correlation coefficient between crude protein degradation and amount of gas production were 0.97, 0.99, 0.99, 0.99 and 0.98 respectively. Due to high correlation coefficient between dry matter degradation, crude protein degradation, ADF degradation, NDF degradation and gas production, regression equations between these parameters and gas production were calculated to estimate amount of these parameters from amount of gas production without doing digestion experiments. The calculated regression equation between alfalfa dry matter degradation and its gas productions was: Y=35.724+0.714X, so for 51 mL gas production for alfalfa at 96 hours, this equation estimate 72.14% degradation for alfalfa dry matter that is in a good agreement with 71.52% from digestion experiments.

Key Words: Feedstuff, Gas Production, Nutritive Value

Ruminant Nutrition: Small Ruminants

T238 Effect of dietary copper supplementation on fatty acid profile of muscle, mesenteric, and subcutaneous adipose tissue in goat kids. E. Ellis[1], W. Bergen[1], S. Solaiman[2], and K. Cummins*[1], [1]*Auburn University*, *Auburn*, [2]*Tuskegee University*, *Tuskegee, AL*.

A feeding trial was conducted to evaluate the effect of dietary copper (Cu) supplementation at 0, 100 and 200 mg/d above basal intake on relative amounts of fatty acids in various tissue depots of goats (n=5/treatment). Copper was given daily in gelatin capsules. Goats were slaughtered at 98 days of the experimental protocol. Samples of longissimus dorsi muscle and subcutaneous and mesenteric adipose tissue were taken after slaughter and flash frozen and kept at -80 degrees C until analysis. Total lipids were extracted with cholorform:methanol (2:1), fatty acid methyl esters were prepared and analyzed using gas chromatography and mass spectrometry. Data are expressed as percent of the total lipids. Dietary Cu supplementation elicited a variable effect depending on the tissue. In muscle C15:0 increased linearly with increasing Cu (P<.05; 0.08, 0.17, 0.17 for 0, 100 and 200 mg/d dietary Cu, respectively). Dietary Cu supplementation resulted in an linear decrease in C14:0 (P<.03; 3.96, 3.22, 2.63 for the 0, 100, and 200 mg/d Cu, respectively) and C16:0 (P<.02; 25.56, 23.76, and 23.86 percent for 0, 100 and 200 mg/d Cu) in subcutaneous adipose. In mesenteric adipose C18:2 trans, trans isomer tended to increase P<.06; 0.05, 0.1, and 0.07 percent for the 0, 100 and 200 mg/d Cu) with increasing Cu. Ten other hydrophobic, methylated compounds for which standards were not available were identified in mesenteric adipose tissue, based on melting point in the GC, linear retention time, and mass, as being altered in relative concentration by dietary Cu supplementation. Two other compounds, one in each of subcutaneous adipose and muscle tissue, were altered by dietary Cu supplementation. Dietary Cu supplementation altered the fatty acid profile of various tissues in the goat kid. The effect varied with tissue and affected different fatty acids in different tissues. The effect on odd-chain fatty acids observed in muscle may indicate an effect of dietary Cu on rumen microorganisms. Dietary Cu supplementation may offer a means of altering carcass lipid profile as well as content.

Key Words: Copper, Goat, Lipid

T239 The effect of dietary n-6/n-3 fatty acid ratio on feed intake, digestibility, and fatty acid profiles in muscle of growing lambs. S. C. Kim*[1,2], A. T. Adesogan[1], C. R. Staples[1], and L. Badinga[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, Gyeongsangnam-do, Korea*.

This study investigated the effect of modifying the n-6/n-3 ratio of dietary oil supplements on apparent digestibility, growth performance and foreshank fatty acid profile of growing lambs. Forty individually housed, Katadhin cross lambs (average of 20.0 kg initial BW) were fed bermudagrass hay (10.5% CP and 1.25% EE) in ad libitum amounts and were supplemented with a concentrate (18.7% CP and 7.7% EE) containing corn, soybean meal and oil (72:24:4) at 3.7% of BW. The lambs were blocked by BW and randomly assigned to four dietary oil supplement treatments containing n-6/n-3 ratios of 2:1, 10:1, 16:1 and 20:1 by mixing linseed oil, cottonseed oil, and soybean oil. At the end of the 28-d trial, samples of blood, rumen fluid and foreshank tissue were collected at slaughter. Increasing the n-6/n-3 fatty acid ratio of the supplemental oils did not affect DM intake (960 g/d), apparent digestibility of DM (74.1%), CP (49.4%), or EE (82.6%), ruminal fluid concentrations of acetate (32.8 molar %), propionate (37.8 molar %) and ammonia (30.6 mg/100 ml) or BW gain (0.26 kg/d). Plasma concentrations of IGF-1 and insulin tended to increase linearly with increasing n6/n3 ratio (P=0.15). Increasing the n-6/n-3 fatty acid ratio of the supplemental oils linearly changed the fatty acid concentration of the foreshank lipid (% of lipid) as follows: C18:2 (17.0, 20.3, 22.9, and 28.8%), trans-10,cis-12 CLA (0.01, 0.04, 0.06, and 0.04%), C20:4 n-6 (8.9, 10.7,13.1, and 14.7%), and total polyunsaturated fatty acids (31.2, 34.6, 39.9, and 47.9%) increased linearly whereas the n6/n3 ratio increased in a quadratic fashion (5.5, 9.9, 10.6, and 10.6). Alternatively, concentrations of C14:0, C16:0, C16:1, C18:1, C18:3, cis-9,trans-11 CLA, saturated fatty acids, and monounsaturated fatty acids decreased in either a linear or quadratic fashion as the n6:n3 ratio increased. Feeding oils to young lambs can change the fatty acid profile of muscle lipid fractions.

Key Words: Lamb, Digestibility, Fatty Acid Profiles

T240 The effect of supplemental feeding duration on performance of Balouchi ewes. V. Kashki*[1], M. R. Kianzad[2], M. Raisianzadeh[1], M. Nowrozi[1], and A. Davtalabzarghi[1], [1]*Agriculture and Natural Resources Research Center of Khorasan*, *Mashhad, Khorasan, Iran*, [2]*Animal Science Research Institute of Iran*, *Karaj, Tehran, Iran*.

Balouchi sheep are a widespread breed of meat-wool sheep in Iran and Khorasan province. The available pastures in this area are low in energy and protein contents. Therefore supplemental feeding is one important management factor for sheep production. In order to study the effect of supplemental feeding duration on performance of Balouchi sheep, 150 Balouchi ewes, aged higher than 3 years were selected for uniformity in BW, age and production from a flock of approximately 3,000 Balouchi ewes and studied in an incomplete random design. 250 g barley grain was fed once daily for supplementing in periods from pre-breeding to weaning. Treatments included 1) no supplement (control) 2) supplemented from 30 d prior to breeding to weaning 3) supplemented from breeding to weaning 4) supplemented from 30 d prior to lambing to weaning 5) supplemented from lambing to weaning. Ewe body weight changes, grease fleece weight, milk production, lamb birth weight, lamb weaning weight and average daily gain for lambs were measured. Experiment data were analysed using the GLM procedure of SAS (6.12). Treatment had significant effects (P<0.05) on ewe weight 30 d after lambing, and control had less weight. All ewes lost weight 30 d after lambing. Control had higher daily loss weight in 30 d after lambing than other treatments and treatment 5 lost less weight. The ewe weight was affected by treatment at the time of weaning (P<0.05). Daily milk production was not affected by treatment. Fleece weight was affected by treatment (P<0.05) and treatment 2 had the largest value. The lamb birth weight was not affected by treatment. But treatment had significant effects on weight of lambs in 30 d (P<0.05) and treatment 5 and 2 were higher than others. The lamb weaning weight and ADG was significantly different between treatments (P<0.05) and receiving feed treatments had lambs with higher weight than control. Result showed if supplemental feeding ewes is done in pasture condition from 30 d prior to breeding to weaning, ewes won't lose weight in the end of year, and their life time will increase.

Key Words: Supplemental Feeding, Barley Grain, Balouchi Sheep

T241 Vitamin E improves the number of transferable embryos and born lambs in superovulated ewes. H. Luo*, S. Zhu, and Z. Jia, *China Agricultural University*, *Beijing, PR. China*.

The effect of Vitamin E on the multiple ovulation embryos transfer (MOET) was studied in two experiments. Fourteen ewes (Poll Dorset) were divided into two groups in Exp 1, and Vitamin E was added 400mg/day to the diet and 16 times higher than the NRC standard in the treatment group. Both group ewes were superovulated normally. The number of the transferable embryos per donor in the treatment group was higher significantly ($P < 0.01$) than in the control group (5.2 and 2.4 respectively). The ratio of the transferable embryos to eggs recovery and the A-grade transferable embryos per donor were significantly different ($P < 0.01$) with 44% vs 100% and 2.25 vs 4.43 in the control and the treatment, respectively. The percentage of number of A-grade transferable embryos was 60.8%, more 2.18 transferable embryos per donor than the control ($P < 0.01$). To investigate the effect of vitamin E on the number of the born lambs of synchronized estrus ewes, the embryos, obtained from the control group and the treatment group in Exp.1, were transferred to the recipients (Small-tail Han sheep, Local sheep) of the control group and the treatment group in Exp.2, respectively. One A-grade transferable embryo was transferred for each recipient. Significantly differences ($P < 0.01$) were found for the rate of the lambs born with 46.15% (6/13) vs 88.88% (16/18) in the control and the treatment groups respectively. However, one dead lamb was in the treatment group, and one weak lamb was in each group. There were no differences significantly ($P > 0.05$) on the birth weights of born alive lambs and the gain body weight per day between two groups. The beneficial effects of Vitamin E could be attributed to its antioxidation. In conclusion, the present study showed that supplement of Vitamin E in the ration increased significantly ($P < 0.01$) the embryos yield and the number of born lambs.

Key Words: Vitamin E, Embryo Transfer, Ewe

T242 Effects of mild heat stress and sub-acute ruminal acidosis on acid-base balance and gastrointestinal tissue histology in lambs. N. Odongo*, O. Alzahal, M. Lindinger, T. Duffield, E. Valdes, S. Terrell, and B. McBride, *University of Guelph*, *Guelph, Ontario, Canada*.

The effect of heat stress (HS) and grain induced sub-acute ruminal acidosis (SARA) on acid-base balance and gastrointestinal tissue integrity in lambs was investigated using 24 yearling wether lambs. Lambs were blocked by body mass and assigned to one of 4 treatments: 1) thermo-neutral zone (temperature = 18 to 20°C; relative humidity (RH) = 30%; TN); 2) TN + SARA; 3) heat stress (temperature = 35°C for 9 h/d, 20°C for 15 h/d; RH = 40%; HS); and 4) HS + SARA in a 2 x 2 factorial experiment. Blood samples were collected by jugular venipuncture and analyzed for pH, blood gases and plasma ions. After all measurements in live animals had been taken on d 17, lambs were slaughtered and tissue samples obtained from the rumen, duodenum, jejunum, ileum and caecum for histological assessment. HS lambs had higher respiration rates (157 vs. 85, HS vs. TN; $P < 0.05$) than the TN lambs. At d 10, HS lambs on the control diet (HS + control) had lower pCO_2 (38 vs. 46, HS vs. TN; $P < 0.05$) whereas HS lambs on the SARA diet (HS + SARA) had higher pCO_2 (42 vs. 37, HS vs. TN; $P < 0.05$). Although the HS + control lambs had lower ($P < 0.05$) [SID] than the HS + SARA lambs at d 10, from d 14 to d 17, all HS lambs had lower [SID] (52 vs. 47 (d 14), 48 vs. 46 (d 17), TN vs. HS; $P < 0.05$). HS + SARA lambs had higher [Cl^-] (106 vs. 102 (d 14), 107 vs. 104 (d 17), HS + SARA vs. HS + control; $P < 0.05$) and lower [HCO_3^-] (27 vs. 29 (d 14), 30 vs. 32 (d 17), HS + SARA vs. HS + control; $P < 0.05$). HS + control lambs had higher papillae count in the ventral sac (rumen) than HS + SARA lambs (1.5 vs. 1.3, control diet vs. SARA; $P < 0.05$). These results suggest that in the short-term, SARA may counteract the alkalizing effects of mild HS on acid-base balance without affecting gastrointestinal tissue integrity.

Acknowledgements: The authors would like to thank the staff of the Ponsonby Research Station, University of Guelph for their technical assistance. We also would like to acknowledge the continued support received from the Ontario Ministry of Agriculture and Food (OMAF) and the Natural Sciences and Engineering Research Council of Canada (BWM).

Key Words: Heat Stress, Ruminal Acidosis, Acid-Base Balance

T243 Assessment of milk yield and milk composition using soybean hulls as a roughage replacer for Santa Ines ewes. R. C. Araujo, A. V. Pires*, I. Susin, C. Q. Mendes, G. H. Rodrigues, I. U. Packer, and L. V. Gerage, *ESALQ/ University of São Paulo*, *Piracicaba, SP, Brazil*.

Soybean hulls (SH) as an alternative feed to forage may maintain the NDF level and increase energy concentration of ruminant diets. The objective of this experiment was to evaluate the efficacy of replacing coastcross hay NDF by SH NDF on lactation performance of Santa Ines ewes. Fifty-six lactating ewes (initial BW 56.0 ± 0.5) were penned individually and used in a complete randomized block design according to parity, type of rearing (single or twin), offspring gender and lambing date. Hay NDF from a 70% roughage-based diet (SH0) was replaced with SH NDF by 33% (SH25), 67% (SH54) and 100% (SH85), containing 0, 25, 54 and 85% of SH in the diet DM, respectively. Diets were formulated to provide a similar amount of NDF (57%) and CP (16%). Ewes were milked by hand once a week, from second to eighth week of lactation (weaning time). Milk production in a 3h-interval was recorded and sampled for composition determination by infrared analysis. A quadratic effect ($P < 0.01$) for 3-h milk production (142.4, 179.8, 212.6, 202.9 g) and DMI (2.27, 2.69, 3.25, 3.00 kg/day) was observed as SH level increased from 0 to 85%. Milk fat (7.59, 7.86, 7.59 and 7.74 %), protein (4.53, 4.43, 4.40 and 4.55%), lactose (4.95, 5.06, 5.15 and 5.13%) and total solids (18.24, 18.54, 18.39 and 18.64%) were similar ($P > 0.05$) for SH0, SH25, SH54 and SH85, respectively. Body weight gain during the trial was 0.37, 0.03, 4.80 and 2.80 kg, as SH level increased from 0 to 85%, showing a cubic effect ($P < 0.01$). Week effect ($P < 0.01$) was observed for milk production, DMI and milk components. Treatment and week of lactation interaction ($P < 0.05$) was observed for DMI and milk protein percentage. The addition of SH as a non-forage fiber source for lactating ewes improved DMI and milk production without changing milk components percentage.

Key Words: Fiber Source, Hair Sheep, NDF

T244 Apparent digestibility of pomegranate seed fed to sheep. R. Feizi*[1], A. Ghodratnama[1], M. Zahedifar[2], M. Danesh Mesgaran[3], and M. Raisianzadeh[1], [1]*Agricultural and Natural Resources Research Center of Khorasan*, *Mashhad, Khorasan, Iran*, [2]*Animal Science Research Institute Iran*, *Karaj, Tehran, Iran*, [3]*Ferdowsi University of Mashhad*, *Mashhad, Khorasan, Iran*.

Pomegranate by-products (peel and seed) contain about 40-45 percent of the fruit's weight, but little information is available on their nutritive value. The general objective of this study was to evaluate nutritive value of pomegranate seed (PS). In order to determine the apparent digestibility of PS 16, Baloochi rams were used in a completely randomized design with 4 replicates in each of 4 treatments. The animals were allocated to individual metabolic cages with four diets including (1) 100% alfalfa hay as a basal diet, (2) 75% alfalfa+25% PS, (3) 50% alfalfa+50% PS and (4) 25% alfalfa+75% PS. A three-period feeding schedule was used consisting of adaptation (10 d), preliminary (21 d) and restricted intake period (10 d) in which total feces were weighed and sampled daily. Data were analysed using the GLM procedure of SAS. The results indicated that amount of DM, OM, CP, CF, ether extract (EE), nitrogen free extract (NFE) and total extractable tannins (TET) of PS were 94.8, 96.8, 11.4, 38.9, 1, 45.5 and 3.5% respectively. The data indicated that increasing the percentage of PS from 25 to 75 resulted in a significant decrease ($P<0.05$) of nutrients digestibility, however, when the digestibility of PS was determined by difference method, there was not significant difference between levels of 25, 50 and 75% of PS. The coefficient digestibility of DM, OM, CP, CF, EE, energy, NFE, TDN and digestible OM content in DM (D-value) PS that calculated by difference method were 44.8, 44.7, 62.5, 21.5, 38.3, 45, 61.5, 45.9 and 48.4% respectively. The results of this experience demonstrate the potential of PS can be used in animal nutrition. Also indicated that inclusion of PS up to 25% of the diet has no negative effect on the nutrients intake and digestibility.

Key Words: Digestibility, Pomegranate Seed, Sheep

T245 Effect of feeding pistachio skins on feed intake, milk yield and milk composition in lactating saanen goats. A. A. Naserian and P. Vahmani*, *Ferdowsi University of Mashhad*, *Khorasan, Iran*.

Pistachio skins (seed coats) are a by-product of the pistachio processing in order to produce green kernels. The objective of this study was to determine the effect of pistachio skins (PS) as a feed ingredient for lactating dairy goats in the early lactation. Four multiparous lactating saanen goats (55±7.2 DIM and 47.12±6 Kg BW) were used in a 4×4 replicated Latin square design experiment. Goats were fed a mixture of 40% alfalfa hay and 60% concentrate (DM basis) ad libitum and milked twice daily. Treatments were 1) 0% PS (Control diet), 2) 7% PS, 3) 14% PS, and 4) 21% PS in dietary dry matter. The PS were substituted for wheat bran in the control diet. Each experimental period was for 21 days, which included 14 days of adaptation to the experimental diets followed by 7 days sampling period for determination of dry matter intake (DMI), milk production and composition. Chemical analysis showed that PS contained 21.3% CP, 19.6% ether extract, 37.6% NDF, 22.1% ADF, and 4.2% ash (DM basis). Increasing levels of PS in diets had no significant effect on DMI, milk yield, milk protein, lactose and SNF ($P>0.05$), but there was a trend for increased milk production and milk protein for goats fed 14% PS compared with goats fed other treatments. Milk fat was increased ($P<0.05$) from 3.1% to 3.96% as the level of PS in the diet increased from 0 to 14% in dietary DM. DMI as a percentage BW was increased ($P<0.05$) for goats fed 21% PS compared to goats fed 7% PS or control diet. The result of this study showed that because of the nutrient content, PS can be a desirable feed ingredient for dairy goats in the early lactation. However additional research projects are needed to determine the nutritive value and effect of PS on other ruminants, particularly in dairy cattle.

Key Words: Pistachio Skins, Milk Composition, Dairy Goats

T246 Dried citrus pulp as a replacement for corn in diets for feedlot lambs. G. H. Rodrigues, I. Susin*, A. V. Pires, C. Q. Mendes, R. C. Araujo, I. U. Packer, and M. F. Ribeiro, *ESALQ/University of São Paulo*, *Piracicaba, SP, Brazil*.

Dried citrus pulp (DCP) is a high energy by-product and may be used to replace corn in early weaned lamb diets. Sixty-four Santa Ines ram lambs (initial BW 18 ± 0.6 kg and 73 ± 1 d old) were assigned to a complete randomized block design according to body weight and age at beginning of the trial. The objective was to evaluate the effects of replacing corn by dried citrus pulp on lamb growth and carcass yield. Lambs were fed a 90% concentrate (ground corn and/or DCP, soybean meal and minerals) and 10% coastcross hay (*Cynodon* spp) diet for 56 days. DCP was added at 23.7, 46.1 and 70.4% of the diet DM replacing corn from the control diet (CON) by 33, 67 and 100% corresponding to the experimental treatments DCP24, DCP46 and DCP70, respectively. Lambs were slaughtered when reached 33-34 kg BW. Average daily gain (ADG) and dry matter intake (DMI) showed a cubic ($P<.05$) effect (ADG: 253, 267, 203 and 166 g; DMI: 943, 1007, 859 and 843g/d for CON, DCP24, DCP46 and DCP70, respectively). Feed efficiency presented a quadratic response. Carcass yield was not affected ($P>0.05$) by citrus pulp inclusion in the diet. However, lambs fed high amounts of DCP needed more days to slaughter. Dried citrus pulp can be included in high concentrate diets for early weaned lambs, up to one fourth of the diet dry matter, with no detrimental effects on performance.

Key Words: By-Product, Hair Sheep, Performance

T247 Comparative effects of soybean meal, canola meal, cull chickpeas and cull chickpeas-meat meal on apparent digestibility of diet for sheep. J. F. Obregón*, J. A. Moroyoqui, J. L. Verdugo, and A. Estrada, *FMVZ-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

With the objective of determining the comparative effects of soybean meal, canola meal, cull chickpeas and cull chickpeas-meat meal on apparent digestibility of diets for sheep, a digestibility experiment was conducted. Four Pelibuey sheep, males (BW = 21 ± 0.79 kg) were used in a Latin square design experiment. The sheep were placed individually in metabolic crates (0.6 x 1.2 m), and randomly assigned to consume one of four diets in that consist the treatments: 1) diet with 17.21% of CP and 3.49 Mcal of DE/kg, containing (DM basis): soybean meal 16.5%, corn 57%, Sudan grass hay 15%, sugar cane molasses 9%, and mineral premix 2.5% (SM); 2) diet similar to control, but containing 21.5% of canola meal and 52% of corn (CM); 3) similar to control but with 55.5% of cull chickpeas and 18% of corn (CHP); 4) diet similar to control but containing 45.5% of cull chickpeas, 3% meat meal and 25% of corn (CHPM). Diets were offered twice a day (0800 and 1600 h), after six days of adaptation period, samples of diets (1 kg) and the total 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 apparent digestibility decreased ($P = 0.03$) by CM treatment with values of 80.23%, 82.07%, 81.78% and 81.21% for CM, SM, CHP and CHPM, respectively. Crude protein digestibility was not affected ($P = 0.98$) by treatments with values of 76.48%, 76.77%, 76.03% and 76.71% for SM, CM, CHP and CHPM, respectively. The content of digestible energy of diets with SM and CHP (3.51 and 3.50 Mcal/kg) was higher ($P = 0.01$) than the diets with CM and CHPM (3.43 and 3.45 Mcal/kg), as consequence of that DE of cull chickpeas was estimated to be near of 3.85 Mcal/kg contented in blend soybean meal-corn, ingredients that was substitute for cull chickpeas. The addition of 3% meat meal at cull chickpeas decreased ($P = 0.01$) the DE in the diet. It is concluded, that cull chickpeas and cull chickpeas-meat meal can be included in diets for sheep substituting usual sources of protein as soybean meal and canola meal.

Key Words: Cull Chickpeas, Digestibility, Sheep

T248 The effect of treated wheat straw with molasses, urea and calcium hydroxide on performance of feedlot lambs. R. Feizi*[1] and A. Mohrrery[2], [1]*Agricultural and Natural Resources Research Center of Khorasan, Mashhad, Khorasan, Iran*, [2]*Shahrekord University, Shahrekord, Chaharmahal Bakhtiari, Iran*.

In order to study the effect of wheat straw (WS) treated with molasses, urea and calcium hydroxide on average daily gain (ADG), feed intake (FI), feed conversion (FC) and carcass characteristics, 36 Iranian Balouchi lambs weighing 31 ± 3.25 kg and average age of eight months were used in a completely randomized design with 6 treatments, each consisting of 6 animals. Wheat straw was treated with solutions (1 liter/kg DM) containing molasses (M) plus either urea (U) or limestone powder (LP) and ensiled for 21 days. Dietary treatments were: 1) WS +10% M + 0% U 2) WS + 10% M + 4% U 3) WS + 10% M + 8% U 4) WS + 10% M + 4% LP 5) WS + 10% M + 8% LP and 6) Alfalfa hay was considered as control. Concentrate part of diet were balanced based on start weight and daily gain according to recommendation of NRC (1989). Lambs were fed individually on total mixed ration TMR (roughage:concentrate; 40:60) ad lib. Data were analysed using the GLM procedure of SAS. ADG, FI and FC in lambs fed alfalfa were 212, 1726 g/day and 8.25, respectively. These parameters were significantly better (P<0.05) in alfalfa treatment compared with other treatments. Among the diets including treated wheat straw, the greatest rate (P<0.05) of ADG were observed for ration with 8% of urea. Economic comparison indicated that treated wheat straw with 8% of urea caused reduced feed costs per kg live weight gain compared with other treatments.

Effect of treated wheat straw with molasses, urea and calcium hydroxide on performance of lambs

	Wheat Straw + 10% M					Alfalfa	SEM
	0% U	4% U	8% U	4% LP	8% LP		
ADG (g/day)	149^{c}	157^{bc}	171^{b}	162^{bc}	148^{c}	212^{a}	7.738
FI (g/day)	1456^{d}	1478^{cd}	1583^{bc}	1631^{ab}	1497^{cd}	1726^{a}	43.725
FC	9.75^{ab}	9.56^{ab}	9.28^{b}	9.98^{ab}	10.35^{a}	8.25^{c}	0.355
dressing percent	46.95^{b}	47.18^{b}	47.90^{b}	47.95^{b}	48.46^{b}	51.71^{a}	0.763

Means on the same row with different superscripts significantly differ (P<0.05).

Key Words: Lamb, Urea, Calcium Hydroxide

T249 Growth performance of sheep fed with diets containing soybean meal, cull chickpeas or cull chickpeas-fish meal as protein source. J. F. Obregon*, E. Ibarra, A. Gomez, A. Estrada, and F. G. Rios, *FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico*.

For comparison of growth performance, sheep were fed diets containing soybean meal, cull chickpeas or cull chickpeas-fish meal. Seventy five hair sheep (males; BW = 17.33 ± 2.3 kg) were used in a complete randomized block experiment design. The sheep were weighed and blocked by weight, in groups of five were placed in fifteen pens (2 x 3 m), and assigned to consume one of three diets (DM basis) in that consisted the treatments: 1) Diet with 17.27% CP and 3.48 Mcal of DE/kg, containing: soybean meal 18%, corn 54.5%, stover corn 15%, sugarcane molasses 10% and mineral premix 2.5% (CONT); 2) Diet containing: soybean meal 5.5%, cull chickpeas 40%, corn 27%, stover corn 15%, sugarcane molasses 10% and mineral premix 2.5% (CHP); and 3) Diet with: cull chickpeas 40%, corn 29%, fish meal 3.5%, stover corn 15%, sugarcane molasses 10% and mineral premix 2.5% (CHPFM). Animals were weighed on day 1 and day 56 at the finish of the trail, feed was offered twice a day under free access condition. Treatments did not affect (P = 0.62) end weight (30.91, 30.58 and 31.46 kg) for CONT, CHP and CHPFM, respectively. Average daily gain (0.242, 0.236, and 0.254 kg) were similar (P = 0.55) between dietary treatments. Feed intake in dry matter basis (0.880, 0.901 and 0.913 kg/day) was not modified (P = 0.54) by treatments. Feed/gain ratio were similar (P = 0.42) between treatments with values of 3.65, 3.84 and 3.73 for CONT, CHP and CHPFM, respectively. It is concluded, that cull chickpeas and cull chickpeas-fish meal can be used in diets as protein source without affecting growth performance of sheep.

Acknowledgements: The authors acknowledgment to PROMEP-SEP-México for financial support.

Key Words: Cull Chickpeas, Growth Performance, Sheep

Teaching/Undergraduate and Graduate Education

T250 Determining graduation rate of students who initially enrolled as animal science majors at the University of Missouri during a consecutive four-year period. G. Jesse* and M. Ellersieck, *University of Missouri, Columbia*.

Data obtained primarily from the University of Missouri's Student Information System (SIS) were used to determine graduation rate of students who initially enrolled as Animal Science majors as freshmen or transfer students during the fall semester of 1996, 1997, 1998 or 1999. Objectives of this study included: 1) determine the percentage of students who completed a B.S. degree in Animal Science (A.S.), 2) determine graduation rate for all students who enrolled as A.S. majors regardless of what degree they completed, 3) determine why students changed their major or failed to complete their B.S. degree, and 4) determine the predictability of graduation rate. Variables included in the analysis of data included: gender, composite ACT score, high school class rank, advising group, high school graduation class size, predicted grade point average, first semester grade point, cumulative grade point and the student's background (farm/ranch, non-farm/ranch or urban). The total number of students in the data set was 457 representing 378 who enrolled as first semester freshmen and 79 transfer students. The data were statistically analyzed using various procedures of SAS. A questionnaire was sent to 256 former students who either did not complete a degree at MU (126) or completed a baccalaureate degree in a major other than A.S. (130) to attempt to ascertain their reason(s) for changing major or leaving MU. Thirty-five percent of the students completed a B.S. degree in A.S. Approximately 14% completed a B.S. degree in some other major in the College of Agriculture, Food and Natural Resources (CAFNR) and 15% completed a baccalaureate degree in some major outside of CAFNR at the university. Graduation rate ws 63.9% which was similar to the campus average. The use of five independent variables resulted in a 64% accuracy at predicting graduation rate. Poor academic performance was the primary reason students did not complete a B.S. degree.

Acknowledgements: This project was approved by the University of Missouri Campus Institutional Review Board (Project #1042765).

Key Words: Graduation Rate, Undergraduates, Animal Science Majors

T251 Digital image gallery to sssist learning animal, dairy and poultry sciences: Photos and illustrations solicited. J. Riesen*[1], H. Hafs[2], L. Katz[2], G. McCone[3], P. Schoknecht[4], and M. Stokes[5], [1]*University of Connecticut, Storrs*, [2]*Rutgers University, New Brunswick, NJ*, [3]*National Agricultural Library, Beltsville, MD*, [4]*University of Richmond, Richmond, VA*, [5]*University of Maine, Orono*.

To assist teaching baccalaureate level Animal Sciences, we are accumulating digitized images and animations at the URL listed below. Sections for Nutrition, Reproduction and Ethology are already installed and the first images are available. For the long term, we aim to add sections for other animal science areas such as genetics, biotechnology, animal management, lactation, zoo and wild animals, individual food animal species, and companion animals including horses. Instructors everywhere are encouraged to contribute images, following the instructions at http://cygnet.richmond.edu/image_gallery. Submitted images and their annotations are peer reviewed to optimize their use in learning. The site will be transferred late in 2005 to the National Agricultural Library (NAL) where the images will be available in perpetuity and without cost. The gallery uses the NAL thesaurus, includes a glossary, and is searchable either by keyword or by advanced search methods.

Acknowledgements: Supported by USDA HEC Grant #2003-04009, and the NE Section of ADSA/ASAS.

Key Words: Image Gallery, Teaching, Learning

T252 Perceptions of high school students towards Advanced Life Science: Animals, academic honors curricula. A. Huerta*, B. Hains, and M. Balschweid, *Purdue University*, *West Lafayette, IN*.

The objective of this study was to evaluate high school students' perceptions, opinions, and perceived benefits gained towards a new academically rigorous animal science curriculum. Two decades have passed since a call for excellence in education suggested that students needed a more rigorous, focused approach to their secondary education as opposed to the general educational tract that provided neither high level academics nor high level workforce preparation skills. With the implementation of the No Child Left Behind Act many high school agriscience and business programs feel the pressure of being an elective-based program. With the recent influx of biomedical and bio-agricultural companies relocating to the regions of the Midwest, advocates of high school agriscience and business programs in one particular Midwestern state have implemented a highly academic animal science curriculum titled Advanced Life Science: Animals. This state's Department of Education put this curriculum into action accounting for a core science academic honors credit without losing it's vocational implementation. Utilizing a mixed methodology approach, both quantitative and qualitative data were collected through a survey questionnaire. This work represents a fundamental shift in the way many in the state view agricultural education and its role within the context of the total curricular offerings. For the first time, agriscience and business teachers have the opportunity to offer an advanced animal science course built upon rigorous, measurable, world-class standards of performance. This research topic gives promise for other states to begin the implementation process for new course standards to be developed based upon these same standards. This process can allow for the opportunity to expand the circle of stakeholders currently involved in agricultural education and can strengthen and broaden the impact agricultural education has upon all students regardless of their future aspirations. Results indicated students perceive an added benefit to using animal science to teach basic biology, and feel they are learning science more effectively.

Key Words: Education, Animals, Science

Tuesday, July 26, 2005

SYMPOSIA AND ORAL SESSIONS

Animal Health I

232 Terminal restriction fragment length polymorphism analysis of gastrointestinal bacteria from conventional and segregated early weaned pigs: colonization and succession of putative pathogens and potential direct fed microbials. M. King*[1], D. Brown[2], E. Davis[2], J. Rehberger[1], J. Spencer[3], D. Webel[3], C. Maxwell[2], and T. Rehberger[1], [1]*Agtech Products Inc.*, *Waukesha, WI*, [2]*University of Arkansas*, *Fayetteville*, [3]*United Feeds*, *Sheridan, IN*.

Terminal restriction fragment length polymorphism (T-RFLP) analysis was performed on bacteria colonizing the pars esophagus, duodenum, jejunum, and ileum of conventional (CON) and segregated early weaned (SEW) pigs. This methodology allowed observation of the effects of differing management practices and weaning on community gastrointestinal (GI) flora and monitoring of succession occurrences. Pigs (n=88) were weaned at 19 ± 2 d of age, separated into two groups based on initial BW, and randomly allotted to either the CON or SEW facility. Pigs from each group were divided into four weight groups, allotted into equal subgroups (2-3 pigs/pen) and stratified based on sex and litter. All pigs were fed common diets and managed under similar conditions by separate management personnel for each group. One pig from each weight block was randomly harvested (n=4 per facility), at d 1, 3, 11 and 24 post-weaning. To establish pre-weaning values, pigs (n=4) were also harvested prior to weaning at 7, 14 and 18 d of age for GI section T-RFLP analysis. Data analyses indicate that TRF peaks putatively containing respiratory pathogens such as *Mycoplasma*, *Bordetella*, and those of the *Pasteurellaceae* family (*Actinobacillus*, *Pasteurella*, or *Haemophilus*) or Direct Fed Microbial (DFM) potential Lactic Acid Bacteria (LAB) are often colonizing the pars esophagus ($P \leq 0.05$ or $P \leq 0.10$ depending on organism) during pre-weaning. A variety of pathogens and LAB also appear to be colonizing other GI sections depending on pig age and type of organism. Specific TRFs seem to be key indicators of CON and SEW management practices. The presence of specific pathogen TRFs were positively associated ($P \leq 0.05$) with pigs reared in CON facilities. Certain LAB which were positively associated with pre-weaning colonization ($P \leq 0.05$), persisted in SEW pigs, while negatively correlating to CON reared pigs ($P \leq 0.05$). These data suggest the potential bacterial factors relating to differences between CON and SEW management systems.

Key Words: Swine, Direct Fed Microbial, T-RFLP

233 Herd level risk factors for non-infectious and infectious causes of lameness for Ontario dairy herds. G. Cramer*[1], K. Lissemore[1], D. Kelton[1], C. Guard[2], and K. Leslie[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Cornell University*, *Ithaca, NY*.

Lameness in dairy cattle is one of the most important issues facing the dairy industry, in terms of both production costs and public perception of animal welfare. The objective of this project was to determine the effect of selected risk factors on the prevalence of infectious and non-infectious lameness lesions on dairy farms. A convenience sample of 5 hoof trimmers were trained and asked to record lesions on a standardized form for all cows they trimmed in a herd. In addition, they completed a risk factor questionnaire for each herd. Complete data was collected on 24 free stall herds and 89 tie stall herds, with an average herd size of 50 cows. Average prevalence of infectious causes and non-infectious lameness lesions was 22.9% and 17.9% respectively. The impact of specific risk factors was evaluated using separate linear regression models for infectious and non-infectious lesions and for free stall and tie stall herds. For both infectious and non-infectious lesions, herds housing milking cows in free stalls had a significantly increased prevalence compared to herds using tie stalls. For tie stall herds, the use of wood shavings for bedding and routinely spraying cows feet were associated with an increased prevalence of infectious lesions. However, the use of a total mixed ration was associated with decreased infectious lesion prevalence. For non-infectious lameness lesions in tie stall herds, trimming heifers prior to calving decreased prevalence by 4.6%. Furthermore there was a tendency for higher prevalence with increasing herd size. In free stall herds, using less than 2.5 cm of bedding was associated with a 13.3% increase in non-infectious lesion prevalence. From these results, it is clear that the dairy industry continues to struggle with both infectious and non-infectious lameness lesions. They also illustrate that certain risk factors are associated with considerable effects on prevalence levels.

Key Words: Lameness, Risk Factors, Prevalence

234 Lactate Dehydrogenase and N-acetyl-b-D-glucosaminidase activities in bovine milk as measures of clinical mastitis. M. G. G. Chagunda*, T. Larsen, M. Bjerring, and K. L. Ingvartsen, *Danish Instituite of Agricultural Sciences, Department of Animal Health, Welfare and Nutrition*, *Tjele, Denmark*.

The activities of lactate dehydrogenase (LDH) and N-acetyl-b-D-glucosaminidase (NAGase) and their relationship to somatic cell count (SCC) was investigated in normal and mastitic bovine milk. A full dataset, consisting of records from Danish Holstein (11893 records), Danish Red (13359 records) and Jersey cows (9135 records) on one research farm were utilized in the study. In healthy cows all the three parameters, LDH, NAGase, and SCC started at a high level immediately after calving and decreased to low levels as the lactation progressed. Although on average all three parameters had higher levels at the end, than at the beginning of lactation, NAGase had a substantially higher variation (CV = 73.89%) at the end of lactation (vs. 64.26% at the beginning of lactation). In healthy cows, the correlation among the three parameters was moderate at the beginning of lactation ($r = 0.40$ for LDH vs. SCC, $r = 0.44$ for NAGase vs. SCC, and $r = 0.37$ for LDH vs. NAGase) and low at the end of lactation ($r = 0.40$ for LDH vs. SCC, $r = 0.34$ for NAGase vs. SCC, and $r = 0.11$ for LDH vs. NAGase). In mastitic cows, LDH and NAGase activity rose rapidly from about 8 days before a diagnosed mastitis incidence while SCC rose slowly from about 12 days before diagnosis. LDH had the highest increase in the period prior to diagnosis while SCC had the lowest increase. The relationships among the parameters in milk from mastitic cows were higher than in milk from healthy cows ($r = 0.61$ LDH vs. SCC, $r = 0.53$ NAGase vs. SCC, and $r = 0.43$ LDH vs. NAGase). The results indicate that especially LDH and to some extent NAGase activity in milk can be used as an indicator of clinical mastitis. As biosensor assays for LDH are now becoming available this affords the opportunity for improved, automated, real-time, in-line mastitis detection.

Acknowledgements: This Study was funded by a grant financed by the Directorate for Food, Fisheries and Agri Business, Lattec I/S, Danish Cattle Association and the Danish Institute of Agricultural Sciences

Key Words: Clinical Mastitis, Lactate Dehydrogenase, N-acetyl-b-D-glucosaminidase

235 Acute experimental mastitis perturbs plasma macromineral and α-tocopherol concentrations in early-lactation dairy cows. M. R. Waldron*[1], B. J. Nonnecke[2], R. L. Horst[2], A. E. Kulick[1], and T. R. Overton[1], [1]*Cornell University*, *Ithaca, NY*, [2]*National Animal Disease Center, USDA.ARS*, *Ames, IA*.

Twenty Holstein cows in early lactation (7 days in milk) were administered 100 µg of *Escherichia coli* lipopolysaccharide (LPS) dissolved in 10 ml sterile 0.9% NaCl saline (TRT, n = 10) or 10 ml sterile saline absent LPS (CTL, n = 10) into both right mammary quarters. The hypothesis that acute experimental mastitis would have negative impacts on plasma macromineral and vitamin concentrations that might be important toward the development of metabolic disorders was tested. The CTL cows were pair-fed with an individual TRT cow to account for potential differences in feed intake due to TRT. The TRT cows displayed productive, clinical, and physiological signs of moderate to severe inflammation, whereas CTL cows displayed no signs of immune activation. Relative to the CTL cows, the TRT cows displayed marked decreases in plasma calcium (treatment by time effect, $P < 0.01$) and phosphorus (treatment by time effect, $P < 0.01$) and a significant increase in plasma magnesium (treatment by time effect, $P < 0.01$) concentrations over time following intramammary infusion. Interestingly, the decrease in plasma phosphorus occurred despite very low pre-treatment plasma phosphorus concentrations (2.70 ± 0.26 mg/dl). There were no effects of TRT ($P > 0.20$) on plasma 1,25-$(OH)_2$ vitamin D_3 (87.8 vs. 81.6, SE = 6.5 for TRT and CTL, respectively) or retinol (50.8 vs. 48.0, SE = 1.6 for TRT and CTL, respectively) concentrations; however, plasma α-tocopherol concentration (459 vs. 514, SE = 16 for TRT and CTL, respectively) was decreased by TRT (treatment effect, $P < 0.05$). Acute experimental mastitis altered plasma concentrations of macrominerals and α-tocopherol in this study. These data suggest that immune activation during cases of natural bovine mastitis may be an important factor for metabolic health in early-lactation dairy cows.

Key Words: Mastitis, Minerals, Vitamins

236 Evaluation of the Petrifilm™ Culture System forthe identification of mastitis bacteria as compared to standard bacteriological methods. K. Leslie*[1], M. Walker[2], E. Vernooy[1], and A. Bashiri[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Atlantic Veterinary College, University of Prince Edward Island*, *Charlottetown, Prince Edward Island, Canada*.

Mastitis is a very costly disease that impacts both on-farm economics and milk quality. Identification of the causative mastitis pathogen is a fundamental aspect of udder health management programs. There is an on-going demand for the development of on-farm milk culturing methods for early identification of bacteriological species. Petriflim™ plates are sample-ready selective culture media, which are used for rapid bacteriological isolation and enumeration in the commercial food processing industries. Petrifilm™ products may be useful for on-farm based culture systems that are used to guide treatment decisions, and optimize antibiotic use. The objectives of this project were to determine the test characteristics of Petrifilm™ for the identification of the causative organism in suspected cases of intramammary infection. This study was performed using milk samples from 156 clinical and subclinical mastitis cases in 10 herds in Southern Ontario. Duplicate quarter samples were taken, with one plated immediately, using a single-use plastic pipette, onto each sterile aerobic, coliform, and Staphylococcus Petrifilm plates. The second sample was frozen at -200C and transferred to the Mastitis Research Laboratory, University of Guelph for milk bacteriological culture as the gold standard for calculation of test characteristics.

For each culture result category, the sensitivity, specificity, and predictive values were calculated. Petriflim™ media had a sensitivity for identification of coliforms and Staphylococcus aureus of 93% and 86% respectively. The specificity for coliforms and S. aureus was 86% and 82%, respectively. It is possible that freezing of the samples used for traditional milk bacteriology may have increased the isolation of S.aureus, and decreased the recovery of coliforms, reducing the sensitivity and specificity for each organism, respectively. The Petriflim™ culture system offers considerable potential as an on-farm diagnostic tool for broad classification of the causative organism allowing implementation of appropriate therapy.

Key Words: Bovine, Mastitis, Petriflim

237 Association between local (udder) clinical signs and important outcomes of clinical mastitis episodes in dairy cattle. J. Wenz*, R. Elia, K. Whitman, and F. Garry, *Colorado State University*, *Ft. Collins*.

Clinical mastitis (CM) is the most common infectious disease of dairy cattle and is responsible for significant economic losses. There are many local clinical signs associated with inflammatory changes of the mammary gland during bacterial infection. Treatment and prognosis of CM is often decided based on one or more of these clinical signs; however, there have been no studies evaluating the association of important outcomes associated with CM and the presence of these signs in cows with mild systemic disease. Cows with CM exhibiting mild systemic disease signs (N=240) from a 1500 cow dairy were enrolled in the study. Cows were examined for the presence or absence of firmness and swelling of the affected mammary gland, clots in milk and character of the secretion (thin, thick or serum). Milk culture results and intramammary (IMM) treatment were recorded. Outcomes assessed were need for re-treatment (RTX), recurrent CM episode in the same quarter 15-60 later (RECUR), dried quarter, death or culling and sick pen days (SPD). Data was evaluated using PROC GENMOD and GLM in SAS. RTX occurred in 27% (63/231) and RECUR in 25% (51/206) of CM episodes. Quarter drying and cow culling occurred infrequntly, (5% each) and no deaths occurred. RTX was the only outcome associated with local clinical signs evaluated. RTX was 3.64 (1.32-10.2) times more likely in a cow with serum vs. thin secretion. Cows with swelling were 2.82 (1.06-8.14) times more likely to be re-treated while those receiving pirlymicin IMM were 6.66 (1.99-25.7) times more likely to be re-treated than those who initially received no IMM treatment. Secretion was the only clinical sign affecting SPD. Cows with serum had significantly greater SPD (11.6) than those with Thick (6.9) or thin(7.4) secretions ($P<0.001$). Results suggest serum secretion and swelling of the affected mammary gland was associated with increased re-treatment rate and serum secretion was associated with greater SPD in cows with systemically mild CM.

Acknowledgements: Work supported by dairy producer donations to the Integrated Livestock Mangement Program

Key Words: Mastitis, Clinical signs, Outcomes

238 Plasma paraoxonase could be a good index of liver activity in dairy cows. M. Bionaz*, E. Trevisi, A. Ferrari, and G. Bertoni, *Istituto di Zootecnica, Facoltà di Agraria, U.C.S.C.*, *Piacenza, Italy*.

Seventy Holstein periparturient dairy cows were used to evaluate the relationship between plasma paraoxonase concentration (PON, an enzyme used to diagnose liver activity in humans), inflammatory conditions and liver activity. Blood samples were collected weekly from cows immediately before feeding from -14 to 42 DIM. Plasma was analyzed to obtain metabolic profiles, inflammatory indices (haptoglobin and ceruloplasmin), low (C-LDL) and high (C-HDL) density lipoprotein cholesterol, vitamin A and PON. Milk yield, body condition score (BSC) and health problems were recorded. Cows were retrospectively grouped into quartiles (UP=upper, INUP and INLO=intermediate upper and lower, LO=lower) based on the plasma PON level during the first 30 DIM.

Cows in the LO had more health problems (94%) than the UP group (12%) during first 30 DIM. LO group exhibited lower ($P<0.05$) plasma vitamin A, albumin, total cholesterol, C-LDL and C-HDL, and significantly higher ($P<0.05$) plasma haptoglobin, total bilirubin and globulin than UP group. However, ceruloplasmin, nonesterified fatty acids and betahydroxybutyrate were not differ-

ent. Plasma glucose, urea, Ca, and Mg were lower in the LO than UP group. Cows in the LO group lost more BCS (0.58 vs 0.47 points) and produced less milk (26.4 vs 37.5 kg/d, P<0.01) during the first 30 DIM than the UP group. INUP and INLO groups generally were intermediate in most of the measurements. It appears that PON is negatively correlated with haptoglobin, an inflammatory indicator, and it behaves similarly to the usually synthesized proteins by the liver (albumin, lipoproteins, and retinol binding protein). A reduction of usual liver activity may be diagnosed with PON, based on the results of this study.

Key Words: Paraoxonase, Liver activity, Periparturient dairy cows

239 A model to predict the reproductive status of cattle throughout the reproductive cycle. N. C. Friggens* and M. G. G. Chagunda, *Danish Institute of Agricultural Sciences*, *Tjele, Denmark*.

Time-series models for detecting estrus from milk traits other than progesterone and decision strategies for interpreting progesterone measures exist but a system combining these aspects to predict not just estrus but reproductive status throughout the reproductive cycle is lacking. The objective of this study was to develop such a model on the basis of automated milk progesterone sampling. A number of additional inputs are incorporated, where available, to make use of other known effectors of reproductive performance. These are: days from calving, breed, parity, signs of behavioural estrus, insemination date, pregnancy determinations, energy status, body fatness, milk urea content and reproductive disorders associated with calving. However, the model is designed to be able to function in the absence of all these additional inputs. Progesterone values are smoothed using an extended Kalman filter before entering the biological component of the model. The model predicts the reproductive status of the cow as one of 3 mutually exclusive states: postpartum anestrus (0), estrus cycling (1), and potentially pregnant (2). The other model outputs are: risk of prolonged postpartum anestrus, risk and type of ovarian cyst, onset of estrus, likelihood of a potential insemination succeeding, and likelihood of being pregnant (following estrus) and days to next sample. The model was tested using only daily progesterone data together with insemination records from 285 lactations gathered over 2 years at one research farm. Independent, external, measures of estrus activity were carried out by visual observation for estrus signs and using activity meters. The model performed significantly better than either the visual or the activity meter based external estrus detection. Approximately 1/3 of model-detected estruses were not detected by external estrus detection. Further, the model accurately predicted pregnancy status 21 days post-insemination in 96% of cases. Reproductive status can be accurately predicted from milk progesterone values using a biological model, this has the potential to provide the basis for a useful reproductive management tool.

Key Words: Reproduction, Progesterone, Estrus

240 The effects of glucosamine and chondroitin sulfate on long term cartilage explants. P. S. Chan and M. W. Orth*, *Michigan State University*, *East Lansing*.

Osteoarthritis (OA) is a significant cause of lameness in companion animals. The hallmark characteristic of OA is degeneration of articular cartilage. Glucosamine (GLN) and chondroitin sulfate (CS) are nutraceuticals popular for OA treatment. Our objective was to determine the effects of GLN and CS supplementation on bovine cartilage explants stimulated with interleukin-1 (IL-1) over a 14d period. The genes studied include inducible nitric oxide synthase (iNOS), cyclooxygenase-2 (COX-2), microsomal prostaglandin E2 synthase-1 (mPGEs1), matrix metalloproteinase (MMP)-3, 13, aggrecanase(Agg)-1, 2 and tissue inhibitor of metalloproteinase-3 (TIMP-3). Cartilage explants (6mm discs) were biopsied from carpal joints of 4 Holstein steers. After 24h of adaptation, all discs received their respective treatments, which included either a fetal bovine serum control (Ctrl), IL-1 (50ng/ml), GLN (5µg/ml) + CS (20µg/ml) or IL-1 (50ng/ml) + GLN (5µg/ml) + CS (20µg/ml) (combination) treatment. IL-1 was added only on d2 and 10 for the relevant treatments. Media collected and replaced every other day were analyzed for nitric oxide (NO) and prostaglandin E2 (PGE2; only d4 and 12) release. Explants collected on d6 and 14 were subjected to relative quantitative PCR (Q-PCR). Statistical analysis for NO and PGE2, and Q-PCR data were performed using Proc MIXED and Friedman test of SAS respectively, with significance at P<0.05. The combination reduced cumulative NO release induced by IL-1 into media by 50% and suppressed IL-1 stimulated PGE2 release by 70% on d4. IL-1 induced COX-2 and iNOS transcripts on d6 and 14 were decreased by the combination while mPGEs1 mRNA expression was repressed on d6. On d6 and 14, up-regulated gene expression of MMP-3, MMP-13, Agg-1 and Agg-2 by IL-1 were reduced by the combination. TIMP-3 mRNA was significantly elevated by the combination relative to IL-1 on d6. The reported anti-inflammatory and chondroprotective properties of GLN and CS may be mediated by down-regulation of genes encoding inflammatory mediators and matrix enzymes.

Acknowledgements: TRH122 CS & FCH649 GLN supplied by Nutramax Laboratories Inc.; Grayson-Jockey Club Research Foundation

Key Words: Glucosamine, Chondroitin, Arthritis

241 Performance and health of group-housed dairy calves fed milk automatically verses manually. R. Engelbrecht Pedersen*[1], F. Skjøth[1], J. Tind Sørensen[2], and J. Hindhede[2], [1]*Danish Agricultural Advisory Service*, *Denmark*, [2]*Danish Institute of Agricultural Sciences*, *Denmark*.

Calf performance and health was studied among group-housed calves (n=2535) in 39 commercial Danish dairy farms. Three group housing systems were identified as follows: manual milk feeding indoors (MI), manual milk feeding outdoors (MO), automatic milk feeding (A).

Live weight gain (LWG) was higher among MI calves (745 g/d; P<0.001) and MO calves (762 g/d; P<0.05) than among A calves (583 g/d). Calves in groups with stocking densities, higher than 0.5 calf/m^2 had lower LWG than other calves (P = 0.038). Damp or wet bedding were contributory to lower LWG (P=0.039).

Diarrhea was diagnosed in about 5 % of all the examined calves (A = 4.3%, MI = 5.2%, MO = 3.9%) and was not significantly different between treatments.

Respiratory disease was prevalent in 15 % of all examined calves (A = 28.1%, MI = 11.8%, MO = 9.3%) and was significantly higher among automatically milk fed calves than calves fed manually (P< 0.05). The prevalence of respiratory disease increased, as calves got older (P < 0.001). Calves diagnosed with respiratory disease were more prevalently diagnosed with diarrhea (P = 0.004).

Typically, larger group size, poor hygiene and continuous introduction of animals into automatic milk feeding systems may be contributable to lower LWG and a higher prevalence of respiratory disease than among manually fed calves.

Within all three systems there were large deviations between individual farms. Present results stress the importance of management in general.

Key Words: Calf performance, Group housing, Automatic milk feeding

242 Impact of subclinical metabolic disease on risk of early lactation culling. T. Duffield*, S. LeBlanc, and K. Leslie, *University of Guelph*, *Guelph, Ontario, Canada*.

Two datasets (1995, 1999) each involving approximately 1000 cows and 20 to 25 herds, were evaluated retrospectively. Both studies contained data on metabolic parameters for the 1st week postcalving and disease and culling data for early lactation. The 1999 study also contained precalving serum data. Data was screened using 2X2 tables testing the associations between clinical disease and culling risk in early lactation. All diseases that were associated with culling (P<0.05) were placed with parity in a logistic regression model using the GLIMMIX macro to account for herd clustering. Variables at P>0.05 were then removed in a backward elimination process. In the 1995 analysis there was an association between milk fever, mastitis, displaced abomasum and metritis on the risk of culling by 95 days. In the 1999 study milk fever, mastitis, lameness,

and displaced abomasum were associated with early lactation culling risk. Serum associations with culling were treated in a similar manner as clinical disease. Initially a series of 2X2 tables at various serum cutoff values for nonesterified fatty acids (NEFA), calcium and beta-hydroxybutyrate (BHBA) versus risk of culling were created. The most significant cutoff values were then submitted to final modeling with the previously identified culling models. Precalving serum NEFA ≥ 0.4 in the last week precalving was associated with 2.0 X (P=0.002) increased risk of culling in the 1999 study. Both studies identified a cutpoint of 1.8 mmol/L of serum calcium in the first week postcalving being associated with a 3X increased risk (P < 0.05) of culling after removing all of the clinical milk fever cows. Finally,BHBA ≥ 1400 umol/L was associated with a two-fold increased risk of early lactation culling in both studies. This suggests that high precalving NEFA and both subclinical hypocalcemia and subclinical ketosis are important predictors for the subsequent risk of early lactation culling.

Monitoring and intervention strategies using this information may be helpful in reducing early lactation culling risk.

Key Words: Subclinical, Disease, Culling

Beef Species: Vertical Coordination in the Beef Industry

243 National Animal Identification: An update. V. E. Ragan*, *USDA APHIS*, *Washington, DC*.

A key to safeguarding the Nation's livestock herds from both endemic diseases and the drastic effects of diseases such as BSE, Foot and Mouth Disease and other potential emerging diseases, is to have a national plan in place to identify livestock in a way that will provide rapid traceability. As some disease eradication programs, especially brucellosis, are nearing completion, fewer animals are being identified. Current world conditions which include the possibility of intentional or accidental introduction of foreign animal diseases make it essential that potentially exposed animals can quickly be traced. USDA, APHIS has been working closely with State and industry partners to develop a National Animal Identification System (NAIS). Once fully developed and operational, the goal of the national identification system will be to help USDA and our State and industry partners quickly identify any livestock or agricultural premises exposed to a foreign animal disease or disease of concern so that the disease can quickly be contained and eradicated. The goal of the system is to be able to identify an exposed animal, the herd of origin and all contact herds within 48 hours. An update on the premises behind the development of the system and the current status of the system will be provided.

Key Words: Livestock, Disease, Identification

244 Implications of beef system vertical coordination on animal identification and data handling. D. A. Blasi*, *Kansas State University*, *Manhattan*.

Vertical coordination implies the skillful and effective interaction between the parts of a whole system. Many US Beef value chains were conceived with the initial objective of adding value by differentiating and ultimately creating a branded product. In retrospect, most if not all have encountered numerous challenging issues in pursuit of their quest for the effective interaction between the supply and the demand for their product(s). While integrating the regulatory capacity of animal health is the primary objective of the National Animal Identification System (NAIS), the use of animal identification systems for verifying conformance to a Bovine Export Verification Program set forth by AMS for regaining access to the Asian export market will be the value proposition which will further drive its implementation as a staple process requirement in all segments of US beef cattle production. This accelerated growth of individual animal identification systems will generate significant amounts of data which will need to be synchronized, filtered, analyzed, managed and acted upon in real-time by data mining software and individuals who possess a dual understanding of beef systems production and technology. Ultimately, the resulting information will be used seamlessly throughout a vertically coordinated production system to conduct management and animal health compliance audits, initiate product recall measures and reveal complex biological and economic relationships.

Key Words: Animal Identification, Beef Industry, Information Management

245 Creating systems to produce high quality beef. D. B. Faulkner* and L. L. Berger, *University of Illinois*, *Urbana*.

Changing calving seasons to match forage resources can dramatically reduce cow feed costs. Making this change often requires weaning calves earlier than the traditional 205 days of age. Early weaning can help producers manage forage and feed supplies when: 1) forage supplies are low, such as during a drought, 2) forage is of low-quality, such as pure fescue pastures in mid-summer, 3) winter feed supplies are limited, or 4) Summer calving is initiated to reduce winter feed cost for the cow. Cow reproductive advantages can also be obtained with early weaning. It makes it easier to get thin cows and/or first or second calf heifers bred and the cows enter the winter in good condition. Cow reproduction can be improved by up to 12% when calves were weaned prior to the breeding season. This would result in savings of $15 for each cow in the herd. Early weaning also can offer marketing advantages because a producer may market cull cows that have calved on a better spring or summer market and this system can produce lean, tender, high quality beef to meet consumer demand. Creep feeding is an alternative to early weaning. Creep feeding research has demonstrated that source of creep feed, amount of creep feed consumed, and length of time calves consume creep feed all have an influence on carcass quality grade. Nutritional management had 6 times more influence on quality grade than the calfÃ¢â‚¬â„¢s genetic merit for marbling. However, the effects of high marbling EPDs have been additive with this management system, so both are important. Producers desiring to produce high-quality cattle for the marketplace should consider the breeds they use in their crossbreeding program, the marbling EPD in the bulls, and the management of their calves to get them on a high-energy diet as early as possible. Research shows that carcass fat can be reduced and quality improved by using appropriate management strategies.

Key Words: Systems, Beef

246 Managing a beef production unit as part of a vertically coordinated supply chain. W. L. Mies*, *eMerge Interactive*, *College Station, TX*.

The obvious benefits to being part of a vertically coordinated system have been demonstrated by the Strategic Alliances Demonstration project in 1993 and the growth of the various alliances that have been created in the beef industry. The structure is designed so that the various production units in the supply chain stop competing with each other for whatever profit is available, but rather share the profit that can be made through producing product better suited to consumer needs. This structure takes some of the hills and valleys out of the profit picture, but makes it a more stable vehicle in order to obtain financing. The decreased risk is thus easier to manage. It is the management of a unit of a vertically coordinated supply chain that is of interest today. When producers enter into a vertical supply chain, they are usually those producers with a vision of the future and they are committed to try to find a better way to be a beef producer. Idealism is very strong during the startup of such an effort and it drives many of the early negotiations. As production starts and decisions are made about how animals are bred, raised and marketed, the idealism melts away and pragmatic business concerns enter the relationships. Vertical supply chains will produce an increasingly larger percentage of the beef in the U.S.

over the next several years. These supply chains will be made up of producers who are willing to sacrifice some of their individuality for less stress, and more profit. These producers need to enter into the supply chain arrangements with their eyes open and have realistic expectations for success.

Key Words: Supply Chain, Vertical Coordination, Beef System

Breeding and Genetics: Dairy Cattle Breeding for Non-Production Traits I

247 Detection of QTL affecting mastitis resistance traits and SCS in Canadian Holsteins. J. Moro-Mendez* and J. F. Hayes, *McGill University*, *Ste-Anne-de-Bellevue, QC, Canada*.

The objective of this study was to test for associations of genetic polymorphisms of genes related to immune response (growth hormone (GH), growth hormone receptor (GHR), ornithine decarboxylase (ODC), insuline-like growth factor-1 (IGF-1), adrenocorticotropin hormone (ACTH), corticotropin releasing hormone (CRH), and prolactin (PRL)) with mastitis resistance traits (incidence of clinical mastitis (ICM), occurrence of clinical mastitis (OCM), culling due to mastitis (CDM), and somatic cell scores (SCS)) in first, second and third lactations. Using lactation records of cows enrolled in milk recording in Québec from 1980 to 1994 (411,291 first, 238,432 second, and 130,983 third lactations, respectively) estimated transmitting abilities of traits were generated with a model that included fixed effects of herd-year-season of calving, age at calving, and genetic group, and random effect of sire. 721 bulls which had daughters with lactation records were genotyped for twenty polymorphisms of the above genes located on autosomes (BTA) 5, 11, 14, 19, 20, and 23. Two types of analysis of associations were performed: across-population analysis with a model that included fixed effect of marker and random effect of bull, and within-family analysis with a model that included fixed effects of grandsire, marker nested within grandsire, and random effect of son nested within marker and grandsire. Permutation tests were performed to reduce Type I error probability. Significant associations were found within families for markers of IGF-1 (BTA5), ODC (BTA11), GH (BTA 19), GHR (BTA 20), and PRL (BTA 23) for ICM, OCM, CDM, and SCS in different lactations. Some of these putative quantitative trait loci (QTL) are located on BTA where other authors have reported QTL affecting SCS and udder conformation. The results from this study may contribute to efforts to dissect the genetic basis of mastitis resistance in dairy cattle.

Key Words: QTL Mapping, Mastitis, Dairy Cattle

248 Characterization of FEZL effects on SCS in a sample of North American Holsteins. T. S. Sonstegard*, C. P. Van Tassell, and R. Li, *USDA, ARS, Bovine Functional Genomics Laboratory*, *Beltsville, MD*.

Previous mapping studies using overlayed daughter designs had identified a putative quantitative trait nucleotide (QTN) affecting somatic cell count within the coding region of the forebrain embryonic zinc finger-like (FEZL) gene. Cows inheriting the variant of FEZL with a glycine stretch of amino acids reduced from 13 to 12 amino acids tended to have lower somatic cell counts during first lactation. In order to validate the utility of this potential QTN in selection for dairy health, we conducted a substitution analysis on a sample of North American dairy sires. Bovine sequence traces were obtained for regions of FEZL flanking the QTN. PCR amplicons from genomic DNA were sequenced to design primers to assay QTN genotypes. FEZL QTN genotypes were generated for 2,379 dairy bulls. The deletion variant of FEZL was not identified in a group of influential Jersey sires (N=49). In Holsteins, the allele frequency of the deletion variant was less than 3% (N=2,325). Estimates of allele substitution effect were obtained using MTDFREML with a model that included a polygenic effect and a FEZL genotype effect with daughter deviations for somatic cell score as the phenotypic data. The estimates were based on the differences between estimated genotypic effects of the heterozygote and the common homozygote because only six homozygotes for the deletion variant were observed. The heritability of the trait was estimated to exceed 90%, because the deviations have been adjusted for all non-genetic effects and accumulated across daughters. The estimated allele substitution effects were 0.006, 0.005, 0.018, 0.026, and 0.043 units of SCS for heritabilities of 0.95 (REML estimate), 0.50, 0.10, 0.05, and 0.01, respectively. Previous analyses of the DGAT1 QTN showed allele effects that were much more robust to heritabilities using a similar analysis model. The extreme allele frequency of FEZL may be partially responsible for this phenomenon. Further analysis of this QTN is necessary before selection based on FEZL variants can be recommended.

Key Words: Quantitative Trait Nucleotide, Somatic Cell Score, Cattle

249 Danish Holstein show inbreeding depression for udder health. A. C. Sørensen*[1,2], P. Madsen[1], M. K. Sørensen[1], and P. Berg[1], [1]*Danish Institute of Agricultural Sciences*, *Tjele, Denmark*, [2]*Royal Veterinary and Agricultural University*, *Frederiksberg C, Denmark*.

Inbreeding depression for udder health was estimated using records on clinical mastitis incidence and somatic cell count. Data were selected based on a pedigree completeness index so inbreeding coefficients were reliable. Average inbreeding was above 3%. Four binary mastitis traits were defined. In first lactation the occurrence or not in two overlapping periods were recorded. The first period was from ten days prior to the first calving to 50 days after (CM1S). The second period was from ten days prior to the first calving to 305 days after (CM1L). In second (CM2) and third (CM3) lactations the period was from ten days prior to calving to 100 days after calving. Somatic cell count (SCC) was also included and analysed on the log-scale. At least 140,000 cows with records were included per trait. REML estimates of (co)variance components were obtained in linear sire models. The models were the ones currently used in routine evaluations augmented by linear and quadratic regressions on inbreeding coefficient. Heritabilities of the traits were all in the range of previously published results. Inbreeding significantly affected all traits investigated. Three traits, CM1L, CM3, and SCC, showed a non-linear relationship between phenotype and inbreeding coefficient. Comparing cows with 5% inbreeding to cows with 2% inbreeding (with standard errors in brackets), SCC increased with 1500 (290) cells/ml in first lactation, well in the range of previously published estimates, and the incidence of mastitis increased by 1.08 (0.26), 0.55 (0.14), and 0.98 (0.48) percentage points in first, second, and third lactation, respectively. The corresponding reduction in net return over three lactations comprised to approximately 10 USD under Danish production conditions.

Key Words: Inbreeding Depression, Mastitis, Somatic Cell Count

250 Effects of ancestral consanguinity on inbreeding depression for yield traits and somatic cell score in Jersey cows. D. Gulisija*, D. Gianola, and K. A. Weigel, *University of Wisconsin*, *Madison*.

Inbreeding depression can be reduced (purged) via selection against deleterious mutants. Inbreeding exposes recessive or semi-recessive mutants, giving an opportunity for selection to act. Therefore, inbreeding depression may be lesser in descendants of inbred ancestors than in inbred contemporaries without inbred ancestors. An Index of Opportunity for Purging (*I*) was developed to evaluate whether or not ancestral inbreeding attenuates inbreeding depression for a quantitative trait. In *I*, each instance of ancestral inbreeding, measured by the inbreeding coefficient (F), is weighted using an estimated genetic contribution of an ancestor to an animal's genome. *I* ranged between 2.8 and 25.6, with a mean of 8.65. First-lactation milk, fat, protein and somatic cell score (SCS) records from 59,778 US Jerseys were used in a two-stage analysis. First, predicted re-

siduals from an animal model (EBLUP) were calculated for each trait; the linear model included fixed herd-year-season, age at calving and days in milk effects, and random additive genetic effects. Second, models with F and *I* of each animal as predictor variables were fitted to the EBLUP residuals, for each trait. Statistical tests indicated that ancestral inbreeding, as measured by *I*, significantly reduces the negative effect of inbreeding by 4.13 kg for milk and 0.16 kg for protein yield per unit of *I*. No evidence of purging was found for fat yield, and SCS was not affected by inbreeding.

Key Words: Inbreeding Depression, Purging

251 Between-founder heterogeneity in inbreeding depression for production and somatic cell score in Jersey cows. D. Gulisija*[1], D. Gianola[1], K. A. Weigel[1], and M. A. Toro[2], [1]*Department of Dairy Science, University of Wisconsin-Madison*, [2]*Departamento de Mejora Genética y Biotecnolog$|iacute;a, INIA*, *Madrid, Spain*.

Severity of inbreeding depression depends on the genetic load carried by a population. If the load is distributed unevenly among founder genomes, descendants from different founders will be differentially affected by inbreeding. Between-founder heterogeneity in inbreeding depression for production traits and somatic cell score in milk (SCS) was studied using records from 59,788 Jersey cows. Inbreeding coefficients (F) were partitioned into components due to four founders, plus a remainder. A two-stage analysis was performed. First, empirical best linear unbiased predictions (EBLUP) of residuals for milk, fat and protein yield, and for SCS, were computed using linear models including fixed effects of herd-year-season, age at calving and days in milk, and random additive genetic effects of cows. Second, models with total and partial inbreeding coefficients as predictor variables were fitted to EBLUP residuals, by trait. Tests of differences between slopes indicated that regressions of milk, fat and protein yield on partial inbreeding coefficients were heterogeneous; SCS did not exhibit inbreeding depression. Hence, alleles contributing to inbreeding depression for production in this Jersey population seem to derive from specific founders. This indicates that a homogeneous effect of inbreeding on production may be an incorrect statistical specification in genetic evaluation models that attempt to account for inbreeding depression.

Key Words: Inbreeding Depression, Between-Founder Heterogeneity

252 Variance components of test-day milk, fat, and protein production, and somatic cell score from all parities of dairy cows in South-eastern Sicily estimated with a random regression model. A. P. W. De Roos*[1], M. H. Pool[2], M. Caccamo[3], G. Azzaro[3], J. D. Ferguson[4], and G. Licitra[3], [1]*NRS, Arnhem, The Netherlands*, [2]*Animal Sciences Group*, *Lelystad, The Netherlands*, [3]*CoRFiLaC*, *Regione Siciliana, Ragusa, Italy*, [4]*University of Pennsylvania*, *Kennett Square*.

Consorzio Ricerca Filiera Lattiero-Casearia (*CoRFiLaC*) aims to develop management figures for dairy farmers with respect to milk production, nutrition, cow health, and farm economics. A proper statistical analysis of milk production records with a random regression test-day model may help to identify problems in herds and cows that need the farmer's attention. The aim of this study was to estimate the variance components of test-day milk, fat, and protein production, and somatic cell score (SCS) records of Sicilian dairy cows in the Ragusa area. The data set comprised 491,426 test-day records from 18,953 cows on 285 herds. Parity was between 1 and 13, and days in milk (DIM) between 5 and 450. Variance components were estimated with a multi-lactation, random regression, test-day animal model. The model comprised four fixed effects and a random herd x test date effect. Random regressions were included for herd x year of test, animal additive genetic effect, common permanent environment and lactation specific permanent environment, using fourth-order Legendre polynomials. The permanent environmental effect was split into a common and a lactation specific part to enable the inclusion of records from all parities. Parameters were estimated with a Bayesian analysis using Gibbs sampling. Heritabilities for test-day production increased from around 0.20 at DIM 5 to around 0.30 at DIM 365, whereas heritabilities of test-day SCS were between 0.12 and 0.20. The correlations of the herd effects between DIM 5 and DIM 365 were around 0.60, indicating differences in persistency across herds. In contrast with production traits, herd variances of SCS were much lower than variances of cow effects. The estimated variance components will be used for routine evaluation of Sicilian dairy cows, with the purpose to present management figures on the herd or cow level.

Key Words: Random Regression, Test-Day Production, Dairy Cattle

Forages and Pastures: Beef Cattle and Pastures

253 Timing of herbage allocation 1. Effect on daily grazing pattern of beef heifers. P. Gregorini*[1,2], M. Eirin[1], R. Refi[1], M. Ursino[1], R. Flores[2], and O. Ansin[2], [1]*FCAyF Universidad Nacional de La Plata*, *La Plata, Buenos Aires, Argentina*, [2]*University of Arkansas*, *Fayeteville*.

Timing of grazing events (GE) determines how ruminants allot grazing to meet nutritional needs. Photosynthesis and respiration increases herbage DM and soluble carbohydrates concentrations daily, which may facilitate longer and intense GE at dusk. Linking the grazing pattern (GP) and the plant phenology with the time of herbage allocation (HA) emerges as an option to manipulate length and intensity of the GE. Herein, we analyzed the Spring daily GP of eight beef heifers in a crossover design. Heifers grazed annual ryegrass pastures using strip grazing. Behavioral activities of each heifer were recorded every 2 min, from 0600 to 1900 (total) and categorized into three intervals (morning, afternoon and evening) to determine time (minutes) of grazing (GT), rumination (RT), and idling (IT) along with bite rate (BR) at each time, when HA was allotted in the morning (0700; MHA) or afternoon (1500; AHA). An interval x HA affect was observed for GT, RT, IT and BR (Table). The AHA increased total IT (253 vs 213, P<0.01) and decreased GT (277 vs 331, P<0.01), concentrating GT in the evening, when BR was higher. The RT varied by time of the day, but total did not (166 AHA vs 152 MHA). With AHA, RT and IT were concentrated in the morning and afternoon. The time of HA alters the way heifers allot GT, RT and IT; AHA generates longer and more intense GE when herbage has higher quality.

	AHA				MHA			
Treatment/Time of the day[a]	GT	RT	IT	BR, bites/min	GT	RT	IT	BR, bites/min
Morning 0600 to 1000	80.5[b]	84.2[b]	95[b]	26.4[b]	119.2[c]	44[c]	75[d]	34.5[d]
Afternoon 1100 to 1400	57.2[c]	63[c]	108[c]	32.7[c]	80[b]	76[d]	76[d]	30.3[c]

[a]Minutes [b]-[e]Means in the same rows or columns with different superscripts differ (P < 0.001).

Key Words: Herbage Allocation, Beef Heifers, Grazing Behavior

254 Timing of herbage allocation 2. Effect on beef heifer weight gain, body condition score and daily herbage intake. M. Eirin[1], P. Gregorini*[1,2], C. Masino[1], R. Refi[1], M. Ursino[1], and O. Ansin[1], [1]*FCAyF Universidad Nacional de La Plata*, *La Plata, Buenos Aires, Argentina*, [2]*University of Arkansas*, *Fayeteville*.

The longer and most intensive meal of grazing ruminants occurs at dusk when herbage has an increased DM and soluble carbohydrates concentration. Thus, linking the daily grazing pattern, phenology of the plant, and changes of fresh herbage allocation (HA) emerges as a management tool to manipulate the pattern of nutrient intake of grazing ruminants. The aim of this work was to assess total weight gain (TWG), daily weight gain (DWG), change in body condition score (CBCS), and estimate herbage intake (HI) when HA was allotted in the morning (0700; MHA) or afternoon (1500; AHA). This experiment occurred in October, 2004; at the University of La Plata. Forty beef heifers were randomized across two treatments during one measurement period of five weeks, in a completely randomized design. They grazed annual ryegrass pastures using strip grazing. Heifers were weighed and evaluated for BCS (1 to 5 scale) weekly. Herbage intake was estimated weekly by measuring herbage offered and refused. Total weight gain and HI were tested by ANOVA and DWG and CBCS were analyzed as repeated measured in time; interactions between week x treatment were analyzed. The TWG (40.5 Kg AHA vs. 20.2 Kg MHA, $P < 0.001$), DWG ($P < 0.001$) and CBCS ($P < 0.02$) differed between treatments. Heifers in AHA gained 580 g (1.14 AHA vs. 0.56 MHA kg) and 0.012 points of body condition score more daily. Since herbage intake did not differ between treatments (5.62 AHA vs. 5.03 MHA; $P > 0.05$), nutrient intake may be higher in AHA. Therefore, the allocation of the new strip in the afternoon may increase animal performance.

Key Words: Time of Herbage Allocation, Beef Heifers, Performance

255 Fatty acid composition in subcutaneous and intramuscular fat of steers grazing pasture supplemented with corn oil. E. Pavan*[1,2] and S. Duckett[1], [1]*University of Georgia*, *Athens*, [2]*Instituto Nacional de Tecnología Agropecuaria*, *Balcarce, Bs. As., Argentina*.

To evaluate the effect of increasing corn oil (55.3% linoleic acid) supplementation of grazing steers on fatty acid (FA) composition, subcutaneous (s.c.) and intramuscular (i.m.) (longissimus at the 13th rib) samples were taken from the left side of the carcass of 18 steers. Steers were finished on a rotationally grazed tall fescue pasture for 117 d. Corn oil was supplemented at 0, 0.075 and 0.15% BW. Cottonseed hulls were used as a carrier for the corn oil and supplemented according to pasture availability (0.7 to 1% BW). Fatty acid composition was determined by GLC. A completely randomized design with a 3 oil level × 2 tissues factorial arrangement was used for data analysis. Linear and quadratic oil effects were tested. Saturated FA (SFA) tend to be higher in s.c than in i.m. fat ($P<0.08$), whereas monounsaturated FA (MUFA) and PUFA were lower ($P<0.01$) in s.c than in i.m. fat. Myristic acid was ($P<0.01$) higher in s.c. than in i.m., palmitic and stearic acids were not different ($P>0.44$). Trans-11 vaccenic acid and also CLA c9, t11 were higher in s.c. than in i.m ($P<0.01$). The percentages of n3, n6 and its ratio were lower in s.c. than in i.m. fat ($P<0.01$). Corn oil supplementation generated a quadratic decrease ($P<0.01$) of myristic acid and linear ($P<0.01$) of palmitic acid, but not of stearic acid ($P>0.10$). Total SFA tended to decrease linearly with increasing oil supplementation ($P=0.10$). A linear decrease was observed for palmitoleic acid ($P = 0.02$). Oleic and linoleic acids were not affected by oil supplementation ($P>0.10$). Linolenic acid was affected by treatments, decreasing linearly with increasing oil level ($P<0.01$); whereas other PUFA were not changed ($P>0.10$). PUFA, n6 and n3 proportion were not affected by oil level ($P > 0.10$). Both, trans-11 vaccenic acid and CLA c9, t11 showed a quadratic increase as oil level increased ($P<0.01$). The ratio n6:n3 increased linearly ($P<0.01$) with oil level. Corn oil supplementation to grazing steers reduced the high atherogenic myristic and palmitic acids concentration and increased the anticarcinogenic trans-11 vaccenic acid and CLA c9, t11 concentration.

Key Words: Pasture, Corn Oil, Fatty Acids

256 Corn oil supplementation to pasture fed steers: *in vivo* digestibility, performance and carcass traits. E. Pavan*[1,2], S. Duckett[1], and J. Long[1], [1]*University of Georgia*, *Athens*, [2]*Instituto Nacional de Tecnología Agropecuaria*, *Balcarce, Bs. As., Argentina*.

Eighteen Angus steers (438 ± 4kg) rotationally grazing endophyte free tall fescue (15.3 ± 0.6% PB, 61.4 ± 1.0% NDF and 1.7 ± 0.1% fatty acids) were supplemented during 117 days either 0, 0.075 or 0.15% BW of corn oil under a completely randomized design to study the effect of oil level on in vivo digestibility, performance and carcass traits. Cottonseed hulls were used as a carrier for the corn oil and supplemented according to pasture availability (0.7 to 1% BW). Chromic oxide (slow release boluses, CAPTEC®) and INDF were use as markers to estimate forage intake and in vivo total diet digestibility. Live weights (LW), ultrasound s.c. fat thickness (FT) and ribeye area (REA) were measured at different times during the supplementation period and evaluated as repeated measurements. Initial weight was used as a covariate, when significant. At the end of the supplementation steers were slaughtered and carcass traits evaluated. Pasture and total DM intake were linearly depressed ($P < 0.01$), and total fatty acids intake linearly increased by oil level ($P < 0.01$; 0.08, 0.13 and 0.16 as %BW for 0, 0.075 and 0.15% BW of supplemented oil, respectively). There was negative linear effect of corn level on the in vivo organic matter and NDF digestibility ($P < 0.01$). However, no interaction or oil level effects were significant ($P > 0.10$) for LW, ultrasound s.c. or REA. Live weight, ultrasound s.c. and REA increased ($P < 0.01$) over time and were 532 ± 3 kg, 0.59 ± 0.04 cm and 67.3 ± 1.2 cm^2 at the end of the trial. Weight gain tended to increase linearly in response to oil level ($P = 0.08$). Dressing percentage ($P = 0.09$), carcass weight ($P = 0.01$) and s.c. fat ($P = 0.01$) increased linearly with oil supplementation. No treatment effect was observed for carcass REA, KPH fat percentage, marbling score or yield grade ($P > 0.10$). These results show that, although corn oil supplementation depressed total intake and digestibility of pasture finished steers, performance was not negatively affected, but carcass weight and s.c. fat thickness improved.

Key Words: Oil Level, Pasture, Supplementation

257 Effects of winter stocker growth rate and finishing diet on beef rib composition and color. R. N. Sonon, Jr.*[1], S. K. Duckett[1], J. Neel[2], C. Realini[1], J. Fontenot[3], and W. Clapham[2], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS*, *Beaver, WV*, [3]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Angus-cross steers (n=68, year 1; n=63, year 2; n=67 year 3) were used in a three-year study to assess the effects of winter stocker growth rate (LOW, MED, or HIGH) and finishing diet (corn silage-concentrate, CONC or pasture, PAST) on rib composition and color. The steers were slaughtered in a commercial meat plant and ribs (IMPS 107) from each carcass were removed, vacuum-packaged and shipped to the University of Georgia Meat Science Technology Center. At 14-d postmortem, the ribs were unpacked and allowed to bloom for 30 min prior to reading objective color score, L* (lightness), a* (redness), and b* (yellowness) in the exposed longissimus (LM) and subcutaneous (s.c.) fat using a Minolta colorimeter. The 9-10-11th rib section was then removed and separated into LM, s.c. fat, lean-trim, seam fat, and bone. The percentage of s.c. fat differed between years and was greater ($P < 0.01$) for CONC than PAST (13.57% vs 7.90%) whereas, PAST was higher ($P < 0.01$) than CONC in percentages of LM (28.94% vs 26.49%) and lean-trim (26.63% vs 21.32%). Seam fat percentage in year 1 for steers at LOW was similar to HIGH but was greater ($P < 0.01$) than MED, while in year 3, steers at MED and HIGH had larger ($P < 0.05$) proportions than those at LOW. Percent seam fat did not differ between growth rates in year 2. Percent bone of steers at HIGH was similar to MED but was higher ($P < 0.05$) than those at LOW in years 1 and 2. The proportion of bone was similar between growth rates on the third year. Longissimus muscle was lighter ($P < 0.01$; L* 42.1 vs 38.9), redder ($P < 0.01$; a* 25.0 vs 23.2) and yellower ($P < 0.01$; b* 11.8 vs 10.7) for CONC than PAST. Subcutaneous fat was yellower ($P < 0.01$; b* 17.4 vs 13.8) and darker ($P < 0.01$; L* 74.9 vs 77.0) for PAST than CONC. Total rib weight and weight of the 9-10-11th rib section was greater for CONC than PAST, however, about 62% of the difference was accounted for by higher proportions of s.c. and seam fat in CONC.

Key Words: Stocker Growth Rate, Finishing Diet, Rib Composition and Color

258 Cow-calf performance on Coastal or Tifton 85 pastures with access to aeschynomene for creep grazing. V. A. Corriher*[1], G. M. Hill[1], J. G. Andrae[2], M. A. Froetschel[1], and B. G. Mullinix, Jr.[1], [1]*University of Georgia*, *Tifton*, [2]*University of Georgia*, *Athens*.

Summer grazing cow and calf performance was determined in a replicated 2 X 2 factorial experiment using Coastal (C) or Tifton 85 (T85) bermudagrass pastures (4 pastures each; 4.86 ha) without or with aeschynomene creep grazing paddocks (n= 4; 0.202 ha; planted in May, 2004, 13.44 kg/ha). On June 10, 2004, 96 tester winter-calving beef cows and their calves were grouped by cow breed [9 Angus (AN), 3 Polled Hereford (PH)/group], initial cow BW (579.2 ± 75.3 kg), age of dam, calf breed (AN, PH or AN X PH), calf sex, initial calf age (113 ± 19.6 d), initial calf BW (155.1 ± 32.3 kg), and randomly assigned to pastures. Additional cow-calf pairs and open cows were added as grazers as forage increased during the season. Forage mass from each pasture was estimated using bi-weekly ground-level samples averaged for the 91-d grazing period. Animal unit equivalents (AU) were computed for cows and calves. Main effect interactions did not occur ($P > 0.10$) for variables, and least squares means were adjusted for significant covariate effects of calf birthweight, breed, sex, initial BW for calves; and, cow breed, calf breed and cow age for cow data. Weaning weights (Calf BW Sep 9) were further adjusted to 205 days of age and for sex and dam age adjustments of Beef Improvement Federation, and adjusted for appropriate covariate effects. Cow and calf performance were improved and cow stocking rates (SR) were higher for Tifton 85 pastures. Calves with access to aeschynomene creep grazing paddocks had higher ADG and weaning weights. Forage mass was abundant throughout the study, and tended to be higher for T85 pastures.

	Pasture		Creep grazing			Probability, $P <$	
Item	C	T85	Without	With	SE	Pasture	Creep
Calf BW Sep 9, kg	227.5	241.5	230.7	238.3	1.72	0.01	0.06
205-d BIF adj. BW, kg	239.0	242.1	241.4	248.8	2.49	0.01	0.06
Calf 91-d ADG, kg	0.80	0.96	0.84	0.92	0.02	0.01	0.06
Calf gain, kg/ha	215.4	243.0	221.5	237.4	6.88	0.07	0.20
Cow 91-d ADG, kg	0.06	0.17	0.04	0.18	0.02	0.01	0.01
Cow gain, kg/ha	17.3	63.1	19.8	60.4	9.07	0.05	0.06
Cow SR/ha	3.13	4.23	3.86	3.49	0.10	0.01	0.08
AU, cows/ha	4.08	3.84	3.89	4.03	0.04	0.05	0.05
Forage mass, kg DM/ha	6984	7775	7301	7459	223.0	0.10	0.66

Key Words: Forage, Bermudagrass, Calf

259 Coastal, Russell, and Tifton 85 bermudagrass hay and supplement intake and digestion by steers. G. M. Hill*[1], J. G. Andrae[2], B. C. Hand[1], and B. G. Mullinix, Jr.[1], [1]*University of Georgia*, *Tifton*, [2]*University of Georgia*, *Athens*.

Coastal (C), Tifton 85 (T85) and Russell (R) bermudagrass hays (H) harvested at 5-wk maturity were fed without or with a supplement (SUP) to steers to determine DMI and digestibility. Hays were third harvest, and had been fertilized 35 d before harvest (84 kg N/ha). Beef steers (n = 36; age = 11 mo; BW = 284.4 ± 12.6 kg) were randomly assigned to treatments (TRT) in a 3 X 2 factorial experiment. Steers had recently completed a similar experiment; therefore, steers were individually-fed C, T85 and R hays free-choice for 17d, without or with a SUP (1.78 kg DM/d; 24.4% CP; 32.8% soybean meal, 67.2% ground corn, DM basis). Steers not fed the SUP were fed corn at 0.20 kg DM/d. Chromic oxide was fed in corn and SUP (10 g/steer daily, d 8 to d 17) as indigestible marker, and fecal samples (12/steer; d 8 to d 18) were analyzed for Cr and nutrients. Hay DM, CP, ADF, and NDF (%, DM basis), respectively, were: C = 90.8, 12.0, 39.2, 76.4; T85 = 91.4, 12.6, 39.9, 75.6; R = 91.3, 15.1, 38.8, 75.4, and all diets provided 12.0 to 15.6 % CP in DM. Least squares means for hay DMI, total dietary DMI (TDMI), and digestion coefficients (DC; Table) were adjusted for steer initial BW. Hay DMI and total DMI were each higher ($P <$ 0.01) for C than R and T85, and DMI was higher ($P < 0.01$) with SUP than without SUP. Digestion of OM, CP, ADF and NDF were lower for R than C and T85 without SUP, but with SUP digestion of these components for R increased to levels similar to C and T85, creating H X SUP interactions. Although similar in composition, R hays had lower DMI and digestibility, but digestion of R was improved greatly by SUP feeding, which supplied additional energy that compensated for low fiber digestion of this hay.

	Without SUP			With SUP				H x SUP
Item	C	R	T85	C	R	T85	SE	$P <$
Hay DMI, kg	4.15	3.40	3.61	4.38	3.58	3.45	0.18	0.53
TDMI, kg	4.35	3.60	3.81	6.15	5.36	5.22	0.18	0.53
OM DC, %	73.0	54.4	70.6	77.0	74.6	77.7	2.76	0.02
CP DC, %	76.9	67.6	70.3	65.1	66.4	58.7	2.76	0.10
ADF DC, %	67.0	43.1	67.4	65.7	60.9	68.8	3.79	0.04
NDF DC, %	70.6	49.4	68.3	67.0	64.1	70.0	3.34	0.03

Key Words: Steer, Hay, Digestion

260 Effects of winter stocker growth rate and finishing diet on beef longissimus fatty acid composition. R. N. Sonon, Jr.*[1], S. K. Duckett[1], J. Neel[2], C. Realini[1], J. Fontenot[3], and W. Clapham[2], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS*, *Beaver, WV*, [3]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Longissimus muscle (LM) of Angus-cross steers (n=68, year 1; n=63, year 2; n=67, year 3) was assayed to determine the effects of winter stocker growth rate (LOW, MED, or HIGH) and finishing diet (corn silage-concentrate, CONC or pasture, PAST) on total lipid content and fatty acid composition. Total lipids were extracted by organic solvents and fatty acid composition was determined by GLC. Total LM lipid content was greater ($P < 0.01$) for CONC than PAST (4.0% vs 2.3%) and was higher ($P < 0.01$) in years 1 and 3 than year 2. Regardless of year and growth rate, LM trans vaccenic acid (C18:1t11) concentration was higher ($P < 0.01$) for PAST than CONC except for steers grown at LOW in year 2. The PAST LM CLAc9t11 concentration was higher by about 100% than in the LM of CONC. Total saturated fatty acids concentration in LM tended to be greater ($P = 0.06$) for steers on PAST than on CONC and was higher ($P <$ 0.01) in year 1 than years 2 and 3. Monounsaturated fatty acids (MUFA) concentration was higher ($P < 0.01$) in the LM from year 1 than year 2 but similar to year 3. Between growth rates, LM MUFA of steers grown on HIGH rate was greater ($P = 0.01$) than those on LOW but was similar to those on MED. Steers finished on CONC had greater ($P < 0.01$) LM MUFA concentration than PAST. In years 1 and 2, LM total omega-6 fatty acids concentration did not differ between growth rates but was greater ($P < 0.01$) for steers at LOW than those on HIGH in year 3. Omega-6 fatty acids concentration was higher ($P = 0.042$) in the LM of CONC than PAST when steers were grown at LOW but was unaffected by diet when stockered at MED or HIGH. Total omega-3 fatty acids concentration was higher ($P < 0.01$) for PAST than CONC in all years. Omega-6 to omega-3 fatty acids ratio in the LM was lower ($P < 0.01$), thus more desirable for human health. Pasture finishing systems produced leaner beef with greater concentration of CLA and omega-3 fatty acids.

Key Words: Stocker Growth Rate, Finishing Diet, Fatty Acids

261 Volatile flavor compounds in beef from cattle finished on pastures or concentrates. S. Duckett*[1], J. Neel[2], W. Clapham[2], and J. Fontenot[3], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS*, *Beaver, WV*, [3]*Virginia Polytechnic and State University*, *Blacksburg*.

Angus-cross steers (n = 68) were stocked at three growth rates (LOW, MED or HIGH) during the winter months prior to finishing on pasture (PAST) or corn

silage-concentrate diet (CONC) to assess differences in volatile flavor compounds as influenced by finishing system. Ribeye steaks were broiled to an internal temperature of 71°C and served to an eight member sensory panel for determination of off-flavor intensity (0 = none; 8 = intense). Sensory off-flavor ratings were averaged for each steak and ranked from highest to lowest by finishing treatment. A sub-sample (n = 20) was selected based on sensory off-flavor ratings to represent lowest (LOW) and highest (HIGH) off-flavor scores for each finishing treatment. Steaks were broiled, cut into cubes, and samples (2.5 g, in duplicate) taken immediately for static headspace analyses by GLC. Flavor compounds reported to impact meat flavor were identified based on retention time. Data were analyzed with finishing treatment, off-flavor score and interaction in the model. Total peak area of all flavor compounds and total aldehydes did not differ due to dietary treatment, off-flavor score, or their interaction. Hexanal, an oxidation product of linoleic acid, was present in greater ($P < 0.05$) amounts for CONC than PAST, regardless of off-flavor score. 2-Methyl propanal was present in greater ($P < 0.01$) concentration for PAST than CONC, regardless of off-flavor scores. Volatile flavor compounds did not differ between steaks of LOW or HIGH off-flavor scores but several interactions between dietary treatment and off-flavor were detected. Propanal peak area was greater ($P < 0.05$) for PAST-HIGH than PAST-LOW or CONC-HIGH. Three unidentified peaks were greater for CONC-HIGH than CONC-LOW and PAST. One unidentified peak, peak 48, was present in higher ($P < 0.01$) amounts for PAST-HIGH than PAST-LOW and CONC. Equations developed to predict off-flavor score using stepwise regression included unidentified peak 48, octanal, and propanal, and explained 31% of the variation in off-flavor scores.

Key Words: Beef, Pasture, Off-flavor

262 Using stockpiled non-toxic endophyte-infected tall fescue to develop beef heifers in the Piedmont of North Carolina. E. J. Oliphant*, M. H. Poore, J. T. Green, and M. E. Hockett, *North Carolina State University*, *Raleigh*.

A 2-yr grazing study was conducted from Dec to Feb of 2002-2003 and 2003-2004. The objective of this study was to evaluate Jesup non-toxic endophyte-infected fescue (EN) compared to endophyte-infected (E+) and endophyte-free fescue (E-) from an animal performance and agronomic persistence standpoint. Forty-eight (yr 1) and 60 (yr 2) Angus X heifers were grazed on E+, E- or EN for 70 d in yr 1 and 86 d in yr 2. Plots were established in the autumn of 1999 and averaged 1.01 ha. Plots were clipped in Aug and fertilized in Sept with 95 kg/ha (yr 1) and 84 kg/ha (yr 2) 30% liquid N. Heifers were allocated fresh forage daily in a stripgrazing system. Forage quality did not differ by treatment (trt) but was higher in yr 1 than in yr 2 (IVTDMD 80% yr 1, 65% yr 2; $P < 0.01$). Crude protein tended to be greater in yr 1 (10.9%) than in yr 2 (9.74%; $P = 0.08$). Average daily gain did not differ by trt but was higher during yr 2 than yr 1 (0.48 kg/d yr 2, 0.40 kg/d yr 1; $P = 0.03$). Serum urea N concentrations did not differ by yr or trt but there was a yr by trt interaction ($P = 0.02$). Serum urea N was below 8.14 mg/dL both years, suggesting CP deficiency. Serum progesterone levels indicated that trt and yr did not affect estrous cycles. Area grazed was greater both years for E- (0.87 ha yr 1, 0.66 ha yr 2) than for E+ (0.68 ha yr 1, 0.56 ha yr 2) or EN (0.71 ha yr 1, 0.58 ha yr 2; $P = 0.01$). Non-fescue plants in the sward was greater for E- (18.9% yr 1, 25.0% yr 2) than E+ (12.2% yr 1, 13.1% yr 2) or EN (12.5% yr 1, 15.9% yr 2; $P = 0.02$). Total forage mass was lower both years for E- than E+ or EN ($P = 0.05$). The percentage of total fescue that was green was greater in yr 1 (66.5%) than in yr 2 (51.8%), but did not differ by trt. Results indicate E+ may not negatively affect animal performance when stockpiled and stripgrazed in the piedmont of North Carolina over the winter. EN appears to have agronomic persistence equal that of E+ and may provide a viable alternative to E+ and E-.

Key Words: Stockpiled Tall Fescue, Beef Heifers, Endophyte

263 Effect of condensed corn distiller soluble supplementation on the fatty acid composition of ribeye steaks from pasture-fed and feedlot steers. H. Koknaroglu*[1], P. Tsengeg[2], T. Knight[2], D. Beitz[2], and P. Hoffman[2], [1]*Suleyman Demirel University*, *Isparta, Turkey*, [2]*Iowa State University*, *Ames*.

A grazing and feedlot finishing trial was conducted to compare the effects of condensed corn distiller solubles (CCDS) on the fatty acid composition of ribeye steaks from steers. Calves (n=112) were weighed and assigned to four treatments group by weight and color pattern. Treatments one (TRT1) and two (TRT2) was rotational grazing (May-September) followed by chopped alfalfa hay and corn (TRT1) or corn stalks and CCDS (TRT2) during the feedlot finishing period. Treatments three (TRT3) and four (TRT4) were fed in the feedlot from May until harvested. TRT3 included chopped alfalfa hay and corn, and TRT4 included corn stalks and CCDS. Cattle were weighed every 28 days and, when cattle reached an average of 586 kg of liveweight, they were harvested. Ribeye steaks were removed from the carcasses and were transferred to the laboratory for analysis. Lipid was extracted and methylated for analysis by gas chromatography. TRT4 caused a greater CLA content in ribeye steaks than did the other treatments ($P<0.05$). TRT1 caused a lesser CLA content than did TRT2 ($P<0.05$). TRT4 caused a greater concentration of trans-vaccenic acid than did the other treatments ($P<0.05$). TRT4 caused a greater total saturated fatty acid content and a lesser total monounsaturated fatty acid content than did TRT1 and TRT3. Polyunsaturated fatty acid content of beef did not differ among treatments. Atherogenic index did not differ among treatments, even though TRT4 caused a numerically greater score ($P>0.1$). Results showed that providing condensed corn distiller solubles into the diet of pasture-fed cattle increases the CLA content of beef.

Key Words: Cattle, Feedlot, CCDS

264 Characterization of protein degradability and diet nutritive value of beef cows grazing native range in eastern colorado. V. A. Aznarez*, J. C. Whittier, T. E. Engle, P. A. G. A Sampaio, and W. S. Mackay, *Colorado State University*, *Fort Collins*.

Our objective was to determine the nutritive value, characterize the protein degradability, and determine the effects of seasonal changes on diets consumed by cows grazing on Eastern Colorado rangelands. Nutrient content of diets was determined from grab-samples collected from 3 fistulated cows, using the rumen evacuation technique. Samples were collected 2x/mo in spring (**SP**) and summer (**S**), and 1x/mo in fall (**F**) and winter (**W**), over a 3 yr period (Oct. 1999-Sep. 2002). Forage availability was determined as adequate by ocular assessment. Ingested forage was analyzed for CP, NDF, ADF, ADL, EE and AIA. *In situ* neutral detergent insoluble nitrogen kinetics of digestibility were determined. Microbial yield was calculated from: Bacterial CP (**BCP**)=2.619948 +1.782321X -0.095981X^2 +0.001777X^3 -0.000010524X^4 (X = %TDN). No interaction between collection-cow and season or yr was found ($P>0.05$). Proximal analysis data showed no difference between yr 1 (**Y1**) and 2 (**Y2**; $P>0.05$). Values for NDF and ADF on yr 3 (**Y3**), were higher than those for Y1 and 2 in early-S and SP, but lower in F ($P<0.05$). Levels of CP in F were higher for Y3 (14.1 ± 1.06%DM) with respect to Y1 and 2 (10.4 ± 1.49 and 9.2 ± 1.48%DM respectively, $P<0.05$), but lower in SP (Y1=15.8 ± 1.23, Y2=18.3 ± 0.64 and Y3=12.8 ± 1.06%DM, $P<0.05$). On average for the 3 yrs, CP was highest in SP (15.6 ± 0.59%DM) and lowest in W (9.2 ± 0.47%DM; $P<0.05$). However, for Y1 degradable intake protein (**DIP**) was highest in W, reaching a maximum of 94.8 ± 0.72%CP ($P<0.05$). Although DIP was adequate yr-round for Y1, metabolizable protein content did not meet the expected animal requirements for W and late-S ($P<0.05$), which was mainly due to the low TDN of the diet that likely restricted the BCP synthesis. Analyses for Y2 and 3 ADL and protein degradability are currently underway. Understanding seasonal effects on native range nutritive values is important for developing cost effective nutrition programs for the cow herd.

Key Words: Ruminal Degradable Protein, Native Range, Beef Cows

265 Diurnal Variation of Blood Metabolites in Response to Time of Feeding and Dietary Forage to Concentrate Ratio in Lactating Dairy Cows. A. Nikkhah*, J. C. Plaizier, C. Furedi, and A. D. Kennedy, *University of Manitoba*, *Winnipeg, MB, Canada*.

The effects of the time of providing fresh total mixed ration and the dietary concentrate level on daily averages and diurnal variation of blood metabolites were examined. Eight lactating Holstein cows (BW = 660 ± 62 kg, 82 ± 22 days in milk; mean ± SD) were used in a 4 x 4 Latin square design with a 2 x 2 factorial arrangement of treatments. Each experimental periods included 2 wk of adaptation followed by 1 wk of sampling. Treatments included two diets (D) and two times of feeding (TF, 9 am and 9 pm). Diets contained either higher concentrate (HC, forage to concentrate ratio (F:C) = 38:62) or lower concentrate (LC, F:C = 49:51). Blood was sampled every 2 h for 2 24-h periods during each sampling week. Proc MIXED Procedure of SAS with appropriate covariance structure for repeated measures was adopted to assess the fixed effects of D, TF, hour of sampling (H), and their interactions on blood metabolites. Feeding HC vs. LC diet significantly increased blood glucose ($P<0.001$) and lactate ($P<0.05$), and decreased β-hydroxybutyrate (BHBA) ($P<0.01$). Evening feeding tended to increase ($P<0.10$) daily average of blood lactate compared to morning feeding. Diurnal variations of all blood metabolites were modified ($P < 0.01$) by time of feeding. Diurnal rhythmicity of blood urea was significantly ($P<0.001$) entrained by the interaction between diet and TF. Evening fed cows exhibited a prefeeding decline and a postfeeding rise in blood glucose, whereas morning fed cows did not. Primiparous cows showed more variation ($P<0.01$) in blood NEFA than multiparous cows. Results revealed that TF modified the diurnal variation of blood metabolites and thus may affect peripheral delivery of the nutrients in high-producing lactating cows.

Table 1. Effects of diet (D), time of feeding (TF), and hour of sampling (H) on blood metabolites

	Diet (D)		Time of Feeding (TF)						
	HC	LC	Morning	Evening	D	T	H	D*H	T*H
Glucose, mg/dL	80.5	76.6	78.5	78.6	***	NS	***	NS	***
BHBA, mmol/L	470	576	513	533	**	NS	***	NS	***
NEFA, mEq/L	0.12	0.13	0.13	0.12	NS	NS	NS	†	**
Urea, mmol/L	4.94	4.75	4.83	4.86	†	NS	***	*	***
Lactate, mmol/L	0.70	0.65	0.65	0.69	*	†	***	NS	***

NS= not significant; † $P < 0.15$; * = $P < 0.05$;** = $P < 0.01$; *** = $P < 0.001$

Acknowledgements: This study was supported by grants from Dairy Farmers of Canada and Dairy Farmers of Manitoba

Key Words: Time of feeding, Diurnal variation, Blood metabolites

266 Citrulline synthesis limits whole-body arginine synthesis in piglets fed an arginine deficient diet. K. L. Urschel*[1], A. K. Shoveller[1], R. Uwiera[2], P. B. Pencharz[1,3], and R. O. Ball[1,3], [1]*Department of Agricultural, Food and Nutritional Science, University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Health and Laboratory Animal Sciences, University of Alberta*, *Edmonton, Alberta, Canada*, [3]*Departments of Paediatrics and Nutritional Science, University of Toronto*, *Toronto, Ontario, Canada*.

Arginine in sows' milk is low and intake in suckling piglets could limit growth. Piglets can synthesize arginine from proline, but there is an upper limit to this synthesis and piglets fed a deficient arginine diet have diminished whole-body arginine status. The objective of this experiment was to elucidate where the limitation in this metabolic pathway occurs by supplementing an arginine deficient diet (basal) with equimolar (9.18 $mmol \cdot kg^{-1} \cdot d^{-1}$) quantities of either proline (+PRO), ornithine (+ORN), citrulline (+CIT) or arginine (+ARG). Male piglets (n=25, ~1.7 kg) were fitted with gastric catheters (IG) for diet and isotope infusion, jugular vein catheters (IV) for isotope infusion, and femoral vein catheters for blood sampling (d 0). Piglets were given a complete diet until d 3 and then received one of the 5 test diets for the remainder of the trial. Beginning on d 5, piglets received 3 primed, constant infusions on separate days: [guanido-^{14}C]arginine given IG and IV to calculate arginine flux, and [U-^{14}C]proline given IG to calculate proline conversion to arginine. Compared to piglets fed the basal, +PRO and +ORN diets, piglets fed the +CIT and +ARG diets had lower plasma ammonia ($P<0.05$) and urea ($P<0.05$) concentrations, higher plasma arginine concentrations ($P<0.0001$), and higher IV and IG arginine fluxes ($P<0.05$). These results demonstrate that citrulline, but neither ornithine nor proline, is an effective precursor for arginine synthesis in week-old piglets. The conversion of proline to arginine, as a % of arginine flux, was greatest in piglets fed the +PRO diet (44.5%), followed by the basal (25.8%), +ORN (22.5%), +ARG (6.2%) and +CIT (5.7%) diets (SEM = 3.1%; $P<0.0001$). This shows that citrulline addition to an arginine deficient diet spared the use of proline in arginine synthesis. Citrulline synthesis appears to be the limiting factor for arginine synthesis in piglets. Strategies aimed at improving arginine status in young piglets should focus on increasing citrulline concentrations.

Acknowledgements: This study was funded by NSERC.

Key Words: Piglet nutrition, Arginine biosynthesis, Amino acid metabolism

267 Early weaning up-regulates the capacity of the small intestinal sucrase-isomaltase and maltase-glucoamylase hydrolysis of maltose in the neonatal pig. D. Lackeyram*[1], D. Pham[1], Q. Liu[2], Y. Mine[1], M. Bakovic[1], B. L. Nichols[3], and M. Z. Fan[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Agri-Food Canada*, *Guelph, Ontario, Canada*, [3]*Baylor College of Medicine*, *Houston, Tx*.

Sucrase-isomaltase (SI) and maltase-glucoamylase (MGA) are small intestinal brush border membrane enzyme complexes responsible for the hydrolysis of maltose. SI is capable of hydrolysing both sucrose and maltose where MGA serves as the final pathway of starch digestion to glucose in the neonate. This study investigated combined changes in the capacity of intestinal MGA and SI in the hydrolysis of maltose as affected by early weaning (EW) stress. Eight Yorkshire piglets, with an average BW of 3 kg at the age of 10 d, were weaned from sows and fed a corn and soybean meal-based diet for 12 d in comparison with 8 suckling (SU) piglets. The entire small intestine was collected and divided into 4 regions: duodenum, proximal jejunum, distal jejunum, and terminal Ileum. Homogenized intestinal tissue from each of the regions was used to conduct kinetic experiments of combined MGA and SI activity with six concentrations of purified maltose (0-75 mM) at 37°C and pH 6.0. Weaning increased ($P<0.05$) the combined maximal specific enzyme activities (Vmax: EW, 29.42±0.60 vs. SU, 24.69±0.39, nmol/mg protein.min, n=48) by 19% and the combined enzyme affinities (Km: EW, 4.16±0.37 vs. SU, 5.86±0.68, mM, n=48) by 29% primarily in the jejunum. Weaning also increased ($P<0.05$) the digestive capacity of the combined enzyme action (EW, 169.29±3.49 vs. SU, 135.54±3.16, mol/kg BW.d, n=16) by 25%. Thus, early weaning up-regulates the capacity of the intestinal SI and MGA to hydrolyse maltose by increasing the combined enzyme activities and their affinities as an adaptation to weaning on vegetal diets.

Key Words: Intestinal sucrase-isomaltase, Maltase-glucoamylase, Weaned piglets

268 Ultrasonic evaluation of intramuscular fat content in yearling beef bulls. R. Bergen*, S. Miller, I. Mandell, and C. Campbell, *University of Guelph, Guelph, Ontario, Canada*.

Two commercially available software programs were used by trained and experienced ultrasound technicians to predict 12/13th rib intramuscular fat percentage in 88 crossbred yearling (435 ± 37 d, 633 ± 78 kg, 5.3 ± 2.1 mm rib fat depth) bulls prior to slaughter. Marbling score and chemical intramuscular fat percentage (2.66 ± 1.08 %) were evaluated post-slaughter. A base model including year indicated that neither ultrasound (R^2 = 0.59 vs. 0.46, residual standard deviation = 0.70 vs. 80%, respectively) nor marbling score (R^2 = 0.45, rsd = 0.81 %) was particularly effective at predicting chemical intramuscular fat content. Combining intramuscular fat estimates produced by both ultrasound programs in the same model did not improve prediction of chemical intramuscular fat percentage (R^2 = 0.60, rsd = 0.69 %). Including ultrasound fat depth, breed composition, hip height, and squared terms of ultrasound intramuscular fat percentage in the model improved ultrasound-based predictions of intramuscular fat percentage (R^2 = 0.64 vs. 0.55, rsd = 0.67 vs. 0.75 %). Scan age, live weight, and other linear body size measurements did not contribute to the prediction models. Further research is needed to assess whether multiple trait evaluations incorporating additional indicator traits may benefit genetic improvement programs for carcass quality.

Acknowledgements: Agriculture and Agri-food Canada's Agriculture Adaptation Council Beef Improvement Ontario Canadian Foundation for Innovation Ontario Cattlemen's Association Ontario Innovation Trust Ontario Ministry of Agriculture and Food

Key Words: Carcass, Marbling, Genetic

269 Evaluation of the NRC (1996) model for predicting feed requirements for beef cows in western Canada. J. L. Bourne*[1], J. J. McKinnon[1], H. C. Block[1], and H. A. Lardner[2], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Western Beef Development Centre*, *Humboldt, SK, Canada*.

A trial was conducted to evaluate the 1996 NRC beef model's ability to predict DMI and ADG of pregnant cows under western Canadian conditions. Over 2 consecutive years, 90 Angus (587 ± 147 kg) cows assigned to 15 pens (N=6) were fed typical winter diets *ad libitum*, formulated to stage of pregnancy. Data collection included pen DMI and ADG (corrected for pregnancy), calving date, calf weight, body condition scores and ultrasound fat measurements, weekly feed samples and daily ambient temperature. Pen DMI and ADG in each trimester was predicted using the 1996 NRC beef model. The results indicate that in the 2nd and 3rd trimester of both years the model over predicted (P<0.05) DMI required to support observed ADG, and under predicted (P<0.05) ADG based on observed DMI. *Ad libitum* intake was over predicted (P<0.05) in all cases except for the 2nd trimester of year 2, where predicted *ad libitum* intake was not different (P>0.05) from observed intake. A second evaluation was carried out assuming thermal neutral (TN) conditions. In this case, it was found that during the 2nd trimester of year 1 predicted DMI and predicted ADG were not different (P>0.05) from observed DMI and ADG, however in year 2 predicted DMI was less (P<0.05) than observed DMI, and predicted ADG was greater (P<0.05) than observed ADG. In the 3rd trimester of both years the DMI under TN conditions was under predicted (P<0.05), and the ADG was over predicted (P<0.05) indicating some negative effect of environment. Assuming TN conditions resulted in DMI and ADG predictions being closer to actual performance. These results suggest current energy equations for modeling environmental stress over predict maintenance requirements for wintering beef cows in western Canada.

Acknowledgements: Saskatchewan Agriculture Development Fund

Key Words: NRC evaluation, Feed requirements, Wintering beef cow

270 Postnatal changes of pancreatic and hepatic fractional protein synthesis rates in piglets measured by an intraperitoneal flooding dose of L-[ring-2H5]phenylalanine. X. Yang*[1], L. Liu[1], G. Werchola[1], Y. Mine[1], Q. Liu[2], and M. Fan[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Agriculture and Agri-Food Canada*, *Guelph, ON, Canada*.

This study examined the hypothesis that postnatal changes of pancreatic and hepatic fractional protein synthesis rates (FSR) were associated with plasma cortisol and insulin levels in piglets. Thirty six littermate purebred Yorkshire gilts were divided into suckling groups at ages of d 1, 4, 6, 12, 20, and one week post-weaning group at d 28, respectively, and injected intraperitoneally a flooding dose of L-[ring-2H5]phenylalanine (Phe) in saline. Plasma, pancreatic and hepatic samples were collected for the determination of cortisol and insulin concentrations by radioimmunoassay and the tracer Phe enrichments with gas chromatography-mass spectrometry. Postnatal changes of plasma hormone levels were observed (P<0.05) for cortisol (quadratic effects) and insulin (quadratic and cubic effects). The average tracer Phe enrichments in the plasma, pancreatic, and hepatic free pools were 27.4, 28.9 and 32.8 molar%, respectively. There was a quartic pattern (P<0.05) of pancreatic and hepatic FSR changes during the postnatal development. Only the postnatal changes of pancreatic FSR were positively (P<0.05) correlated with plasma insulin levels. In conclusion, there are postnatal changes in the pancreatic and hepatic FSR. Insulin and cortisol effects on pancreatic and hepatic FSR may be tissue and age specific.

Key Words: pancreatic and hepatic fractional protein synthesis rates, cortisol and insulin, piglets

271 Changes in the plasma citrulline concentration are a predictor of alterations in gut mucosal morphology and functions in the piglet. D. Lackeyram*[1], D. G. Burrin[2], Y. Mine[1], and M. Z. Fan[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Baylor College of Medicine*, *Houston, TX*.

This study determined quantitative relationships between the plasma urea and amino acid (AA) concentrations and the gut mucosal morphological changes and body weight gains in early weaning (EW) and suckling piglets. The study was conducted for 12 d with 24 Yorkshire piglets of an average initial body weight of 3.4 kg at d 10 of age. The weaned pigs were fed a corn and soybean meal-based diet. There was no sex effects (P>0.05) on any of the endpoint measurements. The EW pig had 32% (P<0.05) of the whole body growth rate of the suckling pigs. The EW pig experienced an elevated whole body AA catabolism (P<0.05) as indicated by significant increases in plasma urea concentration. Weaning decreased (P<0.05) the total counts of mucin-filled goblet cells along the crypt-villus axis. Weaning also caused gut mucosal villus atrophy and crypt hyperplasia (P<0.05) in comparison with suckling piglets. There were linear relationships (P<0.05) between the plasma urea concentration and average daily gain and gut mucosal morphological measurements, supporting the concept that gut mucosal crypt cells are metabolically of a catabolic phenotype, whereas the villus cells are predominantly of an anabolic phenotype. There were also linear relationships (P<0.05) between plasma concentrations of urea and several AA including carnitine, citrulline, glutamate, glutamine, phenylalanine, and taurine. Similarly, there were linear relationships (P<0.05) between the gut mucosal morphological measurements and several AA, with citrulline showing the best correlation. In conclusion, gut mucosal crypt hyperplasia is partially responsible for the weaning-associated elevation in whole body AA catabolism and growth repression. Change in the plasma citrulline concentration is a reliable plasma marker for prediciting alterations of gut mucosal morphology and functions in piglets.

Key Words: Citrulline, Gut mucosal morphology, Piglets

272 Effect of pelleted barley on performance and carcass quality of feedlot steers. L. M. Williams*[1], J. J. McKinnon[1], V. R. Racz[1], D. A. Christensen[1], and K. Ataku[2], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Rakuno Gakuen University*, *Ebetsu, Hokkaido, Japan*.

Development of export markets for cereal grains necessitates shipping grain in processed forms; however, excessive processing can lead to problems such as acidosis. A trial was conducted to evaluate the performance of beef steers fed diets containing ground, pelleted barley as the concentrate. Weaned steers (N=350; 285±22kg) were assigned to one of 12 pens and fed either pelleted or rolled barley as the concentrate. During backgrounding, cattle were fed 42% concentrate (DM), consisting of 85% pelleted or rolled barley and 15% canola meal. During finishing the concentrate was fed at 86% of the diet (DM) and consisted of 94% pelleted or rolled barley and 6% canola meal. Steers were weighed every 4 weeks during growing and every 2 weeks during finishing. Ultrasound backfat (USBF) and *longissimus dorsi* (LD) area were measured monthly. Animals were slaughtered at 12mm of USBF or 625 kg. Carcass data included weight, LD area, grade fat, marbling score, and liver abscess score. Rib fat, lean and bone %, LD and fat color, and marbling fat content were determined on 8-bone rib samples from 40 randomly selected steers. Steers fed pelleted barley had lower (P<0.05) ADG during finishing (1.80 vs. 2.00 kg/d) and for the total trial (1.60 vs. 1.70 kg/d), as well as more (P<0.05) days on feed (196 vs. 186). DMI was lower (P<0.05) for cattle fed pelleted barley throughout the trial. Feed efficiency (kg feed:kg gain) was superior (P<0.05) for the group fed pelleted barley during finishing (6.03 vs. 6.21) and the total trial (6.27 vs. 6.64). Both diets produced similar carcasses, but inter-muscular fat % was higher (P<0.05) for the rolled barley group (60.0 vs. 57.4%), as was (P<0.05) grade fat (11.2 vs. 10.7 mm). Results from this study indicate that pelleted barley can be used effectively in growing and finishing diets, however further research is required to discover why intake of pelleted barley is reduced.

Key Words: Pelleted barley, Carcass quality, Finishing steers

Growth and Development: Postnatal Development as a Harbinger of Future Performance

273 Hormone and growth factor regulation of tissue remodeling in the mammary gland. D. Flint*[1], G. Allan[1], J. Beattie[1], M. Travers[1], M. Barber[1], A. Kolb[1], C. Whitelaw[2], M. Boutinaud[3], N. Binart[4], and P. Kelly[4], [1]*Hannah Research Institute*, *Ayr, UK*, [2]*Roslin Institute*, *Midlothian, Edinburgh, UK*, [3]*INRA Unite Mixte de Recherches Sur la Production du Lait*, *Saint Gilles, France*, [4]*Inserm Unit 584, Hormone Targets*, *Faculty of Medicine Rene Descartes, Paris.*

Insulin-like growth factor binding protein-5 (IGFBP-5) production increases dramatically during forced involution of the mammary gland in rats, mice and pigs. Growth hormone (GH) increases production of the survival factor IGF-I, whilst prolactin enhances the effects of GH by inhibiting IGFBP-5 synthesis which would otherwise prevent the actions of IGFs. A causal relationship between IGFBP-5 and cell death was demonstrated in transgenic mice expressing IGFBP-5 specifically in the mammary gland. DNA content in the mammary glands of transgenic mice was decreased as early as day 10 of pregnancy and remained so during the first 10 days of lactation. The concentration of caspase-3 was increased in transgenic animals whereas the concentrations of two pro-survival molecules Bcl-2 and Bcl-xL were decreased. Furthermore, IGF receptor- and Akt-phoshorylation were both inhibited. We also demonstrated that the effects of IGFBP-5 could be mediated in part by IGF-independent effects involving the plasminogen system, and matrix metallo-proteinases (MMPs). Treatment with prolactin was able to inhibit early involutionary processes in normal mice but was unable to prevent this in mice over-expressing IGFBP-5, although it was able to inhibit expression of MMPs. Thus IGFBP-5 simultaneously inhibits IGF action and activates the plasminogen system, thereby coordinating cell death and tissue remodelling processes. The ability to separate these properties, using mutant IGFBPs, is currently under investigation. We have also developed a mouse model of diet-induced obesity which shows numerous abnormalities relating to mammary gland function. Animals ate approximately 40% more calories, gained weight at three times the rate of controls and exhibited reduced conception rates, increased peripartum pup mortality and impaired lactogenesis. Despite access to high energy diets, the obese animals mobilised even more adipose tissue during lactation than their lean counterparts. Obese animals also exhibited marked abnormalities in ductal branching morphogenesis and alveolar development of the mammary gland, which may partially explain the delay in differentiation evident during lactogenesis.

Key Words: IGF, Proteases, Obesity

274 Effects of modified calf growth on mammary development, endocrine physiology, and performance. M. Vestergaard*[1], S. Purup[1], M. S. Weber Nielsen[2], Y. R. Boisclair[3], and K. Sejrsen[1], [1]*Danish Institute of Agricultural Sciences*, *Tjele, Denmark*, [2]*Michigan State University*, *East Lansing*, [3]*Cornell University*, *Ithaca, NY*.

The purpose of rearing heifers comprises a utilization of the genetic potential of the animal to achieve the most favorable body and mammary gland development by optimizing feeding and rearing conditions. Our research has led to the concept of a 'critical period' before puberty, where reproductive and thus mammary development can be negatively affected by high levels of nutrition. Since then focus has been devoted to exploring the possibilities of promoting a high rate of gain without negatively affecting mammary gland growth and milk yield potential. In vivo studies on the effects of nutrition, somatotropin axis activity, and steroid hormone activity or pubertal stage on mammary development have shown that classical endocrine factors, such as somatotropin and estrogen, are involved in the regulation of normal growth and development, but their role in mediating the effects on mammary development is less clear. Most evidence suggests that the key regulation takes place locally in the mammary gland. Investigations on local regulation of mammary development have included functional receptor studies in specific tissues and in vitro cell culture experiments using tissue and serum from in vivo experiments. The results indicate that locally produced IGFs and IGF-binding proteins play a role, but many other factors, such as TGFβ and leptin, likely also contribute. The importance of other body tissues and the interaction between the mammary gland and other tissues as well as the cross-talk within the mammary gland are less well-studied. However, both the endocrine actions of various growth factors, such as the IGFs, which target most tissues, and the tissue-specific expression and production of important paracrine and endocrine factors have to be considered to further elucidate the complex regulation of mammary gland and body development. We expect that future research will have to focus more on the interactions and synergism among different types of tissues during calf development.

Key Words: Cattle, Mammary, Endocrinology

275 Tissue proteolytic enzymes: Modifiers of muscle and adipose tissue. G. Hausman*, *USDA ARS*, *Athens, GA*.

A fundamental aspect of tissue remodeling is the breakdown and degradation of connective tissue and extracellular matrix (ECM) proteins. Degradation or proteolysis of ECM proteins is implicated in cell attachment, cell migration, ECM invasion, angiogenesis and release and processing of membrane bound cytokines and growth factors. Extracellular proteolysis involves several families of proteolytic enzymes, including the plasminogen activator (PA) - plasmin system, the adamalysins (ADAMs) family and the matrixin matrix metalloproteinases

(MMPs) and their tissue inhibitors (TIMPs). The MMP family is the most prominent of these protease families and MMP-2, MMP-9, TIMP-1 and TIMP-2 are the most studied of the MMP regulatory system. The non-ECM substrates of MMPs and limitations of in vivo studies of MMP protein levels and activities will be discussed. Expression of MMPs is critical for development since deficiencies in both MMP-2 and MMP-14 is lethal and MMP-9 deficiency results in transient abnormal bone development. Many MMPs including MMP-2 and MMP-9 and TIMPs are expressed in skeletal muscle, isolated myogenic cells, isolated muscle fibroblasts, adipose tissue and adipose tissue stromal-vascular cells in a depot dependent manner. The influence of MMP and TIMP knockouts, MMP inhibitors and PA- plasmin system knockouts and over expression on adipose tissue development will be reviewed. The role of extracellular proteolysis in myogenesis is discussed including the evidence that MMPs and the PA- plasmin system components mediate myoblast migration and fusion. Studies of MMP involvement in the initial phase of muscle angiogenesis will also be reviewed. The ramifications of the influence of PA inhibitor-1 (PAI-1) on migration of preadipocytes and associated endothelial cells will also be discussed. Finally, evidence that MMPs and, in particular, MMP-9 mediate adipocyte differentiation in vitro will be reviewed.

Key Words: Adipose Tssue, Muscle, Extracellular Proteolysis

276 Tumor necrosis factor-α (TNF-α) decreases media content of epithelial cell-derived insulin-like growth factor binding proteins (IGFBP) in part through increased proteolytic degradation of IGFBP-3. T. H. Elsasser*[1], T. J. Caperna[1], J. L. Sartin[2], C. Li[1], and S. Kahl[1], [1]*USDA, Agriculture Research Service*, *Beltsville, MD*, [2]*Auburn University*, *Auburn, AL*.

Acute proinflammatory stress is marked by significant alterations in metabolic capacity in animals mediated in part by decreased plasma and tissue levels of insulin-like growth factor-1 (IGF-1) and the respective IGFBP-2 and -3. To determine if a part of the localized tissue regulation of IGF-1 action might encompass the cellular presentation of IGFBP patterns, cultured Madin-Darby bovine kidney epithelial cells (~95% confluent, 10^6 cells/well, 1.0 mL RPMI 1640 serum-free media) were challenged with physiologically relevant concentrations of recombinant bovine TNF-α (1 or 100 nM) in the presence and absence of the IGFBP-3 stimulator forskolin (F), a cyclic AMP pathway effector. IGFBP-2 and -3 media contents were assessed by radioligand blot; protease activity against IGFBP-3 was measured by adding recombinant human IGFBP-3 to media samples, incubating for 30 min, and measuring the residual human IGFBP-3 by Western blot using anti-human IGFBP-3 devoid of crossreactivity with bovine IGFBP-3. Where F promoted a 50% decrease in media IGFBP-2 ($P<0.02$) and a 22-fold increase in media IGFBP-3 ($P<0.001$) content, respectively, the addition of TNF-α not only further reduced IGFBP-2 but also decreased F-stimulated IGFBP-3 media content by 70% ($P<0.005$). As suggested by the decrease in human IGFBP-3 band intensity, F increased media BP-3 protease activity by as much as 75%; TNF-α further increased media protease activity as evidenced by a >95% decrease in human IGFBP-3 band density. The data are consistent with the concept that TNF-α-associated increases in cell-derived protease activity may affect endocrine functions of IGF-1 by degrading IGFBPs leading to a functional decrease in the size and distribution of IGFBP-2- and -3-bound pools of IGF-1.

Key Words: IGF Binding Proteins, Stress, Tumor Necrosis Factor-α

277 Effects of diet and bST on expression of leptin and leptin-receptor in mammary parenchyma of heifers. B. J. Lew*[1,2], J. S. Liesman[1], M. D. S. Oliveira[2], and M. J. VandeHaar[1], [1]*Michigan State University*, *East Lansing*, [2]*Sao Paulo State University (UNESP)*, *Jaboticabal, SP, Brazil*.

Increasing growth rates in prepubertal heifers decrease age at puberty and subsequent milk production. Administration of bST before puberty increases parenchymal tissue and decreases adipose tissue within the udder. Our objective was to examine the effects of a high energy, high protein diet combined with injection of bST on leptin and leptin-receptor (Ob-R) gene expression in mammary parenchyma. The mammary tissue used was collected in a previous experiment conducted in 1994 (Radcliff et al., 1997). In the experiment, Holstein heifers were randomly assigned to one of four treatments - low or high diet (0.8 or 1.2 kg of BW gain/d, respectively), with or without bST administration (25 ug/kg BW/d) - from 120 d of age until the early luteal phase of the fifth estrous cycle. Total RNA was extracted from parenchymal tissue of 32 heifers (8/treatment) and gene expression profile for leptin (GGGTGATTTCAGAGCCTTTGG-F; AGAATCCAGGGAGCATCATGAAGGCTACAG-R) and Ob-R (GGGCACATCCAAGCATTAAAA-F; GGCCGGCATCAAAGCTTT-R) was tested in qRT-PCR, against glucoronidase β (GUS; TGTCATCGCACACAGAGCAA-F; CACAAAATCCAGGTGAGAAGCTT-R) as a control. The results were calculated using the ΔΔCt method and analyzed as a 2 by 2 factorial experiment. High diet increased leptin mRNA 56% ($P<0.03$) and decreased leptin receptor 18% ($P<0.03$) while bST treatment decreased leptin mRNA 74% ($P<0.01$) and leptin receptor 23% ($P<0.01$). The interaction of diet and bST was not significant ($P>0.25$) for either leptin or leptin receptor mRNA. The mechanism by which a high energy diet before puberty decreases subsequent milk production is not understood, but we suggest that perhaps this increase in mammary leptin expression may be a part of it. In conclusion, a high energy diet increases and bST administration decreases expression of leptin in mammary parenchymal tissue of prepubertal heifers, consistent with a possible inhibitory role of leptin in mammary development.

Acknowledgements: To CAPES and CNPq for sponsoring the first author

Key Words: Mammary Gland Development, Leptin

278 Beta-adrenergic receptor agonist-induced skeletal muscle hypertrophy is fiber type-specific through differential involvement of the MAPK signaling pathway. H. Shi*, A. Ricome, K. Hannon, A. Grant, and D. Gerrard, *Purdue University*, *West Lafayette, IN*.

Beta adrenergic (BA) receptor agonists induce skeletal muscle hypertrophy and antagonize atrophy. The molecular mechanisms controlling these phenomena are not, however, well known. Here we report that BA exerts a distinct muscle fiber type-specific hypertrophy that is preferentially restricted to fast-twitch fibers. Moreover, we show herein that pharmacologically or genetically attenuating ERK signaling in muscle fibers results in decreases ($P < 0.05$) in fast but not slow fiber type-specific reporter gene expression in response to BA exposure in vitro and in vivo. Consistent with these data, forced expression of MAPK phosphatase 1 (MKP-1), a nuclear protein that dephosphoryates ERK1/2, in fast-twitch skeletal muscle ablates ($P < 0.05$) the hypertrophic effects of BA-feeding (clenbuterol, 20 ppm in water) in vivo. Further analysis showed that BA-induced phosphorylation and activation of ERK occurs to a greater ($P < 0.05$) extent in fast myofibers than in slow myofibers. Analysis of the distribution pattern of phosphoERK1/2 in slow and fast muscles revealed that ERK1/2 is more activated in fast- than in slow-twitch muscles. These data suggest that the increased abundance of phosphoERK1/2 in fast-twitch myofibers than in their slow-twitch counterparts may account for, at least in part, the fiber-type-specific hypertrophy induced by BA stimulation. Given that other muscle hypertrophy and/or atrophy models respond in a muscle fiber-type specific manner, it seems logical that fast myofibers are pivotal in the adaptation of muscle to various environmental cues and that the mechanism underlying this change is partially mediated by the MAPK signaling cascade.

Key Words: Beta Agonist, Skeletal Muscle Hypertrophy, MAPK Signaling

279 Direct assessment of the conversion of trans-vaccenic acid (TVA) to cis-9, trans-11 conjugated linoleic acid (CLA) in lactating dairy cattle. E. Mosley* and M. McGuire, *University of Idaho*, *Moscow*.

The utilization of ^{13}C TVA by the lactating dairy cow was investigated in Holstein cows (n = 3) through a bolus infusion into the abomasum of 1.5 g of trans-vaccenic-1-^{13}C acid (TVA). Blood samples were taken at -24, -18, -12, -6, 0, 0.5, 1, 1.5, 2, 3, 4, 6, 8, 12, 16, 20, 24, 36, 48, 60, 72, and 84 h, and milk samples were taken at -24, -18, -12, -6, 0, 4, 8, 12, 16, 20, 24, 36, 48, 60, 72, and 84 h relative to TVA infusion. Milk and plasma lipid were extracted using chloroform:methanol. Plasma lipid was separated into triacylglycerol (TG), cholesterol ester (CE), phospholipid (PL), free fatty acid (FFA), and mono- and diacylglycerol (MDG) fractions. Lipid was methylated, converted to dimethyl disulfide and Diels-Alder adducts, and analyzed by GCMS. Enrichment was determined using a t-test for each sample time post infusion compared to samples taken at -24 h with significance declared at $P < 0.05$. Enrichment of ^{13}C in TVA of milk fat was detected at 4 (3.0%), 8 (8.3%), 12 (4.1%), 16 (2.2%), and 20 h (0.8%). Enrichment was also detected in TVA for plasma TG, FFA, PL, and MDG. In plasma TG, TVA was enriched with ^{13}C at 1 (21.2%), 1.5 (53.8%), 2 (45.1%), 3 (18.0%), and 4 h (5.7%) post infusion. Enrichment was detected in TVA at 1.5 (22.9%), 2 (21.1%), and 3 h (11.9%) in plasma FFA. TVA in plasma MDG was enriched only at 3 h (5.1%), however, plasma PL enrichment was detected from 2 h (0.5%) until 84 h (0.3%) with maximum enrichment detected at 8 h (2.7%). Enrichment of ^{13}C in cis-9, trans-11 CLA, the desaturase product of TVA, in milk fat was detected at 4 (2.6%), 8 (6.6%), 12 (3.4%), 16 (1.7%), and 24 h (0.7%). Enrichment was not detected in CLA for any plasma lipid fraction. Conversion of dietary TVA to CLA endogenously was confirmed with almost all of the conversion occurring in the mammary gland.

Acknowledgements: This project was supported by United Dairymen of Idaho and National Research Initiative Competitive Grant no. 2003-35206-13669 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Trans-Vaccenic Acid, cis-9, trans-11 Conjugated Linoleic acid, Desaturase

280 Quantitative importance of endogenous cis-9, trans-11 conjugated linoleic acid synthesis in dairy cows. K. Shingfield*, S. Ahvenjärvi, V. Toivonen, A. Vanhatalo, and P. Huhtanen, *MTT Agrifood Research Finland*, *Jokioinen, Finland*.

Based on the potential benefits of conjugated linoleic acid (CLA) for human health there is a need to develop effective strategies for enhancing milk fat cis-9, trans-11 CLA concentrations. Cis-9, trans-11 CLA is derived from ruminal biohydrogenation of C18:2 n-6 and endogenous conversion of trans-11 C18:1 in the mammary gland. Most evidence to date suggests that endogenous synthesis is the main source of cis-9, trans-11 CLA, but the extent of trans-11 C18:1 bioconversion remains largely unclear. Four lactating cows were used in two sequential 4 x 4 Latin squares with 7 d experimental periods to examine milk fatty acid composition responses to abomasal infusions of CLA and C18:1 preparations enriched (g/100g fatty acids (FA)) with cis-9, trans-11 CLA (88.8) and trans-11 C18:1 (29.4). Experimental periods comprised of a 4 d infusion and 3 d interval between infusions. Treatments consisted of 0, 3, 6 and 12 g cis-9, trans-11 CLA/d (Expt. 1) and 0, 7.5, 15 and 30 g trans-11 C18:1/d (Expt. 2). Infusions of cis-9, trans-11 CLA increased linearly ($P < 0.001$) the concentration of this isomer in milk from 0.69 to 1.44 g/100g FA associated with a mean transfer efficiency of 0.389. Abomasal infusions of trans-11 C18:1 increased linearly ($P < 0.001$) milk trans-11 C18:1 and cis-9, trans-11 CLA concentrations from 1.25 to 2.82 and 0.63 to 1.26 g/100 g FA, respectively. Proportionately 0.081 and 0.214 of infused trans-11 C18:1 was recovered in milk as cis-9, trans-11 CLA and trans-11 C18:1, respectively. The relationship between the output of cis-9, trans-11 CLA with the sum of trans-11 C18:1 and cis-9, trans-11 CLA in milk of cows receiving trans-11 C18:1 infusions indicated that proportionately 0.278 of trans-11 C18:1 available to the mammary gland was bioconverted. In conclusion the relative biological value of trans-11 C18:1 available at the small intestine for incorporation and biosynthesis of cis-9, trans-11 CLA in milk fat was equivalent to proportionately 0.21 of the response to cis-9, trans-11 CLA infusions.

Acknowledgements: This work was funded by the European Union funded BIOCLA project QLK1-2002-02362.

Key Words: Conjugated Lnoleic Acid, Trans Fatty Acids, Desaturase

281 T*rans*-10, *cis*-12 conjugated linoleic acid reduces milk fat synthesis in lactating sheep. A. L. Lock[1], J. W. Perfield II*[1], B. M. Teles[2], D. E. Bauman[1], and L. A. Sinclair[2], [1]*Cornell University*, *Ithaca, NY*, [2]*Harper Adams University College*, *Newport, Shropshire, UK*.

The efficacy of *trans*-10, *cis*-12 conjugated linoleic acid (CLA) in reducing milk fat synthesis in dairy cows has been well documented. To date, there has been no examination of the effects of *trans*-10, *cis*-12 CLA on milk fat synthesis in lactating sheep. The current study was therefore designed to determine if *trans*-10, *cis*-12 CLA would inhibit milk fat synthesis in lactating sheep. Twenty multiparous milking ewes (56 ± 6.2 kg) in early lactation were blocked and randomly allocated to two treatments; grass hay plus concentrate either unsupplemented (Control) or supplemented with lipid-encapsulated *trans*-10, *cis*-12 CLA (LE-CLA; BASF AG, Ludwigshafen, Germany) at the rate of 25 g/d, providing 2.4 g/d of *trans*-10, *cis*-12 CLA. The experimental design was a 2 period crossover with 10 d treatment periods separated by a 10 d interval. Milk protein content and DMI were unaffected by treatment. Compared to the Control, the LE-CLA supplement reduced milk fat content from 6.4 to 4.9% ($P < 0.001$) and fat yield from 95 to 80 g/d ($P < 0.001$), but increased milk yield from 1471 to 1611 g/d ($P < 0.01$) and protein yield from 68 to 73 g/d ($P < 0.05$). The temporal pattern for milk fat content and yield demonstrated a progressive reduction for sheep receiving the LE-CLA supplement, reaching nadir by day 8. The reduction in milk fat yield was due to decreases in both de novo fatty acid synthesis and uptake of preformed fatty acids. Milk fat content of *trans*-10, *cis*-12 CLA was <0.01 and 0.12 g/100 g of fatty acids for the Control and LE-CLA treatments, respectively. The transfer efficiency of *trans*-10, *cis*-12 CLA from the LE-CLA supplement into milk fat was 3.8%. In conclusion, the results of the present study demonstrate that *trans*-10, *cis*-12 CLA reduces milk fat synthesis in lactating sheep in a manner similar to that observed in lactating dairy cows. Furthermore, the energy spared by the reduction in milk fat corresponded to an increase in milk and milk protein yield. Further studies are required to verify and extend these results and to elucidate the mechanism of action for the effects observed with *trans*-10, *cis*-12 CLA supplementation.

Key Words: CLA, Milk Fat, Sheep

282 A comparison of *trans*-10, *cis*-12 CLA effectiveness at inducing milk fat depression (MFD) in early vs. established lactation. C. Moore, J. Kay, R. Rhoads, and L. Baumgard*, *University ofArizona*, *Tucson*.

Abomasal and close-arteriol infusion of mixed CLA isomers reduces milk fat synthesis in established lactation. Long-term experiments utilizing rumen-inert (RI) CLA supplements indicate CLA induces MFD when fed to TMR or pasture fed cows during established lactation. However, similar amounts of RI-CLA appear ineffective at inducing MFD during the periparturient period and the mammary gland is insensitive to CLA until approximately the 3-4th week of lactation. We have recently demonstrated that large quantities of RI-CLA decrease milk fat synthesis immediately postpartum in both TMR and pasture fed cows. We close-arteriol infused 7 g/d of purified *trans*-10, *cis*-12 CLA to investigate the differences in mammary sensitivity to CLA between established lactation and immediately postpartum. Transitioning multiparous Holstein cows (n = 8) fitted with indwelling jugular catheters were blocked by predicted calving date and randomly assigned to either IV CLA or control infusion (Intralipid) for the first 5 d of lactation. Transition cows were simultaneously pair infused

with mid lactation cows (n=8; 102 ± 25 DIM), and infusions started the day transition cows calved. In established lactation, CLA infusion did not alter DMI but tended to decrease (14%) milk yield and neither of these parameters were affected by CLA in early lactation. CLA infusion had little or no effect on milk protein or lactose variables in either established or early lactation. In established lactation, CLA decreased (P<0.01) milk fat content and yield (34 and 45%, respectively), but in early lactation CLA did not alter these parameters. Compared to control, milk fat *trans*-10, *cis*-12 CLA content increased during infusion but levels were similar (1.85 mg/g) between stages of lactation. In established lactation, CLA decreased (26%) and increased (24%) the milk fat content of *de novo* and preformed derived fatty acids, respectively. CLA did not alter the milk fatty acid origin in early lactation. The mammary glands fat synthesizing machinery is much less sensitive to *trans*-10, *cis*-12 CLA immediately postpartum.

Key Words: CLA, Milk Fat, Transition

283 The effect of conjugated linoleic acid on cell growth and glucose transport in bovine mammary cells. A. F. Keating*[1,2], F. Q. Zhao[2], R. J. Weselake[1], and J. J. Kennelly[1], [1]*Dairy Research Group, Agricultural, Food and Nutritional sciences, University of Alberta*, *Edmonton, Canada.*, [2]*Lactation and Mammary Gland Biology Group, Department of animal science, University of Vermont*, *Burlington, VT*.

Conjugated Linoleic Acid (CLA) is a naturally occurring lipid of ruminant milk and meat and is an attractive functional food due to its proposed beneficial health properties such as reducing risks for cancer, atherosclerosis and diabetes. It is, thus, a great interest to increase milk CLA levels by feeding CLA to lactating dairy animals. However, a previous study by this group had indicated that feeding certain CLA isoforms may affect mammary cell growth and induce cell apoptosis (Bell and Kennelly, 2003). For this reason, the effect of fatty acid treatment on both growth and membrane function of a bovine mammary cell line, Mac-T, was investigated. Fatty acids examined were cis-9, trans-11 CLA, trans-10, cis-12 CLA, Linoleic acid, Linolenic acid and Vaccenic acid at concentrations of 15, 20, 25, 30, 35 and 37.5 µM/ml each. Results were analysed by SAS and showed that significant differences in cell growth occurred at 30 µM concentrations and above between the CLA isomers and other fatty acids, with cell death occurring due to CLA treatment (Table 1). The effect of fatty acid treatment on glucose transport in Mac-T cells showed that the CLA isomers showed increases in rates of transport compared to vaccenic acid.

Treatment	BSA	c9,t11 CLA	t10,c12 CLA	Linoleic	Linolenic	Vaccenic	p-value
15	2.21a	1.84a	2a	2.06a	1.8a	1.75a	0.91
20	9.86a	6.33a	6.13a	8.08a	8.16a	11.08a	0.11
25	7.5a	6.16a	5a	12.3a	10.33a	11.33a	0.44
30	5.5a	2.56b	1.91b	7.75a	6.91a	8.16a	0.0008
35	8.8a	1.33b	1.75b	6.73a	6.5a	9.33a	0.002
37.5	5.15a	0b	0b	5.9a	5.85a	5.9a	0.0001

Acknowledgements: This work was supported by the Dairy Farmers of Canada and the CLA Network

Key Words: Conjugated Linoleic Acid, Glucose Transport, Cell Growth

284 T*rans*-9, *cis*-11 conjugated linoleic acid (CLA) reduces milk fat synthesis in lactating dairy cows. J. W. Perfield II*[1], A. L. Lock[1], A. Sæbø[2], J. M. Griinari[3], and D. E. Bauman[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Natural ASA*, *Hovdebygda, Norway*, [3]*Clanet Ltd*, *Espoo, Finland*.

Previous investigations have established that *trans*-10, *cis*-12 conjugated linoleic acid (CLA) is a potent inhibitor of milk fat synthesis in dairy cows whereas *cis*-9, *trans*-11 CLA has no effect. However, in some cases of diet-induced milk fat depression (MFD), the formation of *trans*-10, *cis*-12 CLA in the rumen is inadequate to completely explain the observed effects. An increase in *trans*-9, *cis*-11 CLA has been observed in some instances of diet-induced MFD and our objective was to test the effect of a CLA mixture enriched in this isomer. Four rumen-fistulated lactating Holstein cows (149±18 DIM) were randomly assigned in a 4 X 4 Latin square experiment. Treatments were abomasal infusions of 1) ethanol (control), 2) *trans*-10, *cis*-12 CLA supplement (positive control), 3) *trans*-9, *trans*-11 CLA supplement, and 4) *trans*-9, *cis*-11 CLA supplement. The *trans*-10, *cis*-12 and *trans*-9, *trans*-11 CLA supplements were of high purity (>90%), whereas the *trans*-9, *cis*-11 CLA supplement consisted mainly of 3 CLA isomers: *trans*-9, *cis*-11 (32%), *cis*-9, *trans*-11 (29%) and *trans*-9, *trans*-11 (17%). CLA supplements supplied 5 g/d of the CLA isomer of interest and the daily dose was provided by infusion at 6 h intervals. Treatment periods were 5 d in length with a 7 d washout interval. Milk yield and DMI were unaffected by treatment ($P > 0.05$). Milk fat yield was reduced 27% by the *trans*-10, *cis*-12 CLA treatment and 15% by the *trans*-9, *cis*-11 CLA treatment, while the *trans*-9, *trans*-11 CLA treatment had no effect ($P < 0.001$). Milk protein content and yield were reduced by the *trans*-9, *trans*-11 CLA treatment only ($P < 0.01$). The transfer efficiency of specific CLA isomers within respective treatment groups was 22% for *trans*-10, *cis*-12 CLA, 21% for *trans*-9, *trans*-11 CLA and 46% for *trans*-9, *cis*-11 CLA ($P < 0.001$). Overall, abomasal infusion of *trans*-9, *cis*-11 CLA reduced milk fat synthesis, but to a lesser extent than *trans*-10, *cis*-12 CLA. This indicates that *trans*-9, *cis*-11 CLA may be responsible for a portion of the decreased milk fat production in some situations of diet-induced-MFD.

Key Words: Conjugated Lnoleic Acid, Milk Fat Depression, Dairy Cow

285 Effects of dietary CLA on thermogenesis and body temperature indices in lactating dairy cows. M. Rhoads, R. Rhoads, L. Odens, R. Burgos, S. Baker, B. Pollard, C. Moore, J. Kay, M. VanBaale, R. Collier, and L. Baumgard*, *The University of Arizona*, *Tucson*.

Dietary CLA markedly reduces milk fat synthesis without decreasing caloric intake or circulating NEFA levels in lactating dairy cows. During CLA-induced milk fat depression (MFD), bioenergetic alternatives for spared energy include increased milk synthesis, increased adipose lipogenesis or increased thermogenesis and heat loss, which was previously reported in non-lactating rodent calorimetry trials. Lactating Holstein cows (n=9) were housed in environmentally controlled chambers maintained at thermoneutral conditions (19°C, 39% relative humidity) and fed either a control diet or a CLA supplemented diet in a crossover design (two 6-d periods separated by a 5-d washout period). Diets (alfalfa-based TMR) were isoenergetic and provided either 290 g/d of a rumen inert palm oil supplement or 300 g/d of a rumen inert CLA supplement (containing several CLA isomers, including *trans*-10,*cis*-12). Temperature probes attached to CIDR devices and inserted into the vagina provided continuous (once every 5 min) core body temperature (BT) measurements during treatment periods. Shoulder, rump and tail head skin temperatures were determined twice daily. Skin and core BT are reported for the last 3 d of each period when MFD was maximized. Rectal temperatures were obtained on d 6 of each treatment period. CLA supplementation did not affect feed intake but increased milk yield (38.2 vs. 36.2 kg/d, P<0.02). CLA decreased milk fat content and yield by 34% (P<0.01) and 31% (P<0.01), respectively, but had little or no effect on milk protein and lactose parameters. Feeding CLA did not alter rectal temperature (38.5°C) or skin temperatures at the shoulder (33.8°C), rump (34.2°C) and tail head (33.4°C). Core (vaginal) BT did not differ between treatments (38.9°C). In conclusion, cows exhibiting CLA-induced MFD remained euthermic during CLA supplementation, and spared energy may have been partitioned towards enhanced milk synthesis.

Key Words: CLA, Body Temperature, Dairy Cow

286 Evaluation of gender and lysine during the nursery period. G. M. Hill*, S. K. Baidoo, G. L. Cromwell, D. C. Mahan, J. L. Nelssen, and H. H. Stein, *NCCC-42 Committee on Swine Nutrition*.

Split-gender feeding in the grow-finish period was an innovative technology of the last decade. However, due to various weaning strategies, it has not been adequately evaluated in the nursery. The objectives of our research were to determine (1) if gilts and barrows responded similarly to increased protein (lysine) after weaning and (2) if the current NRC lysine estimated requirements are adequate. Six experiment stations (MI, MN, KY, OH, KS, SD) utilized 748 pigs (average 6.7 kg BW and 19.4 ± 1.1 d). The pigs were allotted to four treatments in 32 replications (five to seven pigs/pen) in a RCB design. Barrows and gilts were penned separately, and complex nursery diets were fed in three phases (d 1 to 7, 8 to 21, 22 to 35). Lysine was provided at NRC estimated requirements or at 0.20% higher (1.35 vs. 1.55%, 1.25 vs. 1.45%, 1.15 vs. 1.35% for the three phases, respectively). Pigs and feed were weighed initially and at the end of each phase. The results demonstrated that gender did not affect ADG, ADFI or GF in any phase or during the 35-d study (453 vs. 452 g/d; 674 vs. 674 g/d; 0.67 vs. 0.67 for barrows and gilts, respectively). The higher lysine concentration improved ADG in phase 3 (627 vs. 588 g; $P \leq 0.001$) and overall (464 vs. 440 g; $P \leq 0.001$) more than when pigs were fed the NRC lysine estimated requirements. Increased lysine in the diet increased ADFI in phase 2 ($P \leq 0.05$), but not in the other phases or for the overall 35-d period. Gain:feed was improved by feeding higher lysine concentrations in phase 2 (0.78 vs. 0.70; $P \leq 0.001$) and in the overall 35-d experiment (0.69 vs. 0.65; $P \leq 0.001$). There was no evidence of a gender x treatment interaction ($P = 0.33$) for any trait during any of the phases or overall. Our results demonstrate that increasing lysine concentrations in nursery diets results in improved pig performance of both genders, and there appears to be no benefit in split-gender feeding during the nursery phase.

Key Words: Lysine, Gender, Nursery Pigs

287 The methionine requirement varies between individual weaned pigs fed a corn-soybean diet. S. Moehn*[1], A. Shoveller[1], M. Rademacher[2], and R. Ball[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Degussa AG*, *Hanau, Germany*.

Lowering dietary protein contents and increasing the use of free L-lysine in swine diets will result in more frequent DL-methionine (MET) supplementation. Better knowledge of the distribution of MET requirements of weaned pigs would allow adjustment of MET contents, based on cost vs. gain to maximize herd profitability. Our objective was to determine the MET requirement of individual weaned pigs and its variability using the indicator amino acid oxidation method. The MET requirement was determined in six pigs entering the study at 7 kg. Each pig received six levels of DL-MET (Degussa, AG) in a random order. The isonitrogenous and isoenergetic diets contained 0.187, 0.250, 0.290, 0.320, 0.350 and 0.363% MET as analyzed. Cysteine (0.46%) and lysine (1.40%) were constant for all diets. Pigs were adapted for 6 d to the basal corn-soybean diet, offered at 95 g/kg$^{0.75}$ body weight. During 4-h oxidation studies, 156.7 kBq, (SE 3.0), of L-[1-14C]phenylalanine (PHE) was mixed with each of eight half-hourly meals and expired CO_2 was collected. Data were tested for co-variables using the mixed procedure of SAS. The breakpoint in PHE oxidation, representing the MET requirement, and its variability, was determined using two-phase linear regression. PHE oxidation decreased when MET contents were increased from 0.187 to 0.29%. PHE oxidation was not different ($P > 0.2$) for diets providing 0.320 to 0.363% MET. The mean MET requirement was determined as 0.34% of diet (SD = 0.03%). Therefore, MET concentrations of 0.34, 0.38 and 0.42% will cover the requirement of 50%, 66% and 95%, respectively, of the population. The dietary MET requirement of 0.34% varied between 0.30 and 0.38% for individual pigs and was normally distributed. The recommended MET concentration for pigs of this body weight and feed intake by the 1998 NRC is 0.32% of diet. To maximize profitability, MET should be supplemented to starter pig diets depending on the cost of synthetic MET and the fraction of pigs whose requirement is to be met.

Key Words: Pig, Methionine, Requirement

288 Biological effectiveness of commercial methionine sources in piglet diets based on an equimolar trial design. M. Locatelli*[1] and R. Hall[2], [1]*Degussa Corporation*, *Kennesaw, GA*, [2]*Consultant*, *Franklin, IN*.

DL-methionine (DL-Met) is a feed industry standard for methionine additions. Two trials were conducted at the Cooperative Research Farms Nursery Unit, Webster City, IA to assess the biological effectiveness of liquid MHA-FA relative to DL-Met in starter pigs. In each trial, 490 crossbred weanling pigs (Cranbrook Swine Genetics), averaging 18 d and 4.85 kg at weaning, were blocked by initial weight and sex and allotted randomly to 49 pens (10 pigs/pen) and seven dietary treatments in a randomized complete-block design. A basal corn-soy diet deficient in methionine (0.22% in Trial 1 and 0.23% in Trial 2, but adequate in all other nutrients and energy was added with equimolar levels of DL-Met (0.03, 0.06 and 0.09% for diets 2, 3 and 4) and liquid MHA-FA (0.0342, 0.0684 and 0.1026% for diets 5, 6 and 7) at each trial. All seven diets were fed to barrows and gilts during a combined Phase 2 and 3 nursery period (9-37 d post-weaning, 8-20 kg live weight) in both trials. Non-linear regression analysis was used for daily gain and gain:feed. In both trials, piglets responded significantly to the addition of liquid MHA-FA and DL-Met, meaning that effectiveness was tested in the sensitive range. In order to reach the same response in weight gain, liquid MHA-FA was only 75% and 70% as effective as DL-Met (on a weight by weight basis) in Trial 1 and 2, respectively. The efficiency of liquid MHA-FA compared with DL-Met on a weight by weight basis for gain:feed was found to be 73% and 80% in Trial 1 and 2, respectively. The relative efficacy of liquid MHA-FA was 75% on average for both trials, which is close to the recommendations reported by the "CVB Study" of approximately 68% for broilers and 72% for piglets.

Key Words: Pig, Methionine Source, Effectiveness

289 Effect of replacing fish meal with synthetic amino acids in diets for 8 to 15 kg pigs. B. W. Ratliff*[1], A. M. Gaines[1], G. L. Allee[1], and J. L. Usry[2], [1]*University of Missouri-Columbia*, *Columbia*, [2]*Ajinomoto Heartland LLC*, *Chicago, IL*.

At a commercial research site with pigs of high health status, three independent experiments were conducted to evaluate the effect of replacing fish meal with synthetic amino acids in diets for 8 to 15 kg pigs. In Exp. 1, a total of 690 pigs (TR-4 × C22; 8.7 ± 0.11 kg) were allotted to one of five dietary treatments with six replicate pens/treatment and 23 pigs/pen. Treatments included five levels of fish meal (6.0, 4.5, 3.0, 1.5, and 0.0%, respectively). Fish meal was replaced with L-lysine·HCl (0.275, 0.363, 0.450, 0.538, and 0.625%, respectively) and additional synthetic amino acids (i.e., L-threonine, DL-methionine, L-tryptophan, L-isoleucine, and L-valine) supplied as necessary. Growth performance data was collected for 10 d. In Exp. 2, a total of 276 pigs (TR-4 × C22; 8.1 ± 0.05 kg) were allotted to one of two dietary treatments with six replicate pens/treatment and 23 pigs pen. Treatments included two level of fish meal (6.0 vs. 0.0%) with fish meal being replaced with L-lysine·HCl (0.275 vs. 0.625%) and additional synthetic amino acids supplied as necessary. Growth performance data were collected for 10 d. In Exp. 3, a total of 276 pigs (TR-4 × C22; 10.5 ± 0.17 kg) were allotted to the same dietary treatments as in Exp. 2 with six replicate pens/treatment and 23 pigs/pen. Growth performance data was collected for 12 d. Diets used for all experiments were formulated at a 1.42% true ileal digestible lysine and contained 7.0% lactose. In Exp. 1, replacing fish meal with synthetic amino acids had no effect on ADG ($P > 0.90$), ADFI ($P > 0.35$) or G/F ($P > 0.14$). Similarly, in Exp. 2 and 3, replacing 6% fish meal with synthetic amino acids had no effect on ADG ($P > 0.48$), ADFI ($P > 0.10$) or G/F ($P > 0.53$). Collectively, these data would suggest that fish meal can be replaced with synthetic amino acids in diets for 8 to 15 kg pigs without affecting growth performance.

Key Words: Pigs, Amino Acids, Growth

290 Estimation of the true ileal digestible sulfur amino acid:lysine ratio for growing pigs weighing 28-49 kilograms. G. F. Yi*[1], A. M. Gaines[2], B. W. Ratliff[2], P. Srichana[2], G. L. Allee[2], C. D. Knight[1], and K. R. Perryman[1], [1]*Novus International, Inc.*, *St. Charles, MO*, [2]*University of Missouri*, *Columbia*.

The objective of this research was to evaluate the optimum true ileal digestible (TID) sulfur amino acid:lysine (SAA:LYS) ratio for growing barrows and gilts weighing 28 to 49 kg reared under commercial conditions. A total of 1,650 growing gilts (TR4 × C22; 30.6 ± 0.50 kg) and 1,648 growing barrows (TR4 × C22; 31.1 ± 0.60 kg) were allotted to one of five dietary treatments in a RCBD with fifteen replicate pens (22 pigs/pen) per treatment. Dietary treatments included five levels of TID SAA:LYS ratios (49.5, 54.5, 59.5, 64.5, and 69.5%, respectively). Diets were formulated at a 0.90% TID lysine (CP 14.5%) and contained 0.40% L-lysine·HCl. Dietary SAA content was increased by adding Alimet® feed supplement (88% L-methionine activity) with additional synthetic amino acids supplemented to meet minimum amino acid ratios. Growth performance data was collected for 17 d. For gilts, increasing the TID SAA:LYS ratio increased (linear, $P < 0.02$; quadratic, $P < 0.27$) ADG (895, 928, 919, 923, and 931 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.01$) G:F (0.449, 0.460, 0.467, 0.465, and 0.466). For barrows, increasing the TID SAA:LYS ratio increased (linear, $P < 0.001$; quadratic, $P < 0.01$) ADG (907, 956, 960, 967, and 955 g/d) and improved (linear, $P < 0.001$; quadratic, $P < 0.001$) G:F (0.446, 0.464, 0.467, 0.469, and 0.465). The breakpoint of the broken-line regression model, the intercept of the broken-line and quadratic curve, and the 95% upper asymptote of the quadratic response indicated that the optimum TID SAA:LYS ratios for ADG were 60.0%, 62.0%, and 62.6% in gilts and 61.0%, 63.5%, and 61.3% in barrows, and for G:F were 57.3%, 60.5% and 62.9% in gilts and 60.7%, 63.0% and 62.0% in barrows respectively. (ALIMET® is a trademark of Novus International, Inc., and is registered in the United States and other countries.)

Key Words: Sulfur Amino Acids, Growth, Growing pigs

291 Effects of protein source on true ileal digestible (TID) isoleucine:lysine ratio in pigs from 58 to 76 kg. S. X. Fu*[1], R. W. Fent[1], P. Srichana[1], B. W. Ratliff[1], G. L. Gary[1], and J. L. Usry[2], [1]*University of Missouri-Columbia*, [2]*Ajinomoto Heartland, LLC*, *Chicago, IL*.

A total of 297 pigs were used to determine the effects of protein source on TID Ile:Lys ratio for pigs from 58 to 76 kg. Pigs were blocked by weight and sex and allotted to one of eleven dietary treatments with seven replicates per treatment (five replicates of three pigs/pen and two replicates of six pigs/pen). Treatment 1 was a corn-SBM control diet containing 0.25% L-Lys HCl. Treatments 2 to 11 were a 2 x 5 factorial arrangement. The factors included: two protein sources [8.5% SBM plus synthetic amino acids (AA) or 7.15% red blood cells (RBC)] and five levels of TID Ile:Lys ratio (47, 53, 59, 65, and 71%). All diets were isocaloric and contained 0.80% TID Lys. Pigs fed corn-SBM+AA diets with Ile:Lys ratio of 53, 59 and 65% and pigs fed corn-RBC diet with an Ile:Lys ratio of 59% had similar performance as control pigs. Interactive effects ($P < 0.01$) on ADG, ADFI and G:F were observed between protein source and TID Ile:Lys ratio. In corn-SBM+AA diets, as TID Ile:Lys ratio increased, quadratic responses were observed for ADG (1.038, 1.104, 1.111, 1.078 and 1.022 kg/d, respectively; $P = 0.04$) and ADFI (2.798, 2.868, 2.879, 2.798 and 2.670 kg/d, respectively; $P = 0.03$) with no response in G:F (0.370, 0.385, 0.387, 0.387 and 0.384, respectively; $P = 0.59$). Increasing Ile:Lys ratio improved performance of pigs fed corn-RBC diets in terms of ADG (0.633, 0.828, 1.071, 1.037 and 1.035 kg/d, respectively; linear and quadratic $P < 0.001$), ADFI (2.124, 2.234, 2.773, 2.655 and 2.619 kg/d, respectively; linear and quadratic, $P < 0.001$) and G:F (0.300, 0.369, 0.387, 0.391 and 0.395 kg/d, respectively; linear, $P < 0.001$and quadratic, $P = 0.02$). Using quadratic model (95% of maximum), TID Ile:Lys ratio was estimated to be 55.2% (ADG) for pigs fed corn-SBM diets and 62.0% (ADG and G:F) for pigs fed corn-RBC diets. In conclusion, TID Ile:Lys ratio of pigs was affected by dietary protein source; pigs fed corn-RBC diets require a higher TID Ile:Lys ratio to maximize growth performance than pigs fed corn-SBM diets.

Key Words: Isoleucine, Blood Cells, Pigs

292 Effect of L-Lysine·HCl supplementation in 52 to 104 kg pigs reared under commercial conditions. P. Srichana*[1], A. M. Gaines[1], B. W. Ratliff[1], G. L. Allee[1], and J. L. Usry[2], [1]*University of Missouri*, *Columbia*, [2]*Ajinimoto Heartland LLC*, *Chicago, IL*.

Two experiments were conducted at a commercial research site to evaluate the effect of L-lysine·HCl supplementation in early and late finishing pig diets. In Exp. 1, a total of 1,680 pigs (TR-4 × C22; 52.13 ± 0.26 kg) were used in a randomized complete block design with 16 replicate pens/treatment and 21 pigs/pen. Dietary treatments included five levels of L-lysine·HCl that corresponded to concentrations of 0.00, 0.10 0.20, 0.30, and 0.40%, respectively. Experimental diets were corn-soybean meal-based with 5% choice white grease formulated at a 0.87% true ileal digestible (TID) lysine (2.43 g TID lysine/Mcal ME). Growth performance data was collected for 21 d. In Exp. 2, a total of 1,680 pigs (TR-4 × C22; 78.02 ± 0.29 kg) were used in a randomized complete block design with 16 replicate pens/treatment. Dietary treatments included five levels of L-lysine·HCl that corresponded to concentrations of 0.00, 0.10, 0.20, 0.30, and 0.40%, respectively. Experimental diets were corn-soybean meal-based with 5% choice white grease formulated at a 0.75% TID lysine (2.11 g TID lysine/Mcal ME). Growth performance data was collected for 25 d. For Exp. 1, increasing the L-lysine·HCl inclusion resulted in a decrease (linear, $P < 0.01$) in ADG (1,098, 1,080, 1,089, 1,084, and 1,061 g/day, respectively), which was attributed to a lower ADG in pigs fed 0.40% L-lysine·HCl. Furthermore, increasing the inclusion of L-lysine·HCl lowered (linear, $P < 0.01$; quadratic, $P < 0.05$) G/F (0.413, 0.411, 0.412, 0.409, and 0.400, respectively). For Exp. 2, increasing the L-lysine·HCl inclusion resulted in a decrease (linear, $P < 0.01$; quadratic, $P < 0.01$) in ADG (1,048, 1,052, 1,066, 1,030, and 1,002 g/day, respectively) and lowered (linear, $P < 0.01$; quadratic $P < 0.001$) G/F (0.331, 0.334, 0.335, 0.331, and 0.320, respectively). There were no differences ($P = 0.16$) in ADFI. These experiments demonstrate that growth performance of early (52-78 kg) and late (78-104 kg) finishing pigs is not compromised when diets contain 0.30 and 0.20% L-lysine·HCl, respectively.

Key Words: Pigs, L-Lysine HCl, Growth

293 Response of boar and gilt pigs in the weight range 60 to 100 kg to lysine concentration in the diet. M. K. O'Connell[1,2], P. B. Lynch*[1], J. V. O'Doherty[2], and P. G. Lawlor[1], [1]*Moorepark Research Centre*, *Fermoy, Co. Cork, Ireland*, [2]*University College*, *Belfield, Dublin, Ireland*.

Two trials were conducted to determine the optimum dietary lysine concentration for maximum growth rate (ADG) or minimum feed conversion ratio (FCR) of boars and gilts from 60 to 90 kg and 80 to 100 kg. Ninety same-sex pairs and six treatments (dietary lysine concentrations) were used in Exp. 1 (60 to 90 kg), and 144 pairs and eight treatments in Exp. 2 (80 to 100 kg) in a randomised block design. Isoenergetic diets (13.8 MJ DE/kg) were based on barley, wheat, soyabean meal, vitamins, minerals and amino acids. Dietary lysine concentrations were: 7.9, 8.8, 9.7, 10.7, 11.7 and 12.5 g/kg in Exp. 1 and 7.0, 7.9, 8.8, 9.7, 10.7, 11.7, 12.5 and 13.5 g/kg in Exp. 2. Ratios of the main amino acids to lysine were held constant. In Exp. 1, ADG increased (quadratic, $P < 0.01$) and FCR improved (quadratic, $P < 0.001$) with increased lysine levels. Although boars grew faster ($P < 0.001$) and more efficiently ($P < 0.001$) than gilts, maximum ADG was predicted at 10.8 g lysine/kg and minimum FCR at 10.9 g lysine/kg for both. In Exp. 2 (80 to 100 kg), a treatment x sex interaction for ADG ($P < 0.01$) and FCR ($P < 0.05$) indicated that boars grew faster and had better FCR than gilts, and the difference between sexes was greater at higher lysine levels. Maximum ADG was predicted at 11.8 and 9.9 g lysine/kg and minimum FCR at 11.9 and 10.0 g lysine/kg for boars and gilts, respectively. In both experiments, daily lysine intake (DLYIN) increased ($P < 0.001$) with increasing dietary concentrations and maximum ADG was predicted at DLYIN of 26.0 and 26.3 g/d for Exp. 1 and 2, respectively. Lysine conversion ratio (LCR) was better for boars than gilts in Exp. 1 and there was a treatment x sex interaction for LCR in Exp. 2 ($P < 0.01$), where the difference between the sexes was greater at higher concentrations. In conclusion, boars grew faster and more efficiently, with interactions indicating a greater sex difference in performance at higher lysine levels.

Key Words: Lysine, Boar, Gilt

294 Influence of diet protein level and season on growth performance of finishing pigs. R. Myer*, J. Brendemuhl, and R. Bucklin, *University of Florida*, *Gainesville*.

A two year study was conducted to evaluate the effects of diet type (low protein diet supplemented with crystalline AA vs. higher protein, non AA supplemented control diet) and season/rearing environment (hot humid summer vs. cool fall/winter) on growth performance and carcass lean content of finishing pigs (52 to 110 kg). For each year, two trials, each with 84 pigs, were conducted - one during the summer and the other during the late fall/winter in north Florida (29.5° N lat.). Outside daily high and low temperatures (C) and RH (%), respectively, averaged 26, 21 and 81; 26, 20 and 83; 14, 7, and 80; and 10, 3 and 77 for yr 1 and 2 summer, and yr 1 and 2 winter, respectively. Diets were corn and soybean meal based (3.3 Mcal ME/kg). The low protein (LP) diets were four percentage units lower in CP than the corresponding control diets; crystalline Lys, Thr, Trp and met were added to the LP diets to meet the pigs' requirements. For each trial, split sex finisher I, from 52 to 82 kg, and finisher II, 82 to 110 kg, diets were fed. Each dietary treatment was fed to six pens of seven pigs for each trial. Pigs were housed in an open sided building in pens with slotted concrete floors and water sprinklers were used during warm weather (> 25°C). Floor space was 0.7m^2 per pig. Pigs reared during the summer grew 9% slower than pigs reared during the fall/winter (0.88 vs. 0.97 kg/d; $P < 0.001$); ADF and G/F were also affected by season ($P < 0.001$). Pigs fed the LP + AA diets averaged 3% lower ADG than pigs fed the control diets (0.91 vs. 0.94 kg; $P < 0.01$); ADF and G/F were not affected ($P > 0.10$). The decrease in ADG was more pronounced during the summer vs. fall/winter (6% vs. 1%; season x diet; $P = 0.05$). The decrease noted occurred only during finisher II (0.91 vs. 0.84 kg/d; $P < 0.001$). Carcass lean (ultrasound) was not affected by diet or season (mean = 51% fat free). The feeding of a LP + AA diet type used appears not to be of particular benefit on improving finishing pig growth performance under hot and humid conditions.

Key Words: Pigs, Protein, Heat Stress

295 Nutrition induced variation in body composition, compensatory growth, cortisol and leptin in growing pigs. H. R. Martínez* and C. F. M. de Lange, *The University of Guelph*, *Guelph, Ontario, Canada*.

In this experiment, we assessed the effect of amino acid (AA) intake restriction in entire male Yorkshire pigs between 15 and 38 kg BW (restriction phase) on growth rate, body composition, and plasma levels of blood urea nitrogen (BUN), cortisol (Co) and leptin (Li) during the subsequent re-alimentation phase. During the restriction phase, 36 pigs were allotted to one of two dietary AA levels (control and -40%AA). Thereafter, all pigs were fed common diets that did not limit whole body protein deposition (Pd). Throughout the experiment, pigs were fed restricted at 90% of voluntary daily DE intake according to the 1998 NRC. At the end of the restriction phase, pigs on control had higher ADG (784 vs. 650 g/d; SE, 11), loin area (LA), loin depth (LD), BUN and Co (19.2 vs. 8.2 ug/dL; SE, 0.81) and lower back fat thickness (BF; 6.56 vs. 7.56 mm; SE, 0.27) and Li (1.8 vs. 2.7 ng/mL; SE, 0.19) than pigs on -40%AA ($P < 0.05$). During the re-alimentation phase, pigs showed full compensatory growth (CG; control vs. -40%AA), in terms of ADG (1077 vs. 1170 g/d; SE, 16), Pd (163 vs. 179 g/d; SE, 2.7; $P < 0.05$), whole body lipid deposition (Ld; 228 vs. 210; SE, 10.3) Ld/Pd (1.42 vs. 1.18; SE, 0.07; $P < 0.05$) and body composition at 110 kg BW (body lipid mass/body protein mass; LB/PB; 1.15 vs. 1.14; SE, 0.04; $P > 0.10$). There were no effects of previous AA intake restriction on Li and BUN at 45, 53 and 68 kg BW ($P > 0.10$). Carcass characteristics at 110 kg BW were not influenced by previous AA intake restriction ($P > 0.10$): BF (17.0 vs. 18.2 mm; SE, 1.4), LA (46.3 vs. 45.6 cm^2; SE, 1.14) and loin colour. Circulating Li levels allow for involvement of the brain in control of body composition (LB/PB). Plasma BUN level is not a sensitive indicator for compensatory Pd. Plasma Co levels may act as indicator of amino acid induced restriction in Pd in growing pigs. CG was observed during the energy dependent phase of Pd and is driven by a target body composition (LB/PB), possibly mediated via plasma leptin levels.

Key Words: Body Composition, Leptin, Cortisol

296 Impact of time of feeding of lysine-deficient diets and dietary protein level on the intramuscular fat content of pork. E. Castaneda*[1,2], M. Ellis[1], and F. McKeith[1], [1]*University of Illinois*, *Urbana-Champaign*, [2]*Consejo Nacional de Ciencia y Tecnologia*, *Mexico, Distrito Federal. Mexico*.

This study was carried out as a completely randomized design with a 3 × 4 factorial arrangement of treatments: 1) time of feeding (9, 6, and 3 wk prior to harvest); 2) dietary protein-lysine levels [a) Control (100% CP, 100% Lys; CP and Lys at requirement); b) 78% CP, 78% Lys; c) 56% CP, 56% Lys; and d) 100% CP, 56% Lys]. A total of 144 gilts were housed in groups of four and fed a two-phase program: Finisher I [70-90 kg BW for 21 d; CP = 14.5, 11.3, 8.1, and 14.5%, and true digestible lysine (TDL) = 0.70, 0.54, 0.39, and 0.39% for Diet 1, 2, 3, and 4, respectively (resp.)], and Finisher II (91-125 kg BW for 42 d; CP = 13.5, 10.5, 7.5, and 13.5%, and TDL = 0.57, 0.44, 0.32, and 0.32%, resp.). Increased feeding time reduced ($P < 0.05$) ADG (1.01, 0.94 and 0.87 kg/d, for 3, 6, and 9 wk, resp.; SEM = 0.028), ADFI (3.06, 2.84 and 2.53 kg/d, resp.; SEM = 0.106), and weight of carcass fat-free lean (51.3, 48.6, and 46.5 kg, resp.; SEM = 1.30), but increased semimembranosus intramuscular fat (IMF; 2.38, 2.67, and 3.06%, resp; SEM = 0.536). Diet had an effect ($P < 0.05$) on overall ADG (1.12, 1.06, 0.78, and 0.81 kg/d for Diets 1, 2, 3, and 4, resp.; SEM = 0.028), ADFI (2.88, 3.04, 2.68, and 2.64 kg/d, resp.; SEM = 0.115), G:F (0.39, 0.35, 0.29, and 0.31, resp.; SEM = 0.010), carcass fat-free lean (53.0, 50.8, 45.5, and 45.9 kg, resp.; SEM = 1.35), and semimembranosus IMF (2.31, 2.56, 2.74, and 3.20%, resp; SEM = 0.541). There was a feeding time by diet ($P < 0.05$) interaction for longissimus IMF. For the control diet, IMF was greater ($P < 0.05$) for the 6- than the 3-wk treatments (2.58, 3.24, and 3.19% for 3-, 6-, and 9-wk treatments, resp.; SEM = 0.273); for diet 2 (3.21, 3.57, and 4.49%, resp.; SEM = 0.274) and diet 4 (3.37, 4.44, 5.72, resp.; SEM = 0.270), IMF increased with feeding time; for diet 3, IMF was lower for the 6-wk than for the 3- and 9-wk treatments (3.74, 2.86, and 3.37%, resp.; SEM = 0.280). These results suggest that dietary protein and lysine level influence the IMF content of pork.

Key Words: Pigs, Protein, Intramuscular Fat

297 The effect of feeding frequency on energy and amino acid digestibility by growing pigs. A. Pahm*, F. Chastanet, C. Pedersen, and H. H. Stein, *South Dakota State University*, *Brookings*.

An experiment was conducted to determine if the feeding frequency affects the digestibility of energy and AA by growing pigs. Six growing barrows (initial BW: 40.1 kg ± 2.3 kg) had T-cannulas installed in the distal ileum and were randomly allotted to one of three dietary treatments in a repeated 3 X 3 Latin square design with three animals and three periods. Each period lasted 7 d and all pigs were fed the same corn-soybean meal based diet (18% CP) throughout the experiment. Pigs allotted to Treatments 1 and 2 were provided the diet at a level of three times the energy requirement for maintenance. The feed to pigs on Treatment 1 was provided in one daily meal while the feed to pigs on Treatment 2 was divided into two equal daily meals. Pigs on Treatment 3 were allowed to consume the diet on an ad libitum basis. Fecal samples were collected on d-5 and ileal samples on d-6 and d-7 of each period. The apparent ileal digestibility coefficients (AID) of DM, CP, AA, and energy and the apparent total tract digestibility coefficients (ATTD) of DM and energy were calculated. No differences among treatments were observed for the AID of DM, energy, CP, or any of the AA. In contrast, the ATTD of DM and energy were lower ($P \leq 0.002$) for pigs that were allowed to consume their feed on an ad libitum basis compared to pigs on the other two treatments (85.1 vs. 87.3 and 88.9% for DM and 83.3 vs. 86.0 and 87.7% for energy). The DE concentration of the diet was calculated as 3,436 kcal per kg for the pigs given free access to feed. This value was lower ($P \leq 0.001$) than the values calculated for the pigs fed once or twice daily (3,544 and 3,617 kcal per kg, respectively). In conclusion, results of this experiment suggest that the AID for DM, energy, CP, and AA are not influenced by the frequency of feeding, but the ATTD for DM and energy is lower if pigs are fed on an ad libitum basis than if they are fed a restricted amount of feed in one or two daily meals.

Key Words: Digestibility, Feeding Frequency, Pigs

298 Measuring aseasonality in a crossbred pedigree developed for mapping QTL. R. G. Mateescu*, M. L. Thonney, W. R. Butler, and M. C. Smith, *Cornell University*, *Ithaca, NY*.

An experimental crossbred pedigree was created to identify QTL contributing to aseasonality by crossing Dorset ewes with East Friesian rams and breeding F1 rams to Dorset ewes. Aseasonality in 117 yearling backcross ewes was assessed using a blood progesterone profile prior to, during and after the spring 2003 breeding season. Blood samples were taken twice weekly during 14 wk from 3 February to 9 May. This period included 28 d prior to breeding with teaser rams included the last 16 d, 31 d with intact Dorset rams known previously to sire August-September born lambs, and 21 d after the intact rams were removed. Rams were brisket-painted and the identification numbers of freshly marked ewes were recorded twice weekly. Blood progesterone levels were used to determine the estrous cycles for individual ewes and to detect early conception as indicated by a constant high level of progesterone. Transabdominal ultrasound was performed at 35 and 55 d after the breeding season to detect early pregnancy. The final measure of lambing out-of-season was the actual lambing in the August-September lambing season. Only 9 ewes did not exhibit an estrous cycle during the spring breeding season. However, only 20 ewes (18.5% of ewes cycling) were detected with an early conception based on the progesterone level. Ultrasound confirmed 19 of them. Only ten ewes lambed in the August-September lambing season. While brisket-painting resulted in 63 ewes marked by vasectomized rams and 43 ewes marked by intact rams, only three of the 10 ewes that lambed were marked by intact rams, indicating that this method of detecting estrus was unreliable. Whether a ewe lambs and how many lambs she delivers after spring breeding is the ultimate and economically important measure of aseasonality. Our data suggest that low out-of-season lambing success is not related to lack of ovulation, but to relatively lower ability to conceive and to maintain pregnancy after spring conception. These results are in agreement with Pope et al. (1989) indicating that relatively lower ability to maintain pregnancy after a spring conception is an important factor contributing to low aseasonal reproductive success.

Key Words: Aseasonality, QTL, Sheep

299 Advanced reduction of estradiol negative feedback on secretion of LH facilitates induction of precocious puberty in heifers that are weaned early and fed a high-concentrate diet. C. L. Gasser*, G. A. Bridges, M. L. Mussard, D. M. Dauch, D. E. Grum, J. E. Kinder, and M. L. Day, *The Ohio State University*, *Columbus*.

Puberty can be induced precociously (< 300 d of age) in beef heifers by early weaning and feeding a high-concentrate diet. We conducted an experiment to test the hypothesis that precocious puberty occurs as a result of advanced reduction of estradiol (E) negative feedback on secretion of LH. Thirty crossbred Angus heifers were weaned at 83 ± 1.9 d of age, blocked by weight, and randomly assigned to receive either a high-concentrate (60% corn; H) or control (30% corn; C) diet and to either receive ovariectomy (OVX), OVX with an E implant (OVXE), or remain intact (INT). All heifers were fed a receiving diet until 4 mo of age, at which time heifers were transitioned to treatment diets. Blood samples were collected weekly starting at 6 mo of age to determine concentrations of progesterone and E. Serial blood samples were collected at 12-min intervals for 12 hr at 4, 5, 6.5, 7.5, 8.5, 9.5, 10.5, 12, 13.5, and 15 mo of age to characterize LH concentrations. Due to incomplete ovariectomy, 6 heifers were removed from the experiment (OVX-C, n = 3; OVXE-H, n = 2; OVXE-C, n = 4; OVX-H, INT-H, INT-C, n = 5). Heifers fed the H diet were heavier ($P < 0.05$) than C heifers by 160 d of age. Heifers in the INT-H treatment attained puberty earlier ($P < 0.05$) than INT-C heifers (275 ± 29.9 and 385 ± 13.6 d of age, respectively). Concentrations of E did not differ between OVXE and INT heifers across the experiment. In OVXE-H heifers LH secretion "escaped" E negative feedback (≥1 LH pulse/hr) earlier ($P < 0.05$) than in OVXE-C heifers (307 ± 29.7 and 420 ± 21.0 d of age, respectively). Age at escape did not differ from age at puberty for INT heifers within the respective diets (OVXE-H vs. INT-H, OVXE-C vs. INT-C). Characteristics of LH were not different between OVX-H and OVX-C heifers. Advanced reduction of estradiol negative feedback on secretion of LH is the mechanism by which early weaning and feeding a high-concentrate diet results in precocious puberty in heifers.

Key Words: Puberty, LH, Heifer

300 Effect of maternal undernutrition on capillary vascularity of the bovine placentome. K. Vonnahme*[1], L. Reynolds[1], P. Borowicz[1], D. Miller[1], B. Caton[1], B. Hess[2], and S. Ford[2], [1]*North Dakota State University*, *Fargo*, [2]*University of Wyoming*, *Laramie*.

Improper maternal nutrition during pregnancy in ewes greatly impacts the capillary vascularity of placentomes (Redmer et al., 2004. Dom Anim Endo. 27:199-217). In the beef cow, the effect of early maternal undernutrition followed by realimentation on placentomal capillary vascular density was determined. Multiparous beef cows bred to the same bull and carrying female fetuses (n=30) were fed in equal numbers to either meet NRC requirements (control; C) to gain weight (average = + 4.25% body weight) or fed below NRC (nutrient restricted; NR) to lose weight (average = - 6.8% body weight) from d 30 to d 125 of gestation. On d 125, ten C and ten NR cows were necropsied, and the remaining 5 C and 5 NR cows were realimented to 100% NRC until necropsy on d 250 of gestation. At necropsy, weights of placentomes were recorded and placentomes were fixed by perfusion of Carnoys-Mercox via the caruncular (CAR; maternal portion of the placentome) and cotyledonary (COT; fetal portion of the placentome) arteries. After fixation, the placentomes were embedded in paraffin, sectioned and stained (hematoxylin and periodic acid-Schiffs). Vascularity was then determined by image analysis (Image-Pro Plus). For modeling purposes we evaluated for CAR and COT: capillary area/unit tissue area (capillary area density, CAD; blood flow related measure), capillary no./unit tissue area (capillary no. density, CND), and capillary surface area/unit tissue area (capillary surface density, CSD; nutrient exchange related measure). On day 125 of gestation, there were no differences between C and NR cows in CAD, CND, or CSD in either COT or CAR tissue. On day 250 of gestation, CAD, CSD, and CND from COT were decreased ($P<0.01$) in NR vs C cows (8.3 ± 1.3 vs 11.2 ± 0.8 um2; 0.039 ± 0.004 vs 0.054 ± 0.004; 421 ± 64 vs 613 ± 82, respectively). CSD in NR CAR tended to be increased ($P<0.09$) compared to C CAR (0.244 ± 0.04 vs 0.193 ± 0.01). The increase in the ability of nutrient exchange in the CAR on day 250 of gestation may have resulted in the catch-up of fetal growth by the end of gestation in the NR cows that were realimented (presented in another abstract at this meeting).

Key Words: Placenta, Vascularity, Cow

301 Effects of estradiol (E2) and flaxseed meal (FSM) on organ weights in ovariectomized (OVX) ewes. M O'Neil*, G. P. Lardy, L. P. Reynolds, J. S. Caton, and K. A. Vonnahme, *North Dakota State University*, *Fargo*.

Flaxseed contains secoisolariciresinol diglycoside (SDG), a phytoestrogen (PE) proposed to have both estrogenic and anti-estrogenic properties. The objective of the current study was to determine the estrogenic properties of SDG in OVX ewes. OVX ewes (n = 48) were fed a PE-free diet for four weeks (d -28 to d 0) following OVX to ensure the absence of any circulating endogenous estrogen or dietary PE. On d 0, OVX ewes were assigned randomly to a control group (PE-free diet; CON; n=12) or a 12.5% FSM for 1, 7, or 14 d (n = 12/group). Diets were based on beet pulp and formulated to provide similar amounts of energy (2.7 Mcal/kg) and CP (13.6%). On the last day of FSM feeding, OVX ewes were implanted with a subcutaneous E2 implant (100 mg) for 0, 6, or 24 h. At necropsy, uteri, liver, and duodenum were weighed. Tissue weights are expressed as % empty body weight (live weight minus blood and digesta weight). Effect of E2 on uterine weight depended upon hours exposed to E2 and days fed FSM ($P < 0.05$). Uterine weight increased ($P < 0.05$) from 0 h to 24 h E2

treatment in CON and 1 d FSM fed ewes. However, in ewes fed FSM for 7 or 14 d, E2 exposure had no effect on uterine weight. Similarly, liver and duodenal weights for CON ewes increased with increased E2 exposure ($P < 0.05$), but the increase in liver weight was ablated in ewes fed FSM for 1, 7, or 14 d. Furthermore, ewes fed FSM for 14 d and 24 h E2 exposure had decreased ($P<0.05$) duodenal weight compared to ewes fed 14 d FSM and 0 h E2 exposure. PE compounds in FSM influence the effects of exogenous E2 on organ mass in OVX ewes. These effects warrant further investigation at a mechanistic level.

Effect of dietary FSM and exogenous E2 on tissue weights in OVX ewes (% body weight)

		D Fed FSM				
	Hr Post E2	0	1	7	14	Pooled SEM
Uterus	0	$0.05^{a,b}$	0.05^{a}	$0.06^{a,b}$	$0.06^{a,b}$	0.01
	6	$0.07^{a,b}$	$0.07^{b,c,d}$	$0.07^{a,b,c}$	$0.06^{a,b}$	0.01
	24	0.10^{e}	0.13^{f}	$0.09^{c,d,e}$	$0.09^{d,e}$	0.01
Liver	0	1.34^{a}	$1.45^{a,b}$	$1.54^{a,b,c}$	$1.48^{a,b,c}$	0.04
	6	$1.52^{a,b,c}$	$1.51^{a,b,c}$	$1.50^{a,b,c}$	1.38^{a}	0.06
	24	1.63^{c}	$1.59^{b,c}$	1.63^{c}	1.39^{a}	0.06
Duodenum	0	0.12^{a}	$0.19^{b,c}$	$0.20^{b,c}$	0.21^{c}	0.02
	6	$0.16^{a,b,c}$	$0.19^{b,c}$	$0.20^{b,c}$	0.12^{a}	0.02
	24	$0.19^{b,c}$	$0.16^{a,b,c}$	$0.14^{a,b}$	$0.15^{a,b}$	0.01

^{a,b,c,d,e,f}Means ± SEM within tissue differ, $P<0.05$

Key Words: Flaxseed, Estrogen, Sheep

302 17ß-estradiol concentrations in Holstein whole milk. D. A. Pape-Zambito*, A. L. Magliaro, and R. S. Kensinger, *Pennsylvania State University*, *University Park*.

Some public health professionals have expressed concern over estrogens in food due to their potential to promote growth of estrogen sensitive cancers. Whereas papers have reported levels of estrogen in milk, relatively few whole milk samples from commercial dairy cows were analyzed. Objectives of this study were to reevaluate E_2 concentrations in Holstein whole milk using solvent extraction and RIA, as well as to relate E_2 concentrations to reproductive status of the cow. Milk samples and weights were collected during a single a.m. milking from lactating cows in the university dairy herd. Triplicate samples were collected; two were analyzed for fat, protein, and lactose content, whereas one was used for E_2 analysis. Homogenized whole milk (1ml) was extracted twice with ethyl acetate and once with methanol. After each extraction the solvent was dried under nitrogen at 50C. Assay buffer (PBSg) was used to reconstitute the final extract prior to quantification of E_2 using RIA. Cows were classified as: early pregnant (EP, 1-140 d pregnant), late pregnant (LP, 141-210 d pregnant), and other (O) which were primarily open cows. The E_2 concentration range in whole milk was 1.2 to 17.6 pg/ml. Milk E_2 concentrations were 4.30 ± 3.2, 8.50 ± 5.1, and 8.61 ± 4.4 pg/ml for O (n = 38), EP (n = 9), and LP (n = 11) cows, respectively. Milk E_2 concentrations were not significantly different between EP and LP cows but milk E_2 was lower for O cows ($p < 0.05$). There was no significant correlation between E_2 concentration and % fat in milk. Mean milk yield at that milking was 17.22 ± 6.02 L, and total E_2 mass in milk averaged 95.65 ± 84.5 ng which was not different among O, EP and LP. Fat and lactose % in milk were 3.63 ± 0.6 and 4.80 ± 0.3%, respectively, for all cows. Mean protein % was 3.15 ± 0.2, 3.27 ± 0.2 and 3.36 ± 0.3% for O, EP, and LP cows, with O having less milk protein than LP ($p < 0.05$). Although E_2 concentrations are increased in pregnancy, the relatively low concentrations of E_2 in whole milk are unlikely to pose a health risk to humans.

Key Words: 17B-Estradiol, Pregnancy, Whole Milk

303 The use of melatonin and progestagen to advance the breeding season in Awassi sheep. R. Kridli* and H. Muhdi, *Jordan University of Science and Technology*, *Irbid, Jordan*.

This experiment was conducted to evaluate the effect of administering hormonal treatments [melatonin, progestagen and pregnant mare's serum gonadotropin (PMSG)] on advancing the breeding season and reproductive parameters in Awassi ewes. Thirty-nine multiparous, winter lambing Awassi ewes were randomly assigned into four treatment groups; no hormonal treatment (NCON; n=9), progestagen (CON; n=10), progestagen and PMSG (PP; n=10) and melatonin plus progestagen and PMSG (MPP; n=10). Ewes in the CON, PP and MPP groups were fitted with intravaginal progestagen sponges for 14 days. On the day of sponge removal, ewes in the PP and MPP groups received 600 IU PMSG. Ewes in the MPP group received subcutaneous melatonin implants (Regulin®, 18 mg melatonin) 36 days before sponge insertion (50 days before the anticipated breeding season). Fertile, harnessed Awassi rams were introduced at the time of sponge removal. More ewes expressed estrus ($P<0.05$) in the CON, PP and MPP than the NCON group while the interval to onset of estrus was similar among treatments. Induced estrus pregnancy rate, lambing rate and the number of lambs born per exposed ewe were significantly greater ($P<0.05$) in the MPP group than NCON group while the remaining groups were similar. Ewes in the CON, PP and MPP groups lambed earlier ($P<0.01$) than those in the NCON group. Litter size was similar among all groups while litter birth weight was greater ($P<0.05$) in the MPP than the NCON group. Results of the present study indicate that early breeding of Awassi ewes can be induced by hormonal treatments. These treatments can be successfully applied to improve induced estrus reproductive parameters in Awassi sheep.

Acknowledgements: This project was funded by Jordan University of Science and Technology

Key Words: Reproduction, Sheep, Breeding Season

304 Plasma progesterone profiles in response to repeated blood sampling after estrus and mating in pregnant and open ewes. R. W. Godfrey*[1], R. E. Dodson[1], and S. T. Willard[2], [1]*University of the Virgin Islands*, *St. Croix, VI*, [2]*Mississippi State University*, *Mississippi State*.

We have reported previously that progesterone (P4) increased during a 6-h period in diestrus ewes. The objective of this study was to evaluate daily patterns of P4 secretion in ewes after mating. St. Croix White ewes were synchronized using CIDRs. On the day of CIDR removal ewes were put with either a fertile or sterile ram resulting in 10 pregnant (PREG) and 11 open (OPEN) ewes. Jugular blood samples were collected hourly from 0600 to 1800 h 2 days after CIDR withdrawal (d 0) and on d 3, 6, 9, 12, 15 and 18. Plasma was analyzed for P4 by RIA. Data were anlayzed using GLM procedures of SAS. The PREG ewes had higher ($P < 0.0001$) P4 than OPEN ewes on d 15 (4.3 ± 0.1 and 0.4 ± 0.1 ng/ml) and 18 (4.8 ± 0.1 and 0.1 ± 0.1 ng/ml). In OPEN ewes the 0600 h sample on d 0 (0.4 ± 0.3 ng/ml) was lower ($P < 0.0001$) than on d 6 (1.9 ± 0.3 ng/ml), d 9 (2.5 ± 0.3 ng/ml) and d 12 (2.9 ± 0.3 ng/ml) and the 1800 h sample on d 0 (0.3 ± 0.3 ng/ml) was lower ($P < 0.0001$) than on d 6 (3.1 ± 0.3 ng/ml), d 9 (4.1 ± 0.3 ng/ml) and d 12 (3.7 ± 0.3 ng/ml). In PREG ewes the 0600 h sample (0.1 ± 0.3 ng/ml) and 1800 h sample (0.1 ± 0.3 ng/ml) on d 0 were lower ($P < 0.0001$) than on d 9, 12, 15 and 18. In PREG ewes P4 in the 1800 h sample on d 9 was higher ($P < 0.02$) than the 0600 h sample on d 12, the 1800 h sample on d 12 was higher ($P < 0.007$) than the 0600 h sample on d 15, and the 1800 h sample on d 15 was higher ($P < 0.0001$) than the 0600 h sample on d 18. In PREG ewes the magnitude of change in P4, relative to the 0600 h sample, increased ($P < 0.0001$) from -0.1 ± 0.2 ng/ml on d 0 to 2.4 ± 0.2 ng/ml on d 18. In OPEN ewes the magnitude of change in P4 increased ($P < 0.0001$) from -0.1 ± 0.2 ng/ml on d 0 to 1.5 ± 0.2 ng/ml on d 9 and decreased ($P < 0.0001$) to 0.2 ± 0.2 ng/ml on d 18. These data show that P4 concentrations rise throughout the day more in pregnant than in open ewes after estrus. The physiological significance of the daily rise in P4 is unclear at the present time.

Key Words: Progesterone, Estrous Cycle, Sheep

305 Plasma progesterone profiles in response to repeated blood sampling in the late gestation ewe as influenced by time of day. S. Willard*[1], R. Dodson[2], and R. Godfrey[2], [1]*Mississippi State University*, *Mississippi State*, [2]*University of the Virgin Islands*, *St. Croix, VI*.

The adrenal gland has been suggested to contribute to pregnancy maintenance during stress through stimulation of adrenal progesterone (P4). We have reported previously a rise in plasma P4 (but not cortisol) during blood sampling (hourly for 12 h) in the pregnant ewe, suggestive of a diurnal rhythm or a response to sampling. The objective of this study was to evaluate 24-h plasma concentrations of P4 in the pregnant ewe as influenced by initiation time of repeated sampling. Pregnant ewes (n = 6 per group; 120.8 ± 1.0 d of gestation; 1.6 ± 0.1 lambs/ewe) were assigned to one of the following sampling schedules: 0600 to 1800 h (TIME-1), 1200 to 2400 h (TIME-2), 1800 to 0600 h (TIME-3), or 0600 (d 1), 1800 and 0600 h (d 2) only (TIME-4). Plasma was collected hourly from each group for analysis of P4 by RIA. Mean P4 was greater (P<0.05) in TIME-3 and TIME-4 groups (25.5 ± 1.3 and 23.5 ± 2.7 ng/ml, respectively) than TIME-1 and TIME-2 groups (18.6 ± 0.85 and 19.5 ± 1.3 ng/ml). The TIME-1 group (12.2 ± 1.8 ng/ml) had a lower (P<0.04) P4 starting value than the TIME-3 group (23.9 ± 4.6 ng/ml); but there was no difference (P>0.05) at the 6-h (20.9 ± 3.3 and 27.2 ± 5.6 ng/ml, respectively) or 12-h (22.0 ± 4.0 and 31.4 ± 6.9 ng/ml, respectively) time-points. Once normalized to starting values, the magnitude of P4 increase (Time: P<0.001) during the 12 h sampling period (a pooled 9.1 ± 1.3 ng/ml increase) did not differ (P>0.05) among the groups regardless of sampling initiation time. However, area under the curve analysis (AUC) of normalized values indicated a greater (P<0.01) AUC for TIME-1 (77.9 ± 15.4 relative units; RU) than TIME-3 (16.6 ± 9.9 RU). The TIME-4 group (minimally handled) exhibited elevated P4 at 0600 on d 2 (27.5 ± 4.1 ng/ml) compared to 0600 on d 1 (14.6 ± 1.9 ng/ml). These data suggest that regardless of sampling initiation time during a 24-h period, P4 continued to rise; yet the magnitude of the P4 increase was similar among groups. It remains unclear whether this rise in P4 is the result of a hormonal rhythm or is of physiological importance during repeated sampling in the pregnant ewe.

Key Words: Progesterone, Gestation, Ewe

306 Effect of ovulatory follicle size and standing estrus on estradiol concentrations, LH surge, and ovulation. G. A. Perry*[1] and D. C. Busch[2], [1]*South Dakota State University*, *Brookings*, [2]*University of Missouri*, *Columbia*.

In postpartum cows ovulatory follicle size at time of insemination (GnRH/TAI) influenced pregnancy rates following timed AI, but follicle size had no effect on pregnancy rates when cows spontaneously ovulated. Furthermore, cows that exhibited estrus (± 24 hr of GnRH/TAI) had higher pregnancy rates compared to cows not detected in estrus. The objective was to assess the relationship between ovulatory follicle size and estradiol concentrations, timing of the LH surge, and timing of ovulation. Cows were synchronized with the CO-Synch (n = 64; induced ovulation) or the Select Synch (n = 20; spontaneous ovulation) protocol. Cows that exhibited estrus and were induced to ovulate medium (11.5-14 mm) or large (> 14) follicles had preovulatory estradiol concentrations similar (*P>0.05*) to cows that spontaneously ovulated and higher (*P<0.05*) than cows not exhibiting estrus. Cows not exhibiting estrus had lower (*P<0.05*) preovulatory estradiol concentrations compared to cows that spontaneously ovulated. There was no effect (*P>0.36*) of follicle size or estrus on LH concentrations. Among cows induced to ovulate, cows that exhibited estrus had a shorter (*P<0.01*) interval from GnRH to the LH surge compared to cows not exhibiting estrus. Cows that spontaneously ovulated were intermediate (interval from onset of estrus to LH surge). Estrus and follicle size affected the interval from GnRH or onset of estrus to ovulation, with cows induced to ovulate and not exhibiting estrus having a longer interval to ovulation compared to cows that exhibited estrus and were induced to ovulate (*P<0.01*) or spontaneously ovulated (*P=0.02*). Cows that ovulated medium follicles had a longer (*P=0.03*) interval to ovulation compared to cows that ovulated large follicles. Cows that ovulated small follicles (≤ 11 mm) were intermediate. In summary, estradiol concentrations, timing of the LH surge, and timing of ovulation could explain the increased pregnancy rates in cows that exhibit estrus and are induced to ovulate compared to cows that do not exhibit estrus.

Key Words: Follicle Size, Estradiol, LH

307 Effect of ovulatory follicle size and expression of estrus on progesterone secretion in beef cows. D. C. Busch*[1], J. A. Atkins[1], J. F. Bader[1], D. J. Schafer[1], D. J. Patterson[1], T. W. Geary[2], and M. F. Smith[1], [1]*University of Missouri*, *Columbia*, [2]*USDA-ARS, Fort Keogh Livestock and Range Research Laboratory*, *Miles City, MT*.

Induced ovulation of small dominant follicles (sdf, <12 mm; CO-Synch protocol) in postpartum beef cows resulted in formation of CL that exhibited a delayed rise in progesterone (P4; $P < 0.05$) compared to CL that formed from large dominant follicles (ldf, >12 mm). The objective was to characterize P4 concentrations (0-60 d post AI) among GnRH-induced or spontaneously ovulated sdf (≤12 mm) or ldf (≥13mm) to determine whether P4 secretion by CL formed from GnRH-induced sdf remains lower during early gestation. Postpartum beef cows were induced to ovulate 48 h after $PGF_{2\alpha}$ (CO-Synch) or underwent spontaneous estrus and ovulation. Follicle size was measured at AI in cows induced to ovulate or 12 h after onset of estrus for cows that ovulated spontaneously. Cows were classified into one of three groups: 1) sdf (≤12 mm)-GnRH-induced ovulation (SF-I; n=9); 2) ldf (≥13 mm)-GnRH-induced ovulation (LF-I; n=38); or 3) ldf (≥13 mm)-spontaneous estrus and ovulation (LF-S; n=26). Blood samples were collected every other day for 60 d beginning at AI (d 0). The rate of P4 secretion was increased (*P*=0.06) in pregnant (d 2-12) compared to nonpregnant cows. Although the rate of increase in P4 from d 2-12 was higher (*P*=0.01) in the LF-I compared to the SF-I groups, there was no difference (*P*=0.94) among groups in P4 from d 14-60 in pregnant cows. Pregnant cows in the LF-S group, however, had higher rate of increase in P4 from d14-60 compared to pregnant cows induced to ovulate. Follicle size at AI influenced the rate of P4 increase in cows that failed to conceive (*P*=0.007), but not among cows that became pregnant (*P*=0.32) to AI. The regression of follicle diameter at AI on serum P4 on d 6 was significant (*P*=0.002) and linear in cows induced to ovulate, but not among cows that ovulated spontaneously. In summary, P4 secretion following GnRH-induced ovulation of small dominant follicles was decreased from d 2-12 compared to large dominant follicles, but similar among pregnant cows from d 14-60 post AI (d 0).

Key Words: Follicle Size, Progesterone, Induced Ovulation

308 Corpus luteum size and function following single and double ovulations in non lactating dairy cows. G. E. Mann*, R. S. Robinson, L. M. Hicking, M. P. Green, and M. G. Hunter, *University of Nottingham,*, *Sutton Bonington Campus, Loughborough, UK*.

While cows are primarily a monovular species and progesterone is normally the product of a single corpus luteum, double ovulations are not uncommon, resulting in two corpora lutea contributing to progesterone secretion. The occurrence of double ovulation has been linked to high milk yield although in a series of recent studies investigating luteal function, we have found a high incidence of double ovulations in non lactating multiparous Holstein Friesian dairy cows. The aim of this study was to determine the effect of double ovulation compared to single on plasma progesterone concentrations in non lactating multiparous Holstein Friesian cows. Studies were undertaken in 53 cows slaughtered on day 5 (n=28, two studies) or day 8 (n=25, two studies) following synchronised oestrus. On day 5, double ovulations were seen in 9/28 (32.1%) cows. Corpora lutea from double ovulating cows (1.5±0.2g) were smaller (P<0.001) than from single ovulating cows (2.9±0.3g). However, total luteal weight in double ovulating cows (3.0±0.4g) did not differ from single ovulating cows. The progesterone content of luteal tissue in single (14.3±1.5ng/mg) and double (13.6±1.4ng/mg) ovulating cows was similar as was the mean plasma concentration of progesterone on the day of slaughter (single 2.0±0.2ng/ml; double 2.1±0.5ng/ml). On day 8, double ovulations were seen in 6/25 (24.0%) cows. Corpora lutea in double ovulating cows (3.4±0.3g) were once again smaller (P<0.001) than single ovulating cows (6.3±0.5g) while total luteal weight was again similar (6.9±0.6g). Both progesterone content (single 11.5±0.9ng/mg; double 12.7±0.8 ng/mg) and mean plasma concentration of progesterone on the day of slaughter (single 6.1±0.7ng/ml; double 5.6±0.7ng/ml) were similar in single and double ovulating cows. In non lactating cows, a relatively high incidence of double ovulation was observed leading to smaller corpora lutea but a similar total weight of luteal tissue with similar progesterone content. The occurrence of double ovulation did not affect circulating progesterone concentrations.

Key Words: Cow, Corpus Luteum, Ovulation

309 Clinical and subclinical diseases predisposing to Johne's disease. E. Raizman*[1], S. Wells[1], S. Godden[1], M. Oakes[2], and J. Fetrwo[1], [1]*University of Minnesota*, *St Paul*, [2]*Univeristy of Minesota*, *Minneapolis*.

The objectives of this study were to: 1) assess the association between clinical or subclinical diseases and risk for subsequent occurrence of clinical Johne's disease (JD), and 2) to determine the association between clinical or subclinical diseases on risk of onset of fecal shedding after 305 days in milk (DIM). A total of 1,297 cows from two Minnesota dairies were enrolled in the study after fecal samples were obtained during the closeup period. A second fecal sample was obtained from cows after at least 305 DIM or at time of leaving the herd (sold/dead). Between 3-21 DIM, blood samples were obtained for serum Betahydroxybutyrate (BHB) and serum total protein testing. Body condition score (BCS) was evaluated during the closeup period, between 3-21 DIM, and at end of lactation. The occurrence of clinical disease events (milk fever, retained placenta, metritis, ketosis, displacement abomasum, lameness, mastitis, and JD clinical signs) was recorded. Average DIM when cows with JD clinical signs (JDCS) were culled (n=66) was 209. In the multivariable analysis, JDCS was associated with pneumonia (OR=2.6 95%CI= 1.2-6.0) and level of fecal shedding (light: OR=13.0 CI=5.3-30.0; moderate: OR= 33.0 CI=13.0-85.0; heavy: OR=63.0 CI=25.0-162.0). In the multivariable analysis onset of fecal shedding was associated only with pneumonia (OR=2.2 CI=1.1-4.2). The results provide insights into the possible role of other diseases on JDCS and fecal shedding, which may enable us to better manage the disease early in the lactation.

Key Words: Johne's Disease, Fecal Shedding

310 Evaluation of environmental sampling to determine distribution and herd infection status for *Mycobacterium avium* subspecies *paratuberculosis*. J. Lombard*[1], R. Smith[2], B. Wagner[1], and B. McCluskey[1], [1]*USDA:APHIS:VS; Centers for Epidemiology and Animal Health*, *Fort Collins, CO*, [2]*Cornell University*, *Ithaca, NY*.

The National Animal Health Monitoring System 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 involved collection and culture of environmental samples for MAP from areas on the farm where manure from a majority of cows accumulated. Operations were selected based on perceived risk factors for *Mycobacterium avium* subspecies *paratuberculosis* (MAP) infection identified in an earlier questionnaire. Individual animal and environmental samples were collected and used to determine the efficiency of environmental sampling to determine herd infection status. Individual animal serum and fecal samples were used to classify herds as infected or not infected based on the presence of one test positive animal in the herd. Animals in lactation 2 and greater were selected for MAP testing. A total of 483 environmental samples were collected and 216 (44.7%) were culture positive for MAP. The highest percentage of positive environmental samples were collected from parlor exits (52.3%), floor of holding pens (49.1%), common alleyways (48.0%), lagoons (47.4%) and manure spreaders (42.3%). Of the 98 operations tested with environmental sample culture, 97 had individual serum ELISA and 60 had individual fecal culture. Of the 50 herds classified as infected by fecal culture, 38 (76.0%) were identified by environmental culture. Two of the 10 operations classified as not infected based on individual animal fecal culture were environmental culture positive. Of the 80 operations classified as infected based on serum ELISA positive test results, 61 (76.3%) were identified as environmental positive. Environmental sample culturing is more cost effective than individual animal sampling and identified more than 75% of infected operations.

Key Words: *Mycobacterium avium* Subspecies *paratuberculosis*, Environmental Sampling

311 Evaluation of fecal culture pooling methods for detection of *Mycobacterium avium* subspecies *paratuberculosis* in a beef herd. S. Jensen*[1,2], J. Lombard[1,2], and F. Garry[1], [1]*Colorado State University*, *Fort Collins*, [2]*USDA:APHIS:VS; Centers for Epidemiology and Animal Health*, *Fort Collins, CO*.

Given the increased cost of whole herd fecal culture for the detection of *Mycobacterium avium* subspecies *paratuberculosis* (MAP) infection, studies evaluating fecal pooling in dairy cattle have been conducted. This beef cattle study evaluated individual fecal samples, strategically pooled samples, and collection order pooled samples in detecting infected animals. Individual fecal samples were collected from 174 beef cattle and subsequently divided into three aliquots for individual animal testing, strategic pooling and ordered pooling. Each sample pool included 4-5 individual samples and all testing was performed concurrently. Individuals were selected for a strategic pool based on their ranked age whereas order pooled samples were based on order of collection. Nineteen of the 174 individual samples, 6 of the 35 strategic pools, and 2 of the 35 ordered pools were culture positive. Four of the six strategic pools and one of the two ordered pools that were culture positive contained at least one of the 19 individual samples found to be culture positive. Both individuals classified as heavy shedders were detected by strategic pooling, while only one heavy shedder was detected by ordered pooling. Of the positive pools, two strategic pools and one ordered pool contained no samples found to be positive upon individual culture. One sample within each pooling method was found to contain two culture positive individuals. The results of this preliminary beef study suggest that bacteriologic culture of strategically pooled samples may provide a more reliable method for detection of MAP infected animals as compared to ordered pooling. However, pooling of samples from beef herds where the majority of infected animals are moderate to low shedders may not be a sensitive enough method because it significantly reduces the ability to detect MAP infection compared to individual fecal culture.

Key Words: *Mycobacterium avium* Subspecies *paratuberculosis*, Fecal Pooling, Beef

312 Effects of photoperiod on immune function in piglets at three different weaning ages. S. R. Niekamp*, M. A. Sutherland, G. E. Dahl, and J. L. Salak-Johnson, *University of Illinois*, *Urbana*.

Photoperiod manipulation provides a non-invasive, easily implemented, effective, method to alter immune status while enhancing production efficiency. The objective of this study was to evaluate the impact of weaning age and photoperiod manipulation on piglet immune responses and BW throughout the nursery phase. Piglets (n=68) used were obtained from sows subjected to a short day (SD; 8L:16D) photoperiod from d 90 of gestation until weaning. Piglets were weaned at 14, 21, or 28 d of age and kept on either a SD or a long day (LD; 16L:8D) until 10 wk of age. Piglet BW and blood samples were collected at weaning and again at 4, 6, 8, and 10 wk of age. Cortisol (CORT), total white blood cell counts (WBC), lymphocyte (Lymph) and neutrophil (Neut) counts, lymphocyte proliferation (LPA), natural killer cell cytotoxicity (NK), and neutrophil chemotaxis (CHTX) and phagocytosis (PHAG) were all measured. Age of weaning impacted various immune measures. Pigs weaned at 28 d had lower Neut counts ($P < 0.001$), PHAG ($P < 0.001$), and LPA response ($P < 0.05$) at weaning compared to those weaned at 14 and 21 d. Pigs weaned at 21 d had lower ($P = 0.075$) Lymph counts relative to 14 and 28 d. Pigs weaned at 14 d had lower NK ($P < 0.01$) relative to 21 and 28 d. Photoperiod also influenced BW and immune status throughout the nursery phase. Generally, pigs kept on LD and weaned at 28 d were heaviest ($P < 0.001$). At 4 wk, Neut counts were highest ($P = 0.029$) in those weaned at 21 d and kept on SD. At 6 wk of age, NK was higher ($P = 0.002$) among those weaned at 14 and 21 d kept on LD than those weaned at 28 d. Piglets on LD and weaned at 28 d had lower PHAG (P =

0.005) at 6 wk of age but higher at 8 wk than those weaned at 14 and 21 d. These data support the concept that photoperiod may influence immune responses in piglets and may imply an inverse relationship between growth and immune status.

Key Words: Photoperiod, Weaning, Nursery

313 Productive performance of primiparous sows progeny in nursery period. C. Piñeiro*[1], J. Morales[1], M. Piñeiro[1], X. Manteca[2], and G. G. Mateos[3], [1]*PigCHAMP Pro Europa, S.A.*, *Segovia, Spain*, [2]*U.A. Barcelona*, *Spain*, [3]*U.P. Madrid*, *Spain*.

Piglets from primiparous sows (PRIM) weigh less at birth and have a higher mortality rate in lactation than piglets from multiparous sows (MULT), which probably affects performance during the fattening period. The reason for this is unknown but might be related to the lower immune transmission via colostrum, resulting in a higher susceptibility to pathogens. Five studies were performed to compare productive performance and mortality rate of piglets from PRIM vs MULT sows from 28 to 60 days of age. Average daily gain (ADG), feed intake (FI) and mortality were registered and Pig-MAP serum concentration, an acute-phase protein, was analysed at 28, 40 and 60 d of age to assess the health status and pathogen susceptibility. Piglets from the PRIM group showed a poorer performance than piglets from the MULT group. PRIM piglets had lower ADG (367 *vs* 420 g/d; P<0.001) and FI (496 *vs* 560 g/d; P<0.001) than MULT piglets. Furthermore, a higher mortality was registered in PRIM than in MULT groups (4.9 *vs* 2.4%; P<0.01), suggesting that the incidence of pathologies was higher for the PRIM group. Also, Pig-MAP serum concentration at weaning was higher in PRIM than in MULT group (1.35 *vs* 1.01 mg/mL; P<0.01). We conclude that primiparous sows progeny has a poorer performance and higher incidence of pathologies in the period from 28 to 60 days of age than progeny from multiparous sows and that the losses in performance, associated with a lower health status, might be detected through the determination of Pig-MAP concentration in serum at weaning.

Key Words: Piglet, Primiparous, Performance

314 Clinical trial testing the effect of vaccination or direct-fed microbial products on colonization of *E. coli* O157:H7 at the terminal rectum of cattle. R. Peterson*, D. Smith, R. Moxley, T. Klopfenstein, G. Erickson, and S. Hinkley, *University of Nebraska - Lincoln*, *Lincoln*.

A clinical trial was conducted to test the effect of vaccination against EHEC type III secreted proteins or feeding a direct-fed microbial product (DFM) on colonization of *E. coli* O157:H7 (EC) at the terminal rectum of commercially fed cattle. Feedlots were classified as either feeding or not feeding a DFM (Lactobacillus acidophilus and Propionibacterium freudenreichii). Vaccinated (VAC) pens of cattle were given two doses of vaccine, one at initial processing and another at reimplant. Within each feedlot, pens of VAC and nonvaccinated (NOVAC) cattle were matched by slaughter date. The sample size for each pen was calculated so that we would be 95% confident to estimate EC prevalence at 50% with a 15% precision. Terminal rectum mucosal cells (TRM) were collected by scraping the mucosa of the terminal rectum 3-5 cm proximal to the rectoanal juncture. EC was isolated and identified from TRM using standard methods involving selective enrichment, immunomagnetic separation, agar plating, biochemical and immunological testing, and PCR confirmation. The outcome of interest was the probability of detecting EC from TRM. EC outcomes were analyzed using a generalized linear mixed model (GLMM) with a logit link function accounting for random effects of pen and feedlot. Cattle were systematically selected from within 21 pens of cattle (11 vaccinated, 10 not vaccinated) selected by convenience from a cohort of 148 pens from a larger study. We collected TRM from 441 cattle from within 13 pens fed DFM and 279 cattle from within 8 pens of cattle not fed DFM. We observed a lower probability for EC colonization among vaccinated cattle (5.0%) compared with NOVAC cattle (19.9%; OR=0.20; P=0.025) within a feedyard. Feeding DFM was not associated with EC colonization (P=0.94). We concluded that this vaccine reduced EC-colonization of terminal rectum mucosal cells of commercially fed cattle.

Key Words: Direct-fed Microbial, *Escherichia coli*, Vaccination

315 Factors influencing first service conception rate in Ragusa and Pennsylvania dairy herds. J. D. Ferguson*[1], G. Azzaro[2], M. Caccamo[2], and G. Licitra[2,3], [1]*University of Pennsylvania*, *Kennett Square*, [2]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [3]*D.A.C.P.A., University of Catania*, *Catania, Italy*.

Reproduction and production records from herd record associations for Ragusa Province and Pennsylvania were compiled from 1998 through 2004 (Ragusa) and 1996 through 2002 (Pennsylvania). Records include cow index, date of calving, lactation number, insemination information, pregnancy status, milk volume, fat and protein content, linear score, and days in milk at milk recording. Insemination information was merged with production information for the test record which occurred within 30 days after days to first insemination (DFB). Linear score for production test record prior to first insemination was retained with the record after first insemination. A total of 859 herds (117 Ragusa (region 1) and 742 PA (region 2)) and 103070 lactation records (27372 Ragusa and 75698 PA) were in the final data set. Mean values were as follows for Ragusa and PA records, respectively (sd): test day milk production, 31.9 kg (8.5) and 35.9 kg (8.8); milk energy, 21.1 mcal (5.6) and 24.6 mcal (6.0), linear score, 3.57 (2.19) and 2.79 (1.99) DFB, 88.9 (46.6) and 90.8 (42.3), days open, 160.6 (104.2) and 158.4 (90.8); services, 2.43 (1.84) and 2.34 (1.49); first service conception rate (FSTCR, %), 40.6%, and 34.0%. Logistic model of FSTCR included significant effects of herd, lactation number (1 through 5+), month of insemination, region, linear score, milk energy, quadratic effects of DFB, and interaction between region and DFB and milk energy. Linear score had significant interactions with DFB. Hosmer and Lemeshow goodness of fit test had a chi-square of 6.8 (p<.55). In general FSTCR declined with increasing lactation number, linear score, and milk energy, whereas it increased with increasing DFB. Change in FSTCR with increasing DFB and milk energy were different between Ragusa and PA cows, although general trends were similar. Factors influencing FSTCR were similar between the different regions.

Key Words: Reproduction, Milk Energy, Dairy Cows

316 Disposal reporting and disposition of culled cows by parity and herd size. A. H. Sanders* and H. D. Norman, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*.

Termination code is used to record completion of lactations, transfer, death, or reason for disposal for lactation records in the national dairy production database. The purpose of this study was to investigate the disposition of culled cows using termination codes. The latest available records for 8 million cows calving since 1998 were examined. Of these, 2.4 million were current records likely in progress, and 400,000 were for cows sold for dairy to herds not participating in DHIA testing. Disposal codes were available for 3.2 million cows in first through fifth parities from 1998 through 2004. Cow disposal records were paired with herd test records from the time of disposal, and difference from herd average for lactation milk and protein yields and average somatic cell score (SCS) were calculated. For cows culled for low production, milk yield was 2% less and protein yield was 4% less than herd average. In contrast, other cows had 4% higher milk yield and 2% higher protein yield than herd average in the lactation coded with disposal. Cows culled for mastitis or high SCS had SCS 22% above herd average. Other cows coded with disposal also had SCS greater than herd average, but only by 5%. For cows disposed of with at least 50 days open, those culled for reproduction had 246 days open, while others had only 165. Reproductive problems and low production were the most common reasons given for culling in first parity while mastitis or high SCS was the most common reason given in third parity and later. Yearly culling rates by termination code were calculated for 40,867 herd-years from 2000-2003, averaging ≥80% records passing edits and having ≥10 test days, by herd size. Overall, 33% of cows per herd-

year had terminal records and 80% of these included an indication of disposition. Reporting was similar across years and herd sizes. Distribution of disposals was fairly constant across herd sizes; however, deaths and culling for low production were more common in larger herds while culling for reproductive problems was more common in smaller herds. These results indicate that termination codes can be useful indicators for several important traits.

Key Words: Culling, Disposal, Termination Code

Ruminant Nutrition: Dairy—Transition Cows

317 Effect of transition diet on production performance and metabolism in periparturient dairy cows. J. Guo*, R. Peters, and R. Kohn, *University of Maryland*, *College Park*.

The objectives of this study were to characterize the homeorhetic change in blood metabolites and to evaluate the effect of transition diet on ketone body accumulation in periparturient cows. Twenty-eight multiparous Holstein cows were listed in order of their anticipated due dates and assigned randomly to one of two groups: with or without a transition diet. The control group received a non-lactating cow diet (1.54 Mcal NEl/kg, 10.9% CP, 53.1 % NDF) from 28 d before expected parturition, and a lactation diet (1.77 Mcal NEl/kg, 16.8% CP, 29.9 % NDF) after parturition. The treatment group received a transition diet (1.71 Mcal/kg of net energy for lactation (NEL), 16.8% of crude protein (CP), 35.2 % of neutral detergent fiber (NDF)) from 14 d before expected parturition to 14 d after calving and were fed the same diets as the cows in control group during the rest of the experimental period. Blood from coccygeal vein was sampled three times per week from 21 d before expected parturition to 21 d postpartum for analysis of glucose, nonesterified fatty acid (NEFA), βhydroxybutyrate, acetoacetate, acetone, and glycerol. Feeding a transition diet resulted in greater area under the curve (AUC) for glucose in the last 17 days of gestation, but no effect within the first 21 days in milk. Acetoacetate AUC was greater for treatment cows than for control cows across the first 21 days in milk. The AUC of NEFA and glycerol between day 15 and day 21 postpartum (after treatment) were greater for treatment cows than that for control cows. Production performance was not affected by transition diet. Plasma glycerol may be an important contributor to gluconeogenesis during the periparturient period. Feeding a transition diet around parturition was associated with greater mobilization of adipose tissue and greater exposure to ketone bodies in early lactation.

Key Words: Periparturient Cow, Ketone Body, Glycerol

318 Microarray analysis of the immunoregulatory actions of OmniGen-AF in periparturient dairy cattle. Y. Wang*[1], J. Burton[2], and N. Forsberg[1], [1]*Oregon State University*, *Corvallis*, [2]*Michigan State University*, *East Lansing*.

The goals of this study were to evaluate the mechanisms by which OmniGen-AF, a novel immunoregulatory feed additive, augments innate immunity in dairy cattle. To accomplish this, we assessed effects of OmniGen-AF on neutrophil gene expression using microarray analysis. Eight periparturient Jersey cows were used in this experiment. Four were assigned to a control diet and 4 were assigned to an OmniGen-AF-supplemented diet for 28 days prior to expected parturition. At 12-15 hours after parturition, a time which corresponds to immunosuppression in dairy cattle, blood samples (400 mL) were drawn from the jugular vein and neutrophils were purified using Percoll gradient centrifugation. RNA was isolated using Trizol and the quality of resulting RNA samples was evaluated using an Agilent BioAnalyzer. Of the eight RNA samples prepared, six (three per treatment) were of good quality. RNA from these six samples was reverse transcribed with Cy3 and Cy5 dyes and hybridized to BoTL-5 arrays. Differences in gene expression for the 1500 BoTL-5 genes were evaluated statistically following LOESS normalization. Twenty genes were differentially-regulated (P<0.05) by the addition of OmniGen-AF to the diet. Two of these (interleukin-1-beta-converting enzyme [ICE] and IL-4 receptor) were confirmed using quantitative RT-PCR. Expression of beta-actin was unaffected (P>0.05) by OmniGen-AF. Of interest, we have noted in previous sheep studies that OmniGen-AF increased concentrations of neutrophil IL-1B. Increased expression of ICE, as determined in this study, may explain how OmniGen-AF increased sheep neutrophil IL-1B. Several of the genes up-regulated by OmniGen-AF are involved in control of apoptosis. We have determined, again in sheep studies, that OmniGen-AF increases (P<0.05) neutrophil concentration in blood. A portion of its action, therefore, may arise from its ability to reduce programmed cell death in neutrophils.

Acknowledgements: Center for Animal Functional Genomics, Michigan State University

Key Words: OmniGen-AF, Microarray, Dairy

319 Effect of CLA dose on milk production in early lactation dairy cows. M. J. de Veth*[1], W. M. van Straalen[2], W Koch[1], T. Keller[1], R. Hayler[1], and A. - M. Pfeiffer[1], [1]*BASF-AG*, *Offenbach, Germany*, [2]*Schothorst Feed Research B.V.*, *Lelystad, The Netherlands*.

Rumen protected fat supplements containing the *trans*-10, *cis*-12 conjugated linoleic acid (CLA) isomer have been shown to be an efficient tool to reduce milk fat synthesis. In addition increased milk yield has been observed in some early lactation studies with CLA. The objective of this study was to evaluate the response at four levels of CLA dose during the first 13 weeks of lactation. Holstein cows (n = 64) were randomly allocated at calving to one of four levels of CLA dose: 0, 5 10, and 15 g/d of *trans*-10, *cis*-12 CLA. The CLA was administered in a lipid-encapsulated form and contained *cis*-9, *trans*-11 and *trans*-10, *cis*-12 isomers at the same ratio. CLA was top dressed once daily. Over the 13 wk treatment period increasing levels of CLA supplementation reduced linearly milk fat content (4.04, 3.61, 3.60 and 3.39% for 0, 5, 10 and 15 g/d *trans*-10, *cis*-12 CLA, respectively; $P < 0.05$) and milk fat yield ($P < 0.05$). The decline in milk fat content from the onset of lactation was gradual, with a nadir not reached until week 5 of lactation. Increased milk yield (6.0, 9.5, 10.5%, $P < 0.01$) and milk lactose yield ($P < 0.05$) was observed with increasing CLA dose, however, milk protein yield was only numerically increased. In addition, DMI, body weight and BCS were unaltered by CLA treatment. The proportion of those fatty acids originating from *de novo* fatty acid synthesis declined with increasing CLA dose. Milk fatty acid content of *trans*-10, *cis*-12 CLA increased linearly ($P < 0.001$) with dose of CLA from <0.001% at 0 g/d *trans*-10, *cis*-12 CLA to 0.04% with 15 g/d *trans*-10, *cis*-12 CLA. Efficiency of transfer of *trans*-10, *cis*-12 CLA into milk fat averaged 2.9% across doses, which is distinctly lower than that reported when CLA is abomasally infused. Overall, results demonstrate that CLA supplementation to early lactation cows will increase milk yield as well as reduce the content of milk fat in a dose dependent manner.

Key Words: Conjugated Linoleic Acid, Milk Fat Depression, Early Lactation

320 Dietary L-carnitine alters hepatic fatty acid metabolism and decreases liver lipid in periparturient Holstein cows. D. B. Carlson*[1], N. B. Litherland[1], J. W. McFadden[1], A. D'Angelo[1], J. C. Woodworth[2], and J. K. Drackley[1], [1]*University of Illinois*, *Urbana*, [2]*Lonza, Inc.*, *Fair Lawn, NJ*.

Our hypothesis was that supplemental L-carnitine would increase oxidation and decrease esterification of fatty acids in liver, thus decreasing peripartal lipid accumulation. Multiparous Holstein cows (n=56) were supplemented with four amounts of Carniking (50% L-carnitine; Lonza, Inc.), mixed with 227 g ground corn plus 227 g dried molasses, as a topdress from d 14 before expected calving date (ECD) until 21 days in milk. Treatments were: control (CON; 0 g L-car-

nitine), low (LC; 6 g L-carnitine), medium (MC; 50 g L-carnitine), and high (HC; 100 g L-carnitine). All cows were fed the same basal prepartum (21 d before ECD) and postpartum diets (calving until d 56). Liver was biopsied on d 21 before ECD (covariate), and at d 2, 10, and 28. Liver slices were incubated with [1-^{14}C] palmitate (PALM) to determine conversion of PALM to CO_2, acid-soluble products (ASP), and esterified products (EP). Orthogonal contrasts were used to compare carnitine treatments vs. CON; LC vs. MC and HC; and MC vs. HC. Carnitine did not alter conversion of PALM to CO_2. Conversion of PALM to ASP was increased by carnitine compared with CON (P<0.01); MC and HC caused higher ASP production than LC (P<0.01), but MC was higher than HC (P=0.03). Conversion of PALM to EP was lower in carnitine-fed cows vs. CON (P<0.01); both MC and HC reduced PALM conversion to EP compared with LC (P<0.01), and HC was lower than MC (P=0.04). Total liver lipid content (% wet tissue) was lower (P<0.01) in carnitine-fed cows than in CON (7.5, 6.1, 5.1, and 4.3% at d 2 and 9.5, 6.0, 5.2, and 5.3% at d 10 for CON, LC, MC, and HC). Supplemental L-carnitine is effective in decreasing liver lipid content in periparturient cows; in vitro data are consistent with a role for carnitine to stimulate oxidation and decrease esterification of fatty acids.

Key Words: L-Carnitine, Liver, Fatty Acid Metabolism

321 Influence of dietary L-carnitine on production and metabolism during the periparturient period in Holstein cows. D. B. Carlson*[1], N. B. Litherland[1], J. W. McFadden[1], J. C. Woodworth[2], and J. K. Drackley[1], [1]*University of Illinois*, *Urbana, IL*, [2]*Lonza, Inc.*, *Fair Lawn, NJ*.

Our objectives were to determine if varying amounts of dietary L-carnitine would influence milk production and serum concentration of nonesterified fatty acids (NEFA) during the transition period. Multiparous Holstein cows (n=56) were supplemented with four amounts of Carniking (50% L-carnitine; Lonza, Inc.), mixed with 227 g ground corn plus 227 g dried molasses, as a topdress from d 14 before expected calving date (ECD) until 21 days in milk. Treatments were: control (CON; 0 g L-carnitine), low (LC; 6 g L-carnitine), medium (MC; 50 g L-carnitine), and high (HC; 100 g L-carnitine). All cows were fed the same basal prepartum (21 d before ECD) and postpartum diets (calving until d 56). Orthogonal contrasts were used to compare carnitine treatments vs. CON; LC vs. MC and HC; and MC vs. HC. Carnitine supplementation did not affect pre- or postpartum dry matter intake (DMI), but HC reduced DMI at wk 1 and 2 of lactation compared with CON and LC (treatment x time, P<0.05). During wk 1 to 8 of lactation, milk yield was 39.0, 36.6, 37.0, and 32.6 kg/d for CON, LC, MC, and HC, respectively. Milk yield for HC tended to be lower than for MC (P=0.08), whereas LC did not differ from MC and HC (P=0.40). Milk fat percentage (4.00, 3.98, 4.35, and 4.55%) was higher for MC and HC compared with LC (P=0.03), but MC and HC did not differ (P=0.42). L-Carnitine did not alter milk lactose concentration vs. CON (P=0.20), but HC was lower than MC (P=0.01). Yield of 3.5% fat-corrected milk was not affected by carnitine. Pre- and postpartum serum NEFA concentration, body weight, and body condition score were not altered by carnitine supplementation during the transition period. Supplementation of 100 g/d of L-carnitine negatively affected DMI and milk yield during early lactation, however, moderate amounts (6 and 50 g/d) did not affect DMI or milk yield.

Key Words: L-Carnitine, Metabolism, Periparturient Period

322 Effect of dietary inclusion of cane molasses in dry cow diets on prepartum and postpartum performance. W. F. Miller*, J. E. Shirley, J. M. Rottinghaus, E. C. Titgemeyer, and D. E. Johnson, *Kansas State University*, *Manhattan*.

Primiparous (13) and multiparous (18) Holstein dairy cows were used in a randomized complete block design to determine the effects of offering cane molasses during a 60 day dry period on pre- and postpartum performance. Treatment structure was a 2 x 2 factorial with parity and molasses as main effects. Treatments were no molasses (NM) and molasses (M). Far-off dry cow diets (fed d60 to d31 prepartum) contained on a DM basis 6.4% alfalfa hay, 56.3% prairie hay, 13.0% corn silage, 9.7% wet corn gluten feed, 6.7% solvent soybean meal, 3.2% whole linted cottonseed, 1.5% mineral/vitamin premix, and either 3.2% cane molasses (53.4% invert sugars) or corn grain. Close-up dry cow diets (fed d30 to parturition) contained on a DM basis 9.0% alfalfa hay, 13.1% corn silage, 36.8% prairie hay, 12.0% wet corn gluten feed, 13.1% corn grain, 5.8% solvent soybean meal, 1.3% menhaden fish meal, 5% whole linted cottonseed, 1.4% mineral/vitamin premix, and either 3.3% cane molasses or 3.3% additional corn grain. Diet x parity interaction was not significant, thus data for primiparous and multiparous were analyzed collectively. Cows fed molasses during the dry period tended (P= 0.093) to consume more DM during the close-up period (15.5 kg/d vs. 13.9 kg/d) and consumed 7% more DM during the first 30d postpartum. Milk yields during the first 30d postpartum for primiparous and multiparous cows fed NM and M were 30.6, 33.0, 41.1, and 47.3 kg/day, respectively, and tended (P= 0.079) to be higher for cows fed M. Components in milk and component yields were similar from cows consuming NM and M diets. Urea nitrogen tended (P= 0.086) to be higher in milk from cows fed diet M. Body weight and body weight change was similarly affected by NM and M pre- and postpartum. Postpartum loss of body condition tended (P= 0.079) to be greater for cows fed NM. Feeding cane molasses had a tendency to increase DMI during the prepartum period and improve milk yield during the first 30 days of lactation.

Key Words: Molasses, Prepartum, Dairy Cow

323 Effects of varying transition diets fed to Holstein cows at two body condition scores on plasma concentrations of IGF-1 in late pregnancy and early lactation. T. Moyes*[1], C. Stockdale[2], S. Humphrys[3], and K. Macmillan[1], [1]*The University of Melbourne*, *Werribee, Victoria, Australia*, [2]*Department of Primary Industries*, *Kyabram, Victoria, Australia*, [3]*Primegro Ltd, Thebarton, South Australia, Australia*.

The objectives of the study were to measure the effects of offering transition diets of varied energy and protein content during the final 3 weeks prepartum on plasma concentrations of IGF-1 in late pregnancy and early-lactation. Sixty multiparous Holstein cows at either Body Condition Score (BCS) 4 or 6 (on a 1 to 8 scale) at enrollment 4 weeks before due calving dates were fed one of 3 diets for the last 3 weeks prepartum. The 3 diets were: i) a standard total mixed ration (TMR) (81.1 MJ ME/cow/d); ii) the TMR + 4 kg of grain concentrate (94.5 MJ ME/cow/d; high energy); and iii) the TMR + 3.5 kg of soybean meal (115.9 MJ ME/cow/d; high protein). Cows received a common diet after calving of pasture offered at 35 kg DM/cow/d and supplemented with 3 kg DM of grain concentrate (11.8 MJ ME/kg DM) each milking for 10 weeks into lactation. Plasma concentrations of IGF-1 were measured weekly throughout this time. Daily milk yields and the interval to first postpartum ovulation (IFO) were also measured. Peak plasma concentrations of IGF-1 ranged from 200 ng/ml (high protein) to 145 ng/ml (standard and high energy; $P < 0.001$) during the treatment period before decreasing rapidly from 1 week (high protein) to 2 weeks (standard and high energy) before calving. Similar minimum concentrations of IGF-1 (65 ng/ml; $P > 0.20$) were measured 1 week after calving before increasing to a common plateau value (100 ng/ml; $P > 0.5$) by 7 weeks. Cows with BCS 6 at enrollment had higher plasma concentrations of IGF-1 at that time (210 vs. 140 ng/ml; $P < 0.005$), but not by 1 week before calving or thereafter ($P > 0.7$). Neither milk yield nor IFO was affected by prepartum treatments. The trial showed that differences in plasma concentrations of IGF-1 associated with a range of transition diets fed to cows of differing BCS did not affect IGF-1 concentrations in early lactation in Holsteins fed a pasture-based diet.

Key Words: Insulin-Like Growth Factor-1, Transition Diet, Body Condition Score

324 The effect of precalving DMI on milk production is dependent on DMI in early lactation in grazing dairy systems. J. R. Roche*, *Dexcel, Hamilton, New Zealand*.

Sixty-eight multiparous grazing dairy cows (BW:523±62.6kg) were randomly allocated to two precalving pasture DMI for 29±7.7 days precalving (Low or High; 4.8 and 11.9 kg DM). At calving, cows in each precalving treatment were randomly allocated to one of two levels of feeding (Low or High; 8.6 and 13.5 kg DM) for 35 d postcalving in a 2x2 factorial arrangement. Following treatment all cows grazed together and were offered generous allowances of pasture and pasture silage. Daily milk yields were recorded, and fat, protein and lactose concentrations determined each wk for 15 wk. Blood was sampled regularly pre- and postcalving and analyzed for indicators of energy status, growth hormone (GH) and IGF-1. Data was analyzed by ANOVA for a factorial arrangement of treatments. Precalving restriction reduced (P<0.05) milk fat production by 8.4% during the first five weeks postcalving, but differences were not evident subsequently. In comparison, postcalving feed restriction reduced (P<0.001) yield of milk, fat and protein by 25, 21 and 28%, respectively, during the first five weeks postcalving. Decreased (P<0.01) yields of milk, fat and protein (12, 10 and 9%, respectively) were also evident for ten weeks after the feed restriction finished. There was a tendency (P=0.13) for a precalving x postcalving DMI interaction in milk component (fat and protein) yield during the first five weeks of lactation. High-High cows produced 7.1 kg more fat and protein than Low-High cows, but there was no effect of precalving level of feeding in cows that were restricted postcalving. The plasma concentration of NEFA, BHBA and GH were elevated (P<0.01) in restricted cows precalving and IGF-1 concentration declined. Plasma NEFA and BHBA concentrations were elevated (P<0.01) postcalving in restricted cows, but postcalving DMI did not affect GH or IGF-1 concentrations. The milk production gains from higher levels of feeding precalving are only realized when cows are fed well after calving in pasture-based systems. Irrespective, the effect of precalving DMI on postcalving milk production was small.

Key Words: Transition Cow, Pasture, Dry Matter Intake

Ruminant Nutrition: Dairy and Beef—Minerals

325 Dietary cation-anion difference and dietary protein effects on performance and acid-base status of dairy cows in early lactation. W. Hu*[1], M. R. Murphy[1], P. D. Constable[1], and E. Block[2], [1]*University of Illinois, Urbana*, [2]*Church & Dwight Co., Inc., Princeton, NJ*.

Our objective was to examine the effects of dietary cation-anion difference (DCAD) with different concentrations of dietary protein (CP) on performance and acid-base status in early lactation cows. Six lactating Holstein cows averaging 44 days in milk were used in a 6 × 6 Latin square design with a 2 × 3 factorial arrangement of treatments: DCAD of -3, 22, or 47 meq (Na + K - Cl - S)/100 g of dry matter (DM), and 16 or 19% CP (on a DM basis). Linear increases with DCAD occurred in DM intake (24.4, 25.9, and 27.6 kg/d; $P < 0.01$), milk fat percentage (2.99, 3.36, and 3.59%; $P = 0.01$), 4% fat-corrected milk production (30.7, 32.8, and 34.2 kg/d; $P = 0.01$), milk protein (3.11, 3.18, and 3.24%; $P < 0.01$), milk lactose (4.81, 4.78, and 4.90%; $P = 0.03$), milk total solids (11.92, 12.45, and 12.65%; $P = 0.01$), blood pH (7.387, 7.404, and 7.416; $P < 0.01$), and jugular venous HCO_3^- concentration (25.7, 27.5, and 28.3 mmol/l; $P < 0.01$). Milk production itself was unaffected by DCAD (36.0, 36.1, and 36.4 kg/d; $P > 0.10$) and whole blood Cl concentration decreased linearly with increasing DCAD (100.1, 98.9, and 97.5 mmol/l; $P < 0.01$). Cows fed 16% CP had lower milk urea N than cows fed 19% CP (14.8 and 20.7 mg/dl; $P < 0.01$); the same was true for plasma urea N (17.3 and 24.3 mg/dl; $P < 0.01$). Dry matter intake, milk production and milk composition, and acid-base status did not differ between 16 and 19% CP treatments. The DCAD affected DM intake and performance of dairy cows in early lactation, effects likely mediated by modification of acid-base status of the cows; however, these variables were not affected when early lactation cows were fed either 16 or 19% CP diets.

Key Words: Dietary Cation-Anion Difference, Dietary Protein, Performance

326 Dietary cation-anion difference effect on performance and acid-base status of dairy cows in early lactation. W. Hu*[1], M. R. Murphy[1], P. D. Constable[1], and E. Block[2], [1]*University of Illinois, Urbana*, [2]*Church & Dwight Co., Inc., Princeton, NJ*.

Our objective was to examine the effect of dietary cation-anion difference (DCAD) on performance and acid-base status of cows in early lactation. Sixteen Holstein and 8 Jersey cows were used immediately after calving to compare two DCAD [22 and 47 meq (Na + K - Cl - S)/100 g of dry matter (DM)] in a completely randomized design. The corn silage based diets contained 19.0% crude protein, 25.4% neutral detergent fiber, 15.0% acid detergent fiber, and 1.69 Mcal of NE_L/kg (on a DM basis). An additional 2.3 kg of alfalfa hay was fed during the first 5 d postpartum then milk, blood, and urine samples were collected for 6 wk. Repeated-measures, with an extra between-subject effect, mixed model analysis indicated that DCAD did not affect ($P > 0.15$) DM intake (18.2 and 18.3 kg/d), milk production (33.5 and 33.3 kg/d), milk composition (3.96 and 4.11% fat, 3.11 and 3.00% protein, and 8.95 and 8.83% SNF), jugular venous HCO_3^- concentration (27.3 and 27.6 mmol/l), or pCO_2 (43.2 and 42.8 mmHg). Urinary pH increased with DCAD (8.12 and 8.20, $P = 0.08$), as did urinary Na:creatinine (1.08 and 1.57, $P = 0.01$) and K:creatinine (2.56 and 3.62, $P < 0.01$). Blood pH tended to increase as DCAD increased (7.421 and 7.428, $P = 0.11$); whereas, whole blood Cl concentration decreased as DCAD increased (98.8 and 97.6 mmol/l, $P = 0.06$). Intake of DM and performance of cows in early lactation were not improved when DCAD increased from 22 to 47 meq/100 g of DM.

Key Words: Dietary Cation-Anion Difference, Performance, Acid-Base Status

327 Utilization of phosphorus in lactating cows fed varying amounts of phosphorus and sources of fiber. Z. Wu*, *Pennsylvania State University., University Park*.

The effect of dietary P content and fiber source on P utilization in dairy cows was determined using the following 4 dietary treatments formed in a 2 x 2 factorial arrangement: low P, alfalfa hay (LPAH); low P, soyhulls (LPSH); high P, alfalfa hay (HPAH); and high P, soyhulls (HPSH). The P content was 0.32 or 0.44%, and the fiber source was varied by substituting 10% soyhulls for 6% alfalfa hay on a DM basis. Diets also contained approximately 50% corn silage and alfalfa silage for all treatments. The diets were fed to 32 Holsteins (97 ± 19 DIM) for 10 wk. Milk yield was 42.1 and 44.0 kg/d, fat 1.553 and 1.790 kg/d, and protein 1.240 and 1.323 kg/d, for the 0.32 and 0.44% P diets, respectively. Differences in milk production were associated with 1.5 kg/d less DMI for the lower P diets on average. Increasing dietary P increased fecal P excretion. Partial substitution of soyhulls for alfalfa hay did not affect milk production, but resulted in less fecal P excretion. Based on lactation performance 0.32% P appeared inadequate for cows milking 43 kg/d, while the requirement was 0.37%, calculated according to the 2001 NRC. Using highly digestible nonforage fiber sources in place of forage fiber sources in the diet may reduce fecal P excretion.

Item	LPAH	LPSH	HPAH	HPSH	SEM	P[1]	F[1]	P x F[1]
DMI, kg/d	25.8	24.2	26.9	26.1	0.7	0.04	0.11	0.57
Milk, kg/d	42.5	41.7	43.4	44.5	1.6	0.26	0.93	0.55
Fat, %	3.67	3.68	4.04	4.20	0.13	0.01	0.55	0.58
Fat, kg/d	1.542	1.564	1.753	1.827	0.102	0.03	0.64	0.80
Protein, %	3.02	2.89	3.04	3.06	0.07	0.19	0.40	0.28
Protein, kg/d	1.264	1.215	1.314	1.332	0.048	0.10	0.75	0.50
Fecal P, %	0.62	0.54	0.87	0.82	0.03	0.01	0.02	0.63
Fecal P, g/d	57.5	45.6	96.8	82.4	3.4	0.01	0.01	0.72

[1]*P* values for the effect of P, fiber source, and their interaction.

Acknowledgements: This work was supported in part by USDA NRI (2003-35101-12933), Church & Dwight Co., Inc. (Princeton, NJ), and Pennfield Corp. (Lancaster, PA).

Key Words: Phosphorus Requirement, Fiber Source, Dairy Cow

328 Estimate of phosphorus (P) maintenance requirement of lactating dairy cows over a range of feed intake rates. Z. H. Myers and D. K. Beede*, *Michigan State University*, *East Lansing*.

Inevitable fecal P excretion (IFPE) is endogenous fecal P excretion (EFPE) plus unabsorbed fecal P of dietary origin. By definition, EFPE of a ruminant animal fed very near its true requirement for P (zero P balance) represents the majority of the P maintenance requirement. In ruminants fed very near true requirement absorbability of dietary P is high (e.g., > 90%). Therefore, IFPE can be an estimate of EFPE and a large part of the P maintenance requirement. Objective was to evaluate German estimates of IFPE and the P maintenance requirement of lactating dairy cows over a range of DMI rates. Twenty-one lactating Holstein cows in early-, mid-, and late-lactation groups (n = 7/group) were used to achieve a range of DMI. Additionally, the DMI of mid- and late-lactation groups was restricted to 75 and 50% of pre-trial ad libitum intake rates, respectively. Resulting experimental treatments were DMI rates of 11.3, 15.3, and 25.1 kg/d for Treatments 1 (T1), 2 (T2), and 3 (T3), respectively. All cows were fed a low P diet (0.26% P, dry basis) so that total P intake was as near the true P requirement as possible. Phosphorus balances were not different from zero and unaffected by DMI treatment (P > 0.1). Average total IFPE was 15.3, 18.2, and 26.3 g/cow per d for T1, T2, and T3. Expressed as g/kg DMI, IFPE was 1.36, 1.19, and 1.04 for T1, T2, and T3 and decreased linearly with increasing DMI (P < 0.01). These values are similar to the German estimate of 1.2 g/kg DMI. The regression equation: (g IFPE/d) = [0.85 ± 0.070 (g/d)] x DMI (kg/d)] + [5.30 ± 1.224 (g/d)]; (R^2 = 0.90; P < 0.01) described IFPE across a range of DMI. Because P balances were not different from zero, the estimated IFPE is assumed to be EFPE, and the fecal portion of total P maintenance requirement.

Key Words: Phosphorus Maintenance Requirement, Inevitable Fecal Phosphorus Excretion, Dairy Cows

329 Effect of supplementing lactating dairy cows on a commercial dairy with chromium-L-methionine. M. Etchebarne[1], M. Socha*[2], and D. Tomlinson[2], [1]*Michel A. Etchebarne PhD, Inc.*, *Modesto, CA*, [2]*Zinpro Corporation*, *Eden Prairie, MN*.

Three hundred thirteen multiparous Holstein cows (162 control cows, 151 treatment cows) were blocked according to calving date and randomly assigned to a study to determine the effect of feeding 0 or 7.5 mg chromium/d from MiCroPlex chromium-L-methionine (Zinpro Corporation, Eden Prairie, MN) on lactation and reproductive performance. Treatments were incorporated into a TMR and delivered to cows twice daily. Cows received treatments from 3 wk precalving through 36 wk postpartum. All cows received a subcutaneous injection of 500 mg bovine somatotropin (Posilac, Monsanto Company, St. Louis, MO) every 14 d beginning at wk 15 postpartum. Chromium supplementation increased yield (P<0.05) of 3.5% fat-corrected milk (51.9 vs. 50.6 kg/d) and milk fat (1.87 vs. 1.81 kg/d) and tended to increase yield (P<0.15) of energy-corrected milk (50.5 vs. 49.5 kg/d) and milk solids (3.27 vs. 3.20 kg/d). Response to treatment did not vary by week (wk x treatment effect, P>0.15). Chromium supplementation decreased (P<0.05) milk protein content (2.81 vs. 2.84%), tended to (P<0.15) increase milk fat content (3.78 vs. 3.71%) and tended to (P<0.15) decrease somatic cell content (72,000 vs. 78,000). For cows that conceived in the first 250 d of lactation, chromium supplementation decreased (P<0.05) services per conception (2.5 vs. 2.7), increased (P<0.05) first service conception rates (36.8 vs. 21.7%) and tended to decrease (P<0.15) days open (94 vs. 106). Survival curve analysis of cows eligible to be bred indicated that chromium supplementation tended to (P<0.15) decrease percentage of cows pregnant. In conclusion, supplementing lactating dairy cows with chromium increased lactation performance and had mixed effects on reproductive performance.

Acknowledgements: The authors would like to acknowledge the dedication and hard work of Ryan Mattingly, John Fiscalini and the staff at Fiscalini Farms in carrying out the trial protocol.

Key Words: Chromium, Lactating Dairy Cow, Reproduction

330 Selenium yeast improved selenium status in blood and milk in first calf heifers. R. Wallace*[1], R. Aberle[1], M. Hutjens[1], T. Herdt[2], and I. Yoon[3], [1]*University of Illinois*, *Urbana*, [2]*Michigan State University*, *East Lansing*, [3]*Diamond V Mills*, *Cedar Rapids, IA*.

Thirty eight pregnant Holstein heifers were randomly assigned to one of two treatment groups, organic (SelenoSource™AF, Diamond V Mills, Cedar Rapids, IA) or inorganic selenium (sodium selenite) diets to determine the effect of source of selenium (Se) on Se concentrations in blood and milk. Beginning 60 days before projected due date, the heifers were placed in tie stalls and fed respective experimental diets containing 0.3 ppm added Se. After calving, the cows were switched to post-calving TMR diets that contained the same source and concentration of Se by treatment group. On day 21, all cows were moved from individual tie stalls to loose housing with free stalls and placed on the same diet containing sodium selenite. Whole blood was collected at day -60, -21, 0, +21, +60 days relative to calving (day 0). Milk was collected at calving (colostrums) and at days 21 and 60. At the start of the trial (day -60), there was no significant difference in whole blood Se for heifers fed organic Se when compared to heifers fed inorganic Se (171 ng/ml vs. 188 ng/ml, P=0.25). At calving, heifers fed organic Se had increased (P<0.01) whole blood Se compared to heifers fed inorganic Se (236 ng/ml vs. 196 ng/ml). From enrollment to calving (~60 days), whole blood Se for heifers fed the organic Se diet increased 65 ng/ml while whole blood Se values for the heifers fed the inorganic Se diet only increased 8 ng/ml. This trend continued through 21 d postpartum when mean whole blood Se for heifers fed organic Se remained 29 ng/ml higher than those fed inorganic Se. Organic Se increased (P<0.01) Se concentration in milk at calving (128 ng/ml vs. 92 ng/ml) and 21 d postpartum (61 ng/ml vs. 38 ng/ml). These results suggest that organic Se transferred dietary Se into blood and milk more efficiently than inorganic Se. The effect of organic Se on blood Se was not detected until after 60 days of feeding; suggesting that feeding organic Se for more than 40 days may be required to see this effect. Increased serum and milk Se concentrations in heifers fed organic Se disappeared by day 60 postpartum after all heifers were switched to inorganic Se at day 21.

Key Words: Selenium, Organic, Blood

331 Effect of trace mineral source and level on production and fertility of dairy cattle in two successive lactations. J. Nocek*[1], M. Socha[2], and D. Tomlinson[2], [1]*Spruce Haven Farm and Research Center*, *Auburn, NY*, [2]*Zinpro Corporation*, *Eden Prairie, MN*.

Primiparous and multiparous Holstein cows (573) were blocked by parity and 305d Mature Equivalent milk yield (sire PTA for primiparous cows) and randomly assigned to a study to determine the effect of supplementing 1) 75% of NRC (2001) requirements (75C) for Zn, Mn and Cu using metal specific AA

complexes and Co using cobalt glucoheptonate (CTM, Zinpro Corporation, Eden Prairie, MN); 2) 100% of NRC Zn, Mn, Cu and Co requirements (100I) using inorganic sources; 3) 100% of NRC Zn, Mn, Cu and Co requirements (100C) using CTM; and 4) a combination of Zn, Mn, Cu and Co from inorganics and CTM (C/I). Supplemental Zn and Cu levels were similar between treatments 3 and 4; Mn and Co levels in treatment 4 were 3.4 and 9.1X Mn and Co levels in treatment 3. Cows were assigned to treatment 60 d prepartum and continued through a full lactation, a second dry period, and 200 d into the subsequent lactation. In lactation 1, C/I cows produced more (P<0.05) energy-corrected milk (ECM, 39.4 vs. 37.2), fat (1.47 vs. 1.40 kg/d) and protein (1.12 vs. 1.06 kg/d) than 100I cows. In lactation 2, 100C and C/I cows produced more (P<0.05) ECM (46.3, 45.5 vs. 43.3. 43.6 kg/d), fat (1.76, 1.72 vs. 1.62, 1.65 kg/d) and protein (1.27, 1.26 vs. 1.22, 1.21 kg/d) than 75C and 100I cows. In addition, 100C and C/I cows produced milk with lower (P<0.05) somatic cell content (x1,000) (234, 243 vs. 447, 437) than 75C and 100I cows. Compared to 100I cows, C/I cows had fewer days to first estrus (50 vs. 56 d), higher (P<0.05) first service conception rates (36.9 vs. 29.6%) and tended to have (P<0.15) fewer days open (116 vs. 132 d). Fortifying diets with trace elements from inorganic and CTM sources above NRC requirements increased production and appeared to improve fertility of dairy cattle. Performance was similar between cows supplemented at 75% of NRC Zn, Mn, Cu and Co requirements using CTM as cows supplemented at 100% of NRC Zn, Mn, Cu and Co requirements using inorganic sources.

Key Words: Trace Minerals, Lactation, Reproduction

332 Effects of dietary sulfur and sodium bicarbonate on performance of growing and finishing steers. J. W. Spears* and K. Lloyd, *North Carolina State University*, *Raleigh*.

An experiment was conducted to determine the effect of increasing dietary cation:anion balance with sodium bicarbonate ($NaHCO_3$) on performance of growing and finishing steers fed varying sulfur (S) concentrations. The experimental design was a 3x2 factorial with S (from NH_4SO_4) supplemented at 0, 0.15 or 0.30% DM, and $NaHCO_3$ added at 0 or 1.0% of DM. Each treatment consisted of three replicates containing 5 steers/pen and one replicate containing 4 steers/pen. Steers were fed a corn silage-based growing diet for 84 d and then gradually switched to a high corn finishing diet for 102 to 116 d. Growing diets analyzed 0.12, 0.30, and 0.46% S while finishing diets analyzed 0.13, 0.31 and 0.46% S for treatments supplemented with 0, 0.15 and 0.30% S, respectively. During the growing phase, ADG and gain:feed were higher (P<0.05) in steers supplemented with 0.15 compared to those supplemented with 0.30% S. Performance of control steers did not differ from those supplemented with 0.15 or 0.30% S during the growing phase. In the finishing phase, control steers had greater (P<0.05) feed intake than steers supplemented with 0.15 or 0.30% S. Average daily gain of steers supplemented with 0.15% S did not differ from controls, while steers receiving 0.30% supplemental S had lower (P<0.05) ADG than controls. However, gain:feed was not affected by dietary S during the finishing phase. Addition of 1% $NaHCO_3$ did not affect performance during the growing or finishing phases. In conclusion, steers tolerated a total dietary S of 0.30% (0.15% supplemental) without negative effects on ADG or gain:feed. A total dietary S of 0.46% reduced ADG and ADFI during the finishing phase. Increasing dietary cation-anion balance with $NaHCO_3$ did not prevent depressed ADG in steers fed high S.

Key Words: Sulfur, Cation-Anion Balance

333 Dietary copper effects on brain copper concentration and brain prion protein characteristics in mature Angus cows. L. R. Legleiter*[1], J. W. Spears[1], J. K. Ahola[2], and T. E. Engle[3], [1]*North Carolina State University*, *Raleigh*, [2]*University of Idaho*, *Caldwell*, [3]*Colorado State University*, *Fort Collins*.

Twelve copper-deficient multiparous Angus cows were used to determine the effects of copper (Cu) repletion on brain Cu concentration and brain prion protein (PrP^c) characteristics. Cows were considered Cu-deficient based on liver Cu concentrations (< 30 mg Cu/kg DM) after receiving a low Cu diet supplemented with 5 mg molybdenum/kg of diet DM and 0.3% sulfur for 216 d. Copper-deficient cows received one of three treatments; 1) control (no supplemental Cu), 2) organic Cu (10 mg/kg DM), and 3) inorganic Cu (10 mg/kg DM), during a 159 d repletion phase. Liver and brain samples were taken immediately after euthanasia. Liver Cu concentrations were greater (P = 0.001) in supplemented (treatments 2 and 3) than non-supplemented (control) cows. Brain Cu concentrations tended (P = 0.17) to be greater for Cu-supplemented cows than control cows. Brain PrP^c were extracted from brain tissue by homogenization followed by centrifugation. Supernatant protein concentration was measured to ensure identical gel loading. Prion proteins were electrophoretically separated (10% Bis-Tris SDS-PAGE) and transferred to polyvinylidene diflouride membranes. Prions were probed with primary and secondary antibodies, visualized using chemiluminescence, and relative optical densities of bands quantified. Relative optical densities of bands were greater (P = 0.02) for Cu-supplemented cows than non-supplemented cows. Proteinase degradability was not affected by treatment as all PrP^c were completely degraded after exposure to proteinase K. The apparent molecular weight of PrP^c, as determined by comparison to a molecular weight standard, was not affected (P = 0.27) by treatment. These data suggest that PrP^c concentrations are affected by the Cu status of the animal.

Key Words: Prions, Copper

334 The effect of dietary selenium levels on human health and milk and milk product selenium content when supplemented in dairy cattle diets. J. K. Margerison*[1], J. A. Harrison[1], and D. Wilde[2], [1]*University of Plymouth*, *Plymouth, Devon, UK*, [2]*Alltech (UK) Ltd*, *Stamford, Lincs, UK*.

The effect of selenium supplementation on the selenium content of milk and cheese was measured using 12 lactating dairy cows which were assigned to one of three treatments: 6mgSe/d from sodium selenite (ST), 3mgSe/d from Sel-Plex (LS)(Alltech Inc, USA) or 6mgSe/d from Sel-Plex (HS). Cows were offered 7kg/h/d compound and ad libitum access to spring pasture. Individual milk samples were analysed for Se content (weekly) and used to manufacture a whole milk, unripened soft cheese. There were no difference in body weight, milk yield, milk composition between treatments except for milk protein which was significantly lower in the LS group (ST 31.1, LS 29.3, HS 30.7 g/kg; s.e.m. 0.30; P<0.05). Milk selenium content was significantly higher for the HS group (ST 14.7, LS 15.5, HS 21.6 mg/l; s.e.m. 0.65; P<0.001), Se content of cheese was higher in the HS group (0.10, 0.10, 0.16 mg/kg; s.e.m. 0.02), but not significatly. MC, pH, lactic acid levels, cheese yield were not significatly different, though less milk was required to produce 1kg of cheese from the HS group (ST 8.41, LS 8.15, HS 7.31 kg milk/kg cheese). Selenium from Sel-Plex is more bio-available than selenium from sodium selenite and significantly increased the selenium content of human foods such as milk. Although not significant, milk from cows offered 6mg/h/d Sel-Plex tended to have a higher cheese selenium content and a greater cheese yield.

335 Long term effects of dietary manganese in beef heifers on performance and manganese status of their offspring. S. L. Hansen*, C. S. Whisnant, K. E. Lloyd, L. R. Legleiter, H. S. Stahlhut, and J. W. Spears, *North Carolina State University*, *Raleigh*.

Previously we reported (J. Anim. Sci. 87(Suppl. 1):269) that feeding weanling heifers a control diet, containing only 18 mg manganese (Mn)/kg DM, during growth and development did not affect performance, but tended to reduce pregnancy rate compared to Mn-supplemented heifers. In the present study, 20 pregnant heifers receiving the control or 50 mg supplemental Mn/kg DM treatments were continued on their dietary Mn treatments during gestation and early lactation to determine if the low Mn diet would affect performance or result in deficiency signs in their offspring. Heifers were group fed by treatment (4 pens per treatment, 2 head per pen). Heifers were approximately 23 mo of age at calving and had been on treatments for 380 d. Calves were weighed and a blood sample collected within 24 h of birth. Calves born to dams fed the control diet had

lower birth weights (P=0.05) than calves born to dams fed supplemental Mn (32.5 vs. 38.3 kg). Whole blood samples were lower in Mn (P=0.01) from calves born to control heifers than calves born to supplemented heifers. Several calves born to control heifers suffered from varying signs of Mn deficiency. These symptoms included unsteadiness, enlarged joints, dwarfism, and superior brachygnathism. Results of this study indicate that 18 mg Mn/kg diet DM during gestation is not adequate for normal calf development.

Key Words: Manganese, Heifers, Reproduction

336 Effects of nutrient restriction and organically bound selenium on maternal and fetal organ mass in pregnant ewe lambs. M. A. Ward*[1], J. S. Caton[1], J. B. Taylor[2], J. J. Reed[1], P. P. Borowicz[1], K. A. Vonnahme[1], D. A. Redmer[1], and L. P. Reynolds[1], [1]*North Dakota State University*, *Fargo*, [2]*USDA-ARS Sheep Experiment Station*, *Dubois, ID*.

To examine effects of nutrient restriction and dietary Se on maternal and fetal visceral tissues, 36 pregnant Targhee-cross ewe lambs (53.8 ± 1.3 kg) were randomly allotted to one of four treatments in a 2 x 2 factorial design. Factors were nutrition (maintenance; M vs. 60% maintenance; R) and dietary Se (7.4 µg/kg BW; NSe vs. 81.5 µg/kg BW; HSe) from a seleno-yeast product. Selenium treatments were initiated 21 d before breeding and restriction treatments on d 64 of gestation. All diets were similar in CP (16.0%) and energy (2.12 Mcal/kg) density. On d 140 ± 5 of gestation, ewes were slaughtered and tissues harvested. There were no nutrition x Se interactions in ewe data; therefore, main effects are reported. Maintenance fed ewes had heavier ($P < 0.09$) BW (66.3 vs. 55.9 ± 1 kg), stomach complex (1266.3 vs. 935.5 ± 24.9 g), small intestine (569.9 vs. 456.5 ± 12.4 g), large intestine (367.7 vs. 271.3 ± 13.6 g), liver (688.4 vs. 563.3 ± 16.1 g), and kidney (142.9 vs. 127.7 ± 3.6 g) compared with R. Stomach and intestinal differences persisted when data were scaled by empty body weight (EBW). Lung and blood mass (% of EBW) increased ($P < 0.09$) in ewes fed R compared with M diets. Ewes fed HSe had lower ($P < 0.05$) lung mass (0.90 vs. 0.97 ± 0.03 % EBW) compared with NSe. Restricted maternal diets decreased ($P < 0.05$) fetal BW, empty carcass weight, crown rump length, and liver, pancreas, perirenal fat, small intestine, and spleen weights compared with fetuses from M fed ewes. Ewes fed HSe had fetuses with heavier ($P < 0.05$) BW, empty carcass, total viscera, heart, lung, kidney, spleen, and large intestine compared with those fed NSe. These data indicate that maternal nutrition impacts both maternal and fetal organ mass. Further research is needed to assess impacts of maternal nutrition on growth and production of offspring.

Key Words: Nutrient Restriction, Pregnancy, Selenium

Ruminant Nutrition: Small Ruminants

337 Nutritional evaluation of broccoli (Brassica oleracea) fodder for goats. K. R. Yadav*, B. S. Tewatia, and S. S. Khirwar, *CCS Haryana Agricultural University*, *Hisar, Haryana, India*.

Broccoli has been introduced in India recently and nearly 75% of the plant material is left out in the field after harvesting for human consumption. This left over material has potential value as animal feed. Chemical composition and in vitro dry matter digestibility of eight varieties of broccoli were determined with the objective of utilizing as green fodder for goats. These varieties contained 20.3 to 29.4% crude protein on dry matter (DM) basis while in vitro dry matter digestibility ranged from 77.4 to 92.6%. A digestion trial was conducted on five non-lactating Beetal goats having similar body weight and age, maintained on fresh chaffed broccoli plants as sole feed. The total DM intake of experimental goats was 624.4 ± 39.9 g/d, which was 2.67% of the body weight. Broccoli was highly palatable but its consumption was limited due to high moisture content. The digestibility coefficient of DM, OM, CP, EE, CF and NFE were 83.70, 84.04, 87.84, 87.08, 69.64 and 83.84%, respectively. The broccoli contained 23.94% digestible crude protein (DCP)and 87.20% total digestible nutrients (TDN) on DM basis. All the goats were in positive nitrogen, calcium and phosphorus balance. The results indicated that green broccoli could be utilized as animal feed after harvesting the heads for human consumption.

Key Words: Broccoli, Proximate Composition, Beetal Goat

338 Effects of linseed and cottonseed supplementation on fatty acid composition of goats milk and muscle of suckling kids. A. Nudda*, G. Battacone, S. Fancellu, and G. Pulina, *University of Sassari*, *Sassari, Italy*.

The effects of dietary fat supplements on fatty acid (FA) composition of goat milk and possible consequence in the FA profile of muscle in suckling kids was investigated. Fifteen Sarda breed goats, fed 1.2 kg/day of concentrate and hay ad libitum, were divided in two groups supplemented with: i) 40 g/d of fat from linseed (LS), characterized by a high C18:3 concentration, ii) 40 g/d of fat from cottonseed (CS), having high C18:2 content. Kids were fed exclusively on maternal milk until slaughtering (approximately 50 days of age). Twenty-four hours after slaughtering, the *Longissimus dorsi* (LD) muscle was removed from kids. FA profile of goats milk and kids LD was determined. The milk FA profile was significantly influenced by the diets. Compared to CS, the use of LS significantly decreased the content of C6-C14 (22.5vs 19.7%), C16:0 (23.0 vs 20.4) and n6/n3 ratio (7.9 vs 3.5), whereas increased the content of t11-C18:1 (4.54 vs 2.38%) and C18:3-n3 (1.34 vs 0.67%). Moreover, the content of conjugated linoleic acid (CLA) isomers c9,t11 (1.46 vs 0.86%), t11,c13 (0.10 vs 0.03%), t11,t13 (0.11 vs 0.06%) and others trans,trans isomers (0.13 vs 0.10%) were higher in LS group ($P<0.10$). The t10,c12 CLA content was low both in LS and CS (0.01 vs 0.02; $P = 0.13$). The differences in the FA profile of LD between LS and CS groups tended to mirror the differences observed in milk, even if the lack of significant difference probably due to the small number of kids. The results suggested that it may be possible to modify the nutritional value of FA profile of meat from suckling kids by manipulating the diet of the mothers.

Acknowledgements: Research funded by FISR project (MIUR and MIPAF).

Key Words: Goat Milk, Kid Muscle, Fatty Acid

339 Effects of feeding oilseeds on total tract nutrient utilization and milk composition of lactating ewes. R. Zhang, A. Mustafa*, and X. Zhao, *McGill University*, *Ste-Anne-De-Bellevue, QC, Canada*.

Sixteen pure breed Dorset ewes (39 ± 8 DIM) were used in a completely randomized design to determine the effects of feeding different oilseeds on total tract nutrient utilization and milk composition of lactating ewes. Ewes were randomly assigned to one of four dietary treatments (4 ewes per treatment): a control diet with no oilseed (C), a canola seed supplemented diet (CS), a sunflower seed supplemented diet (SS) and a flaxseed supplemented diet (FS). All diets were formulated to be isonitrogenous and the oilseed diets were formulated to contain 6% fat. Experimental period was 21 d in duration with the first 14 d for diet adaptation and the last 7 d for data collection. Results showed that Oilseed supplementation had no effect on DMI (average 2.6 kg/d) or on total tract digestibility of CP (average 62%), NDF (average 57%) and ADF (average 55%). However, DM and gross energy digestibilities were higher ($P < 0.05$) for ewes fed FS than for those fed C or CS. Ether extract digestibility was highest for FS, intermediate for SS and lowest for CS and C ($P < 0.05$). Ewes fed CS produced less ($P < 0.05$) milk than those fed the other dietary treatments. Milk fat and protein percentages were higher ($P < 0.05$) for ewes fed the oilseed diets relative to those fed C. However, milk protein fractions were not affected by dietary treatments. Cheese yield was higher ($P < 0.5$) from milk of ewes fed

oilseed diets than from milk of ewes fed C. However, cheese fat and protein percentages were not affected by dietary treatments

Key Words: Oilseeds, Lactating Ewes, Milk Composition

340 Lactational effects of including soybean oil in the concentrate of dairy goats to increase CLA in milk. M. A. Bouattour, R. Casals*, E. Albanell, X. Such, and G. Caja, *Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*.

A total of 24 Murciano-Granadina dairy goats milked once daily throughout lactation were used to study the effects of adding soybean oil (**SBO**) to the concentrate, on lactational performances and fatty acids profile of milk. After 30 DIM, goats were allocated to two balanced groups according to number of lactation, BW and daily milk yield, and kept in two separate pens. Goats were fed daily with a mixture of 50% dehydrated fescue (90.7% DM; 12.3% CP, and 59.0% NDF) and 50% alfalfa pellets (90.9% DM, 15.0% CP, and 47.3% NDF), and 1 kg of concentrate (89.7% DM, 18.5% CP, and 12.4% NDF), to which the SBO was or was not added. Dietary treatments were: **C** (control) and SBO (6% SBO in the concentrate). Ether extract in the concentrate increased from 4.1 to 9.3% by effect of SBO. The experiment consisted of a two period crossover design (28 d each), during which the forage was offered ad libitum in the pens (1000 and 1700) and the concentrate was individually fed in two portions at milking (0900) and in the afternoon (1600). Data was analyzed using the PROC MIXED of SAS. Final SBO intake in the ration was 2.4% on DM basis. There was no effect of SBO on intake (2.34 kg DM/d), milk yield (1.87 L/d), FCM (2.03 L/d), milk conversion rate (0.86 L/kg DM), BW (40.5 kg), and BCS (2.68). Addition of SBO increased milk fat content (4.4 vs. 4.8%; $P < 0.001$) and fat yield (83 vs. 88 g/d; $P < 0.05$), without effect on milk protein content (3.42%). Short and medium chain fatty acids were reduced ($P < 0.01$) by SBO: C10:0 (11.1 vs 8.9%), C12:0 (6.2 vs. 4.2%), C14:0 (11.2 vs. 8.6%), and, C16:0 (26.8 vs. 21.9%). On the contrary, SBO increased ($P < 0.01$) long chain fatty acids: C18:0 (8.9 vs. 11.5%), C18:1 (20.4 vs. 27.8%), C18:2 (4.0 vs. 5.1%) and cis 9-trans 11 CLA (0.72 vs. 2.17%). Increase in CLA was 200% compared to control. In conclusion, adding a moderate dose of SBO in the concentrate of dairy goats was a useful way of increasing milk fat and CLA content, without negative effects on intake, milk yield and protein content.

Acknowledgements: CICYT Spain (Project AGL2001-2617)

Key Words: Soybean Oil, Dairy Goats, CLA

341 Effects of addition of different fats to flushing diet on reproduction in ewes. A. Nikkhah*, H. Sadeghi Panah, and A. Zare, *University of Tehran*, *Karaj, Tehran, Iran*.

To determine the effects of addition of different supplemental fats to flushing diet on reproductive parameters in Iranian fat-tailed ewes, a randomized complete block design was used. Fifty-two non-lactating and non-pregnant six years old Zandi ewes were selected. Feeding of diets was carried out, from two weeks before ram introducing until three weeks after it. Diets were: 1) without supplemental fat, 2) containing 4.5% calcium salts of fatty acids from tallow, 3) containing 4.5% calcium salts of fatty acids from soybean oil and 4) containing 2.25% calcium salts of fatty acids from tallow + 2.25% calcium salts of fatty acids from soybean oil. Diets were isoenergetic and isonitrogenous. Laparascopy was performed and follicles larger than 3mm and corpus lutetium (CL) on both ovary were counted and number of CL was concerned as ovulation rate (OR) index. At lambing, number, weight and sex of lambs and lambing date of ewes were recorded. Analyses of variance were performed using the general linear models procedure of the SAS. OR in group 3 was higher than other groups ($p<0.05$). Number of follicles which were larger than 3mm in group 2 was lower than other groups ($p<0.05$). Pregnant rate from first, total of two and three first service periods in groups 3 were higher than other groups ($p<0.05$). Lambing rate and lamb crop from each of the three service periods were highest in group 3 and lowest in group 1 ($p<0.05$). Twining rate from first service period in group 3 was higher than other groups and in groups 2 and 4 was higher than group one ($p<0.05$). Twining rate from total of two first service period in groups 3 and 4 were higher than group 1 ($p<0.05$). No significant differences were detected among dietary groups for twining rate from total of three first service period. Addition of fat supplement especially from rich sources of unsaturated fatty acids to flushing diet had positive effects on the OR and reproduction performance of ewes. Based on these results we can say that ovary of ewe might need special fatty acids for optimum function. To appear this subject, we need more studies in future.

Key Words: Ewe, Flushing, Ovulation Rate

342 Effects of abomasal infusion of wheat starch or cottonseed oil on performance of lactating Sannen dairy goats. M. Bashtani, A. A. Naserian*, and R. Valizadeh, *Ferdowsi University of Mashhad*, *Mashhad, Khorasan, Iran*.

Four multiparous lactating Sannen dairy goats in mid lactation (110 days postpartum) were used in a 4×4 Latin squares design to determine the effects of abomasal infusion of wheat starch and cottonseed oil on milk yield and composition. Treatments were abomasal infusion of 1. water (600 ml/d), 2. cottonseed oil (45 g/d), 3. wheat starch (100 g/d in 600 ml water) and 4. mixture of cottonseed oil and wheat starch (22.5 and 50 g/d in 600 ml/d respectively). Goats were fed with a basal diet consisting of 40% alfalfa hay and 60% concentrates that were offered ad libitum. The amount of infused was isocaloric. Each experimental period was 7 days, The first 5 days were used to adaptation goats to infusion treatments, and the last 2 days of each period, were taken samples of milk, rumen liquid and blood. Infusion carried out twice daily with a 50-ml syringe. Infusion of cottonseed oil decreased intake of DM and increased milk fat and total solids. No treatments effects on milk yield, total protein, true protein, casein, NPN, MUN of milk were observed. Cholesterol and triglycerides of plasma increased by infusion of cottonseed oil, however, infusion of starch with cottonseed oil only increased plasma glucose concentration. Ruminal pH and NH_3-N concentration were different among treatments. It is concluded that abomasal infusion of cottonseed oil decreased DMI and increased milk fat percentage.

Acknowledgements: Ferdowsi University of Mashhad

Key Words: Cottonseed Oil, Wheat Starch, Dairy Goat

343 Effects of abomasal infusion of glucose or cottonseed oil on performance of lactating Sannen dairy goats. M. Bashtani, A. A. Naserian*, and R. Valizadeh, *Ferdowsi University of Mashhad*, *Mashhad, Khorasan, Iran*.

Four multiparous lactating Sannen dairy goats in mid lactation (139 days postpartum) were used in a 4×4 Latin squares design to determine the effects of abomasal infusion glucose and cottonseed oil on milk yield and composition. Treatments were abomasal infusion of 1. water (600 ml/d), 2. cottonseed oil (48 g/d), 3. glucose (100 g/d in 600 ml water) and 4. mixture of cottonseed oil and glucose (24 and 50 g/d in 600 ml water respectively). Goats were fed a basal diet consisting of 40% alfalfa hay and 60% concentrates that were offered ad libitum. The amount of infused was isocaloric. Each experimental period was 7 days, the first 5 days were used to adaptation goats to infusion treatments, and the last 2 days of each period, were sampled from milk, blood, and rumen liquid. Infusion of glucose solution and cottonseed oil carried out twice daily with a 50-ml syringe. DMI and milk yield were not affected by any of the infusion treatments. Infusion of cottonseed oil or mixture of glucose and cottonseed oil increased content of milk fat and tended to decreasing content of milk total protein. True protein, casein, NPN, and MUN of milk were not also affected by any of the infusion treatments. Plasma cholesterol and triglycerides concentrations were elevated by infusion the cottonseed oil and mixture of glucose and cottonseed oil, but no effect on other plasma metabolites (glucose, BUN) were obseved. pH and NH_3-N concentration were not different treatments. It is concluded that in mid lactation, abomasal infusion of cottonseed oil increased milk fat percentage.

Acknowledgements: Ferdowsi University of Mashhad

Key Words: Glucose, Cottonseed Oil, Dairy Goat

344 The effect of live yeast (Saccharomyces cervisiae-1026) on rumen fermentation parameters and blood metabolites of sheep. M. Nowrozi*[1], M. Danesh Messgaran[2], and M. Abazari[1], [1]*Agriculture and Natural Resources Research Center of Khorasan,IRAN*, *Mashhad, Khorasan, Iran*, [2]*Ferdosi university,IRAN*, *Mashhad, Khorasan, Iran*.

In order to examine the effect of live Saccharomyces cervisiae-1026 on rumen fermentation parameters and blood metabolites, four rumen fistulated Balouchi lambs at approximately 6 months of age and mean weight of 35±4 kg were randomly assigned to two treatment groups in a change-over split-split plot design. Treatments were: H) High fiber diet (30% concentrate + 70% hay), HY) H + 4 g Yeast /head/d, C) High concentrate diet (70% concentrate + 30% hay) and CY) C + 4 g Yeast /head/d. Yeast supplement contained 1-1.5×10^{10} live cells per gram with 96.6% of dry matter and 46% of crude protein. Blood and ruminal fluid samples were collected over a 108 d period at 27 d intervals (including: 10 d of transition period, 14 d of adaptation to the new diet and 3 d of sampling). Yeast culture did not have considerable effect on ruminal fluid of lambs fed HY diet; only it slightly increased the pH from 6.38 to 6.58 during 3 h after feeding, besides, in lambs received CY diet, two hours after feeding a slight increase ($P<0.1$) was observed due to yeast function (6.05 to 6.22). Both HY and CY treatments significantly affected the ammonia concentration of ruminal fluid; HY decreased ($P<0.05$) the ammonia contents of ruminal fluid during 1 to 4 h after feeding and CY showed similar effect during 0.5 to 3 h after feeding. Blood urea was significantly decreased 3 h after feeding by HY diet when compared with animals fed H diet (10.72 vs. 13.76 mg/dl). CY significantly prevented the blood urea from increasing two hours after feeding in comparison with C treatment (10.69 vs. 13.74 mg/dl). The production of microbial protein exhibited slight increase in HY treatment (7.48 vs. 6.03 g) and for CY, its increase was not significant (5.85 vs. 5.53 g). The results of present study demonstrate that yeast may increase the efficiency of feed due to increased ammonia consumption by microorganisms existed in rumen.

Acknowledgements: Authors would like to thank Agricultural and natural Resources Research Center of Khorasan,Iran for funding this project.

Key Words: Saccharomyces Cervisiae, Rumen Fermentation, Sheep

345 Effect of two beta-adrenergic agonists and low energy diet on carcass composition, adipose cell size, blood hormones and metabolites in an Iranian fat-tailed breed of sheep. M. Nowrozi*[1], M. Abazari[1], M. Raisianzadeh[1], A. Zare Shahne[2], and M. Mohammadi[3], [1]*Agriculture and Natural Resources Research Center of Khorasan*, *Mashhad, Khorasan, Iran*, [2]*Tahran University*, *Karaj, Tahran, Iran*, [3]*Guilan University*, *Rasht, Guilan, Iran*.

Effects of terbutaline (T), metaproterenol (M) and low energy diet (LE) on carcass composition, adipose cell size, blood hormones and metabolites of 72 Moghani culled ewes were evaluated in a completely randomized design for three months. In the first month, ration (12.14 MJ/kg DM) was similar for seven groups and the eighth group was fed low energy ration (10.71 MJ/kg DM) in the whole of study. Diets were fed ad libitum. After 30 days terbutaline and metaproterenol were added to the ration each one at three doses of 5, 10 and 20 mg/kg DM for 60 days. Data were analysed by SAS (1992) and means were compared with LSMEAN. T10 (10 mg/kg DM terbutaline) and M20 increased ($P<0.05$) final and cold carcass weights of ewes. LE ewes had lower daily dry matter intake than controls (1126 vs. 1500 g/day). Except for T5 and LE, all beta-adrenergic treated groups showed improved ($P<0.05$) gain:feed of 17.6 to 26.9% compared with controls. Increased ($P<0.05$) carcass efficiency was obtained by M5, M10 and M20 relative to controls (49.94, 50.07 and 50.64% vs. 46.31%). Total carcass crude protein was higher ($P<0.05$) for ewes receiving the M20. Ewes treated with T20, M5, M10, M20 and LE had lower ($P<0.05$) fat-tail weight than controls (3.64, 3.55, 3.54, 3.52, 3.99 kg vs. 4.52 kg). Both beta-agonists and low energy diet resulted in lower ($P<0.01$) adipocyte mean diameter. Plasma insulin concentration was 24% and 50% lower for M5 ewes than controls on days 30 and 60 respectively. Blood urea concentration was reduced by LE treatment 12.5 and 23.8% on days 30 and 60 respectively. In the second month, plasma T4 concentration was increased ($P<0.05$) by middle dose of both beta-agonists but in the next month this effect disappeared. Metaproterenol, terbutaline and low energy diet had significant effect on plasma triglyceride, cholesterol, HDL and LDL concentrations.Results indicated that metaproterenol causes a repartitioning of nutrients resulting in improved gain:feed, increased carcass meat and lowered weight of fat tail.

Key Words: Beta-Agonist, Terbutaline, Metaproterenol

Teaching/Undergraduate and Graduate Education: Scholarship of Teaching as Related to Promotion and Tenure

346 The scholarship of teaching and learning: The synergy of scholar and teacher. W. M. Schlegel*, *Indiana University*, *Bloomington,*.

"What we urgently need today is a more inclusive view of what it means to be a scholar – a recognition that knowledge is acquired through research, through synthesis, through practice, and through teaching."

Ernest Boyer (1990) Scholarship Reconsidered, Priorities of the Professoriate.

We continue in the 21st century to struggle with what is means to be a scholar and how scholarship is recognized and rewarded. With vast commitments to our discipline, institution, students, colleagues, family, community, and efforts to be global citizens, we struggle to find a balance and to do so within a system of institutional rewards that has not yet caught up with the interdisciplinary and integrative view of scholarship. Scholarship and teaching have been considered antithetical rather than synergistic. The scholarship of teaching and learning [SOTL] integrates the intellectual efforts of research and teaching. Integration of the fundamental and cutting-edge questions of a discipline with how those questions are conceived, represented, understood, and applied allows for the synergy of disciplinary scholar and teacher resonating a scholarship that is greater than the sum of its individual parts. This scholarly synergy affords a creative synthesis of ideas that enhances and renews our disciplinary thinking and teaching. SOTL is problem posing, aided by methods appropriate to disciplinary epistemologies, with application of results to practice, communication of results, self-reflection, and peer review and it is a process that facilitates advancement of the profession of teaching (Shulman & Hutchings, 1999). This endeavor is quite different from the pursuit of excellence in teaching and scholarly teaching. This presentation will address these differences as well how SOTL is being represented by individual faculty, disciplines, and institutions with mention of an emerging international society to support this work. Examples illustrating this view of a synergistic relationship between research and teaching will be introduced with a discussion of how this synergy enhances the efforts of both endeavors providing a larger context for the work.

Key Words: Teaching, Learning, Scholarship

347 Promotion and tenure on the basis of excellence in teaching: An institutional perspective. L. Connor*[1] and J. Armstrong[2], [1]*University of Florida*, *Gainesville*, [2]*Michigan State University*, *East Lansing*.

Excellence in teaching must be achieved in the prevailing institutional culture (beliefs, values, rules, and processes). Both faculty and administration must be involved in this quest. Teaching must be placed on the same plane as research/extension with no preferential treatment. To attain an appropriate teaching culture, the following institutional actions should be considered: 1) teaching

workload guidelines need to be implemented to minimize inequities between units; 2) faculty performance should be evaluated on the basis of assigned responsibilities, with teaching, research, and extension valued equally; 3) teaching quality/output indicators need to be specified, such as student teaching/counseling evaluations, awards, teaching publications, unique teaching methods, teaching portfolios/peer evaluation, professional workshops, teaching committees/task forces, and workloads; 4) faculty/unit bias in the T & P process must be mitigated by administration and appropriate peer committees at the unit and college level; 5) college/university teaching reward systems must recognize outstanding undergraduate/graduate teaching and advising (where possible, development efforts should be geared toward this endeavor); 6) college teaching portfolios/peer evaluations should be included in the T & P and teaching award processes; 7) faculty development seminars/workshops need to be regularly offered to enhance teaching/advising and faculty cohesiveness; 8) faculty research and publishing on teaching should be encouraged; 9) faculty participation on teaching committees/task forces needs to be stressed, while minimizing the number of such groups; 10) some open position salary funds should be allocated to updating teaching labs/equipment and mini-grants; 11) faculty teaching internships (ACOP and university) should be encouraged to develop administrators and broaden faculty perspectives; 12) faculty should be encouraged to regularly take sabbaticals to update disciplinary knowledge and teaching skills; 13) academic deans/unit chairs need to respond to changing trends/paradigm shifts impacting teaching.

Key Words: Rewarding Teaching, Teaching Excellence, Faculty Performance

348 Promotion and tenure on the basis of excellence in teaching: A faculty perspective. M. Wattiaux*[1] and J. Moore[2], [1]*University of Wisconsin, Madison*, [2]*North Carolina State University, Raleigh*.

With a renewed emphasis on their educational role as institutions of learning and teaching, many universities are revising guidelines for tenure and promotion of assistant professors with major teaching appointments. During the hiring process, a candidate should obtain in writing an up-to-date list of expectations and modes of assessment. Unfortunately, guidelines for tenure and promotion based on "excellence" in teaching are often described vaguely. They rarely distinguish "excellence" from "expertise" or "scholarly activity" in teaching. This lack of clarity combined with a lack of pedagogical training during graduate school may make it difficult for a newly hired individual with a major teaching appointment to find a focus. Thus, each institution should develop clear and specific guidelines that are congruent with its mission statement to help future teaching faculty members understand the standards against which they will be evaluated. Teaching faculty should excel in their teaching and (or) should have a record of accomplishment in Scholarship of Teaching and Learning (SoTL). If "research in teaching" is an expectation, then the newly-hired faculty members should be given support to integrate SoTL successfully into their academic careers such as time to develop teaching proposals and grants and funding for a teaching or research assistant dedicated to the SoTL. Demonstrated impact can be done at the national, regional, campus, college, departmental or classroom level. Examples include but are not limited to authorship of peer-reviewed publications, abstracts or invited presentations, teaching-related grants, developing and (or) leading sessions in teaching-related workshops, seminars or conferences, new course development, peer-review (and student evaluation) of classroom activities and syllabi, and peer-review of electronic educational packages (web or CD). The proper assessment of a teaching program is a rigorous process in part because of its multi-faceted nature. The SoTL offers genuine opportunities for enthusiastic instructors willing to pursue systematic improvement in student learning and the quality of teaching in their institution.

Key Words: Teaching, Scholarship, Tenure

Breeding and Genetics: International Evaluation of Dairy Bulls—In Honor of Dr. Rex Powell

349 Dr. Powell's contribution to international comparison of dairy bulls. F. Miglior*[1,2], [1]*Agriculture and Agri-Food Canada - Dairy and Swine Research and Development Centre, Lennoxville, QC*, [2]*Canadian Dairy Network, Guelph, ON, Canada*.

Dr. Powell wrote his first article on conversion equations between Canada and US in a popular press magazine in 1979, several years before Interbull was created and preliminary methodology of international comparison were developed. In that article he concluded that the international scientific community needed to provide guidance to users of sire evaluations across national borders, though derived equations were not as near perfect as would be desired. Four years later Interbull was created and Dr. Powell has been a member of the Interbull Steering Committee in 18 of the last 21 years. Dr. Powell is an international leader in collaborative efforts to coordinate genetic evaluations of dairy cattle and to enhance genetic improvement on a global basis. Apart from his strong contribution to the improvement of national genetic evaluations in US, Dr. Powell has worked extensively to develop genetic evaluations in several countries. Dr. Powell conducted the most extensive comparison of methods for converting genetic evaluations of dairy bulls among countries. His most relevant findings were: a) importance of correct definition of genetic groups; b) impact of different criteria for data editing and inclusion in international evaluations; and c) presence of bias when imported data were included in evaluations. Once Interbull MACE evaluations became available in 1995, Dr. Powell carried out many projects that have helped to increase the accuracy of international bull evaluations. Recently his focus has been on outlining the impact of genetic correlations among countries on accuracy of sire rankings. His findings have increased international awareness of the importance of improved estimation procedures of genetic correlations and in 2004 an Interbull Technical Workshop was devoted to this topic.

Key Words: International Evaluations, Conversion Equations, Interbull

350 Country bias in international dairy bull evaluations. R. L. Powell*, A. H. Sanders, and H. D. Norman, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD*.

The International Bull Evaluation service combines national dairy bull evaluations and provides results on each participating country scale. Theoretically, this process is designed to avoid favoring one country relative to another, but this concern has been raised frequently by international marketers of bull semen. Existence of a bias is difficult to assess; one approach is to compare evaluation results for full brothers from different countries. On average, these full brothers have the same genetics and should have similar evaluations. Over 12,000 Holstein bulls in 4336 full-brother families linked yield evaluations from 20 countries having bulls in at least 25 multi-country families. Slightly fewer bulls and families were in 16 countries with SCS data. The model analyzed with SAS® GLM included fixed effects of full-brother family (absorbed) and home country, where home country was the country of most daughters. To improve estimates of within-family variation, 6761 single-country families were also included. Primary analyses were on the US scale but results were similar on other scales. Full brothers from several countries had significantly higher evalu-

ations than their US sibs for milk (Australia, Czech Republic, Germany, France, Great Britain, Japan, and South Africa), fat (Australia, New Zealand, and South Africa), and protein (Australia, Czech Republic, Germany, Japan, and South Africa). In contrast, bulls from the United States had significantly favorable evaluations for milk relative to Italy and SCS relative to South Africa. Largest biases involved bulls from South Africa where only 8 to 9 families were in common with the United States (thus giving indirect data greater importance), but other significant differences were based on hundreds of direct ties. The reason for these inequities is unknown but elimination of biases is important to maintaining confidence in international evaluations.

Key Words: Genetic Evaluation, Interbull, Evaluation Bias

351 Multiple-trait multiple-country genetic evaluations of dairy bulls for udder health traits. T. Mark*[1] and P. G. Sullivan[2,3], [1]*Interbull Centre*, *SLU, Uppsala, Sweden*, [2]*Canadian Dairy Network*, *Guelph, Ontario, Canada*, [3]*Beef Improvement Ontario*, *Guelph, Ontario, Canada*.

Udder health is an economically important trait group and several measures of clinical and sub-clinical mastitis describe this trait complex. Interbull routinely computes two separate single-trait-by-multiple-country genetic evaluations (ST-Mace) for clinical mastitis (CM) and milk somatic cell (SC), for bulls from more than 20 countries. Separate evaluations are sub-optimal and it is desirable to extend ST-Mace to allow more than one trait per country. The aim of this study was to quantify the expected gains for Multiple-Trait-by-Multiple-country genetic evaluations (MT-Mace) compared with the current ST-Mace for udder health. For this purpose national SC (and CM) results from 8 (and 3) Holstein populations were considered. In MT-Mace, weighting factors were adjusted to account for residual correlations, while within country genetic correlations were considered in a multivariate deregression procedure. Predicted international genetic merits, of all bulls evaluated, were highly correlated between MT-Mace and ST-Mace, for SC in all 8 countries (>.99), and for CM in all 3 countries (>.98) when SC from the remaining 5 countries was included in the ST-Mace analysis for CM. Among several groups of bulls studied, the international predictions were most strongly affected for bulls that had national evaluations for both CM and SC in the same country. The genetic correlations from the ST-Mace model were also used for MT-Mace, so these results may change once correlations are re-estimated for the MT-Mace model, based on observations generated by the multivariate deregression procedure. Essentially the same results that required two 8-trait ST-Mace analyses, for these 11 traits of interest, were generated with a single 11-trait MT-Mace analysis. Additional traits for some or all countries could also be added into the MT-Mace system, for example udder depth, fore udder attachment, dairy form or milking speed. However, reduced-rank algorithms or other computational techniques may be needed to implement MT-Mace for a very large number of country-by-trait combinations, especially for the estimation of required covariances.

Key Words: International Evaluation, Clinical Mastitis, Milk Somatic Cell

ADSA Southern Section: Innovative Approaches to Address the Changing Needs of Our Dairy Industry

352 Innovative staffing models to enhance dairy educational programs. V. Ishler*, L. Holden, and R. Stup, *Pennsylvania State University*, *University Park*.

Universities are challenged with having fewer resources available to conduct educational programming. Dairy extension programs provide educational opportunities, but the complex planning processes, numerous departmental and geographic divisions and multiple academic responsibilities of traditional specialists make effective coordination of programs difficult. Penn State's department of dairy and animal science recognized that progressive dairy producers were being faced with challenges that were outside the discipline oriented programs of tenure-track dairy faculty. Critical gaps in educational programs for dairy producers and the agricultural industry were not being addressed in a timely manner. In-depth focus groups were conducted with agribusiness and producers to determine their educational needs. These groups identified four areas of critical need: information management, human resource management, business management and nutrient management. A new initiative, "Dairy Alliance", was launched to provide a system to integrate all available resources and to responds to the identified needs of the dairy industry. It was designed so highly skilled individuals could be hired in a timely manner with a specific expertise in a particular area. Positions were non-tenure track for a fixed-term basis giving greater flexibility to make program changes compared to traditional tenure-track positions. Dairy Alliance is organized as a self-managing team with specialists in the key program areas and a program manager who organizes activities and resources. A tenure-track faculty member and the department head of Dairy and Animal Science guide Dairy Alliance. The results of this new initiative have surpassed expectations. New relationships have been forged with key members of the dairy industry. An additional specialist has been hired to coordinate a dairy certification program and to address producer needs in milking management. Dairy Alliance is positioned to be a leading dairy extension/outreach program in the United States.

Key Words: Dairy, Education, Outreach

353 A dairy consultant's perspective on the changing needs of our dairy industry. N. Ohanesian*, *Consulting Nutritionist*, *Clovis, CA*.

Dairymen in the western states have become dependent on nutrition consultants to assure that their herds are properly fed and supplemented to achieve maximum production and health. In addition to the nutrition and feeding aspects of their herds, dairymen have become dependent on the nutritional consultant for advice on management aspects such as herd record analysis, breeding, disease, environmental issues, labor utilization, equipment evaluation, etc. Therefore, a professional nutritional consultant must become proficient in all management aspects of the industry. Proficiency means staying current in feeding strategies, current events, new products, new equipment, university and industry research and record keeping programs. The most precious commodity the consulting nutritionist has is time, he or she must balance their schedule with continuing education. Professional meetings must be evaluated for the information being offered along with the locations and time so that the consultant can schedule efficiently. Professional organizations such as American Dairy Science Association (ADSA) and American Registry of Professional Animal Scientists (ARPAS) are the foundation for continuing education. ADSA meetings offer the broadest spectrum of current research and techniques utilized by the consulting nutritionist. Membership in ARPAS and a regional chapter bring professional animal scientists together. Continuing education seminars such as those offered by the California chapter of ARPAS, are shorter in duration and target a specific technical topic. The consulting nutritionist has the opportunity to interact with industry and university professionals on a friendly and informal basis. This interaction is valuable in that professionals are able to exchange ideas and experiences that are helpful in increasing the knowledge base for those participating. Recent trends in the dairy industry have been larger dairy farms with integration of farming and milk. The consulting nutritionist of the future will have a larger roll in the management team of the dairy farm if he or she has a solid academic background and the ability to bring together theory with practicality.

Key Words: Consultant, Professional, Dairy

354 Meeting the changing needs of the dairy industry: perspective from an AI company. M. A. Faust*, A. Knuth, C. Marti, N. Michael, and A. Storch, *ABS Global, Inc.*, *DeForest, WI.*

Internal and external factors constantly influence the socioeconomic climate in which dairy farms operate. Successful dairy farms achieve sustainability and profitability within these dynamic conditions. The current result of changing socioeconomic conditions appears to be more distinct segmentation in dairy demographics with large, specialized dairies producing a commodity product and growth in importance of niche segments such as organic dairies, low input dairies, and cottage-industry operations. AI companies also are influenced by market forces, including industry success in generating genetic progress; thus high genetic merit is a customer expectation and it is difficult for AI companies to produce a differentiated product. Furthermore, semen expense represents <1% of dairy operating expense. The marketplace approach adopted by ABS Global which serves an international customer base has been to tailor products and services to individual market segments - using service and science to solve customer problems. Specifically, ABS sources and develops genetics appropriate for all market segments from three different continents. These genetics include elite breeder quality, mainline including a subset of European sourced bulls with higher milk components, show type, and grassland bulls. To further individualize sire selection, inbreeding, and breeding goals for dairies, sire selection and mate assignment programs are offered. Also, ABS and others offer specialized expertise and problem solving for herd reproduction management. Dairies can tailor the reproductive program further by selecting from a list of services such as heat detection, breeding and data entry, technical service consultation, performance monitoring, and evaluating measures of synchronization success. Acceptance of these programs by ABS customers has been great - during 2004, >2 million dairy cows were mated through the company's proprietary program while professionally trained reproductive management representatives walked behind >500,000 breeding eligible cows daily. Dairies expect products and services that meet their unique needs.

Key Words: Industry segmentation, Genetic improvement, Reproductive management

Breeding and Genetics: Genetics of New and Emerging Traits

355 Emerging traits of interest to the livestock industries: scrapie resistance in sheep. R. M. Lewis*[1] and B. Villanueva[2], [1]*Virginia Polytechnic Institute and State University*, *Blackburg*, [2]*Scottish Agricultural College*, *Edinburgh, UK*.

Many loci with major effects on performance, including fitness, have been identified in livestock. Where genotype tests characterizing polymorphisms at such loci are available, breeders have opportunity to use such information to increase the frequency of beneficial alleles. A clear example is the Prion Protein (PrP) locus in sheep, which is associated with resistance to the fatal transmissible spongiform (TSE) scrapie. Five main haplotypes have been identified for this locus resulting from polymorphisms at codons 136, 154 and 171. Animals homozygous for the ARR haplotype are considered resistant while animals carrying the VRQ haplotype are considered highly susceptible. Genetic strategies based on PrP genotyping have thus been adopted to eradicate scrapie in infected flocks while increasing the resistance of national flocks. The voluntary National Scrapie Plan (NSP) in Great Britain is one of the earliest PrP genotyping programs. It began in 2001 by genotyping rams registered with breed societies favoring rams with beneficial genotypes for breeding. Since other TSE diseases may be present in sheep, another aim of NSP is to remove the theoretical risk of bovine spongiform encephalopathy naturally affecting sheep. Although increasing genetic resistance to TSEs is clearly important, the path to achieving resistance requires care. For instance, limited evidence suggests ARR homozygosity may not unequivocally result in scrapie resistance, perhaps reflecting variable strains of scrapie. Semen banks designed to preserve alleles currently disfavored are needed to ensure flexibility to manage future TSEs. Furthermore, if favored alleles are antagonistic to other economically important traits or are sufficiently rare that selection increases inbreeding and reduces genetic variability, a focus on scrapie alone may prove risky. The careful integration of scrapie resistance into the overall breeding goal is thus central.

Acknowledgements: We are grateful to the Department for Environment, Food & Rural Affairs for funding.

Key Words: Scrapie, Genotyping, Risk

356 Effects of different strategies for breeding towards scrapie resistance in East Friesian milk sheep on inbreeding levels and production traits. F. de Vries*, H. Hamann, C. Drogemuller, and O. Distl, *University of Veterinary Medicine*, *Hannover, Germany*.

The European Union forces each member state to introduce a breeding programme for all sheep flocks of high genetic merit to breed towards scrapie resistance. The objective of the study was to assess the effects of different strategies to breed towards the scrapie resistant ARR/ARR homozygous genotype of the ovine prion protein gene in East Friesian milk sheep on inbreeding, drift variance, possible negative side effects, bottleneck effects and breeding costs. A simulation programme was developed, in which different population structures could be used. In this study the population structure of the region of origin of the East Friesian milk sheep was selected because of its low ARR allele frequency (10%) and an observed negative effect on withers height.

The simulation parameters were the allele frequencies of male and female founder animals, the population size, the age structure, the mating ratio, the effect of a QTL, a polygenic component associated or not with the QTL, the genetic distance between QTL and prion protein gene locus. Breeding strategies were optimized based on the mean inbreeding coefficients, the genetic distribution of founder rams to later generations, and the distributions of phenotypic and breeding values.

Based on the results, the strategy for East Friesian milk sheep should be to breed initially towards ARR heterozygous sheep until a threshold value of 30% for the ARR allele is reached in order to avoid a genetic bottleneck. After this the strategy should change and only ARR homozygous sheep should be selected. The higher cost of this strategy should be accepted in respect to minimal loss in genetic diversity. The developed simulation programme allows optimizing breeding schemes for other breeds.

Acknowledgements: Frerich de Vries got a scholarship from the Friedrich-Ebert-Foundation (Bonn and Berlin, Germany).

Key Words: Scrapie, Breeding Programme, Inbreeding

357 Association analyses between the prion protein locus and reproductive and weight traits in Ripollesa sheep. J. Casellas*[1], J. Piedrafita[1], G. Caja[1], R. Bach[2], and O. Francino[1], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*Associació Nacional de Criadors d'Ovins de Raça Ripollesa*, *Monells, Spain*.

The aim of this study was to analyze the association between the alleles of the prion protein locus (PrP) and performance traits in the Ripollesa sheep, an autochthonous breed of Catalonia (Spain). PrP genotypes were analyzed by the SnaPShot Multiplex technique in blood samples from 121 adult rams and ewes and 68 lambs from the experimental flock of the Universitat Autònoma of Barcelona. The genotype of 24 descendants of the genotyped adult individuals was also reconstructed, since both parents were homozygous for PrP alleles. Reproductive traits of ewes (n = 88) included conception rate (CR; n = 408) and litter size (LS; n = 364) whereas the lamb traits studied were birth weight

(BBW; n = 211) and 90 d BW (90BW; n = 164). Only three alleles were observed in the PrP locus of the Ripollesa flock: ARR (39%), ARQ (46%) and ARH (15%). The additive effect of PrP alleles was analyzed using the Bayesian threshold and linear models for reproductive and weight traits, respectively. No associations between PrP alleles and conception rate and weight traits were observed (Table 1). For litter size, the effect of the ARH allele was significantly greater than that of the ARQ allele. Difference between ARH and ARR alleles also suggested that ARH allele was superior for litter size. Our results indicate that the selection against the ARH and ARQ alleles, for which scrapie positive sheep have been observed in Spanish sheep breeds, might decrease litter size in the Ripollesa breed.

Table 1. Mode and 95% highest posterior density region bounds (HPD95) of the differences between additive effects of each pair of alleles.

Trait	ARR-ARQ Mode (HPD95)	ARR-ARH Mode (HPD95)	ARQ-ARH Mode (HPD95)
CR	-0.14 (-0.51 to 0.06)	0.01 (-0.41 to 0.44)	0.15 (-0.24 to 0.57)
LS	0.10 (-0.15 to 0.37)	-0.41 (-0.87 to 0.05)	-0.51 (-0.97 to -0.08)
BBW	0.03 (-0.14 to 0.19)	0.01 (-0.20 to 0.22)	-0.02 (-0.23 to 0.19)
90BW	0.33 (-0.60 to 1.26)	-0.51 (-1.66 to 0.81)	-0.84 (-2.03 to 0.53)

Acknowledgements: Conveni DARP-ANCRI-UAB

Key Words: Association Analysis, Prion Protein, Ripollesa Breed

358 QTL Scan for disposition in *Bos taurus* x *Bos indicus* cattle families. M. Wegenhoft*, J. Sanders, and C. Gill, *Texas A&M University*, *College Station*.

Disposition, or temperament, of cattle is important from both a commercial and purebred producer standpoint. Some studies suggest a correlation between an animalÃ¢â‚¬â„¢s disposition and meat tenderness. Others have suggested a relationship between behavior and circulating cortisol levels. However, relatively few groups have studied quantitative trait loci (QTL) for disposition in cattle, although heritability of the trait is moderate to high. The objective of this study was to detect QTL affecting disposition in a three-generation *Bos taurus* x *Bos indicus* reciprocal backcross population produced through embryo transfer. Disposition was scored prior to slaughter (n=567) on a scale of 1 (calm) to 5 (crazy). A sex-averaged map consisting of 313 markers and spanning 2796 cM was built for the 29 autosomes and the X chromosome. Disposition data were studied through analysis of covariance using the mixed model procedure of SAS. Independent variables included sire-type x dam-type (STxDT) interaction, the three-way interaction of sex x ST x DT, the regression of birth date within season-year combination, and family nested within ST x DT as a random effect. Residuals were used for interval mapping by linear regression under a line cross model to detect QTL segregating between breeds. Six QTL with suggestive evidence of linkage were detected on bovine chromosomes (BTA) 1, 4, 8, 9, 16 and 18. Four of these QTL were estimated to have dominance or overdominance effects, while two were estimated to have additive effects. Overdominance effects were detected for the QTL on BTA8 and BTA16 when evaluated under a Mendelian model and large imprinting effects were found when parent-of-origin effects were included in the model. The six putative QTL identified in this population provide a starting point for identification of positional candidate genes affecting disposition. None of these six putative QTL are on the same chromosome as the gene for cortisol.

Acknowledgements: This research was funded by the Texas Agricultural Experiment Station. We thank Colette Abbey for technical assistance.

Key Words: Bovine, Disposition, QTL

359 Are time-budgets of dairy cows affected by genetic improvement of milk yield? P. Lovendahl* and L. Munksgaard, *Danish Institute of Agricultural Sciences*, *Tjele, Denmark*.

Time is a resource that the cow can spend on feed intake, walking between different loca-tions, waiting and resting. Our hypothesis is that components of dairy cows time budget have genetic variation and those parts closely connected with production traits may be affected by selection for improved yield. We studied time-budgets of 243 first lactation Holstein cows twice in early lactation (mean 86, range 50 to 123 DIM). Estimates of minutes spent eating, lying, standing or walking in alleys were obtained from scan sampling of the activities at 10 min intervals during 24 hours. Daily milk yield (ECM) was recorded at 3 week intervals. Data were analysed by AI-REML using two-trait repeatability models including relationship matrix. The heritability of daily ECM was $h^2 = 0.12 \pm 0.14$, and eating time had similar heritability (0.13 ± 0.13), but lying time had very low heritability (0.02 ± 0.15). Correlations between traits were calculated as individual animal correlations (r_i) based on permanent animal and additive genetic covariance components. Eating time was positively correlated with yield ($r_i = 0.23$), and lying time negatively correlated with yield ($r_i = -0.26$). Although eating time was negatively correlated with lying time ($r_i = -0.38$), the magnitude of this cor-relation decreased at higher yield. As restrictions on lying time are known to induce stress responses, further selection for higher yield may increase the liability to metabolic disease caused by deficits in time budgets of dairy cows.

Key Words: Behavior, Welfare, Cattle

360 Genetic variation of Johne's disease susceptibility in U.S. Holsteins. M. Gonda*, Y. Chang, G. Shook, M. Collins, and B. Kirkpatrick, *University of Wisconsin*, *Madison*.

Johne's disease infection, measured by serum antibodies (S/P ratio) and fecal culture of *Mycobacterium avium* subsp. *paratuberculosis,* is an enteric infection of ruminants causing weight loss, diarrhea, decreased milk production, and eventually death. Because the antibody and fecal tests have low false positive and high false negative error rates, cows positive for either antibody ($S/P \geq 0.10$) or culture test were classified as positive in a combined phenotype. Blood and fecal samples were collected primarily from daughters of twelve project bulls in their second or third lactation. These twelve sire families, which are part of a study to map major loci affecting Johne's disease susceptibility, were selected for their large family sizes and low relationships among sires. Approximately 92% of cows in this study were daughters of these twelve sires, although 46 sire families were represented in the edited dataset. Herds without a positive Johne's disease test and sire families with less than five daughters were removed from the dataset. The remaining 4655 cows from 241 herds were used for estimating heritability of susceptibility to Johne's disease with three traits: the antibody test, culture test, and combined tests. Overall disease prevalences were 0.248 with the antibody test and 0.0324 with the culture test. Mean prevalence with the combined phenotype for the twelve largest sire families was 0.259 (maximum sire prevalence = 0.324; minimum = 0.187). Analyses were carried out with a Bayesian linear sire model for log transformed antibody phenotypes and threshold sire models for culture and combined test phenotypes. Models included a fixed effect for parity and random effects for herd and sire using Markov chain Monte Carlo methodology. The posterior mean of across herd heritability was 0.211 (± 0.087) for the antibody test, 0.253 (± 0.135) for the culture test, and 0.148 (± 0.069) for the combined tests.

Key Words: Johne's Disease, Paratuberculosis, Heritability

361 Fine mapping of a QTL in a swine population selected for ovulation rate. M. Mousel*, G. Rohrer, K. Leymaster, and R. Christenson, *USDA-ARS; U.S. Meat Animal Research Center*, *Clay Center, NE*.

Fine mapping of a QTL located on chromosome 10 (SSC10) was conducted in a four-breed, white composite population of swine selected for ovulation rate (OR). Animals were selected for 11 generations for increased OR and compared

to unselected controls (CO). The selection line had an increase of 3.0 corpora lutea (CL) and an increase of 0.3 pigs in total litter size as compared to controls. DNA was collected from 262 CO and 258 OR gilts and boars at generations 12 and 13. Six microsatellite markers, including two utilized in validation of the QTL, that spanned from 69cM to 96cM were genotyped. Utilizing SAS/Genetics, the marker which had showed the most significant (P<0.001) divergence between OR and CO lines was SW1041 (69cM). Significant differences (P<0.001) of SW1041 alleles on CL were identified with a model including allele, line, year born, season born, and sire as a random effect. The most frequent SW1041 allele in the OR line was associated with the second largest CL mean. Two markers (SWR1829, SW951) had the most frequent OR allele associated with greatest CL mean. An additional two markers (MRC1MS, GAD2) had an increase in the frequency of the OR line allele, compared to CO, which was associated with greatest CL mean for the marker. These data indicate that the divergence in allele frequencies on SSC10 between the OR and CO lines is likely due to a CL QTL and they refine the region in which a CL QTL is located. The selection line will be useful to identify genetic markers and causative genes for use in the industry.

Key Words: Swine, Fine Mapping, Ovulation Rate

362 Genetics of immune response in Canadian dairy cows and potential use in selection. R. Rupp[1], A. Hernandez[1], F. Miglior*[2,3], and B. Mallard[1], [1]*Ontario Veterinary College*, *Guelph, ON, Canada*, [2]*Agriculture and Agri-Food Canada - Dairy and Swine Research and Development Centre*, *Lennoxville, QC, Canada*, [3]*Canadian Dairy Network*, *Guelph, ON, Canada*.

In the last years selection goals for dairy cattle have evolved worldwide, with increasing interest for functional traits and special attention given to resistance to disease. As an alternative or complement to various indirect traits, improving immune response of animals is a promising mean to increase broad based resistance to disease. Recent progress has enabled characterization of both antibody (AMIR) and cell mediated (CMIR) immune responses, two complementary traits that indicate the general immune ability of the host. AMIR can be measured as serum concentration of specific antibody after immunization with an inert antigen. In addition, a delayed type hypersensitivity test based on the increase in skin-fold thickness following injection with test antigens has been developed to characterise CMIR. Accordingly, AMIR and CMIR were measured in 127 cows in an experimental farm. Heritability of CMIR varied from 0.27 to 0.50, showing a large genetic determinism of this trait although standard errors were high. Heritability of AMIR, relationships between both immune response traits and relationships with production traits are in progress. The indirect response of the selection based on the Canadian Lifetime Profitability Index (LPI) on both immune traits has been evaluated and showed that AMIR and CMIR may be deteriorating under current selection if their genetic correlations with protein and fat are antagonistic. A simulation study is in progress in order to assess the desirability, feasibility and modality of including AMIR and CMIR in an health index (as an alternative or together with other indirect traits such as somatic cell counts) to improve resistance to mastitis and other diseases.

Key Words: Disease Resistance, Immune Response, Genetic Parameters

363 Electrical conductivity of milk are genetically correlated to mastitis. E. Norberg*[1], G. W. Rogers[2], J. B. Cooper[2], and P. Madsen[1], [1]*Department of Genetics and Biotechnology, Danish Institute of Agricultural Sciences*, *Tjele, Denmark*, [2]*University of Tennessee*, *Knoxville*.

Electrical conductivity (EC) of milk was introduced as an indicator of mastitis several decades ago. Until now EC has solely been used for detection of bovine mastitis on the phenotypic level. However, EC may, if it shows genetic variation and is genetically correlated to mastitis, be used as an indicator trait in a breeding program. In this study, daily measurements of EC and mastitis on ~ 1500 first lactation Holstein cows, sired by 125 bulls, from 4 herds in Florida were used to estimate genetic parameters for EC and its relationship to mastitis. Electrical conductivity was measured in millimho (mmho) in composite milk from every milking with the Afikim computerized milking and management system (SAE Afikim, Kibbutz Afikim, Israel). Udder health status (mastitis or no mastitis) was recorded every day from DIM 6 to the last day of lactation. A bivariate analysis was carried out using a linear animal model with repeated measurements. Age at first calving, herd-test-day and DIM were included as fixed effects. Electrical conductivity was modeled with a constant additive genetic effect and a permanent environmental effect as a forth-order Legendre polynomial along the lactation trajectory. For mastitis, a simple repeatability model without random regressions was used. The permanent environmental variance of EC and mastitis was assumed to be uncorrelated. For EC, the estimated heritability ranged between 0.22 and 0.39 during the lactation. For mastitis, the heritability was as expected low (0.013). The genetic correlation between EC and mastitis was estimated to be 0.75, with a standard error of 0.13. These results show that electrical conductivity of milk has a high genetic correlation to clinical mastitis, and therefore has potential as an indicator trait in breeding programs were selection against mastitis is included.

Key Words: Dairy Cow, Electrical Conductivity, Mastitis

Dairy Foods: Cheese I—Cheddar, Mozzarella, and Kashar Cheeses

364 Effects of incorporation of probiotic *Lactobacillus acidophilus*, *Lb. casei*, *Lb. paracasei* and *Bifidobacterium* spp. on proteolytic patterns and production of organic acid in Cheddar cheese. L. Ong[1], A. Henriksson[2], and N. P. Shah*[1], [1]*Victoria University*, *Werribee Campus, School of Molecualr Sciences, PO Box 14428 melbourne City MC, Vic 8001 Australia*, [2]*DSM Food Specialties*, *Moorebank, NSW, Australia*.

Our objectives were to study i) the survivability of probiotic organisms in Cheddar cheeses and ii) the influence of these organisms on proteolytic patterns and production of organic acid.

Three types of Cheddar cheeses were made with lactococci starter (control) and a combination of probiotic bacteria. Probiotic, starter and non-starter lactic acid bacteria were enumerated using selective media. The compositional analysis was carried out as per AOAC. Concentration of organic acid was analysed using HPLC. Proteolytic patterns were examined using SDS-PAGE and soluble nitrogen method.

All probiotic adjuncts survived manufacturing process and maintained viability of >7.5 log10 CFU/g at the end of ripening for 6 months at 4°C. Lactococci counts decreased by one to two log cycles. No significant differences (P>0.05) were observed in fat, protein, moisture and salt contents, but acetic acid concentration was higher in probiotic cheeses. Primary proteolysis was not significantly different (P>0.05) between cheeses, but secondary proteolysis as indicated by concentration of free amino acids was significantly higher (P<0.05) in probiotic cheeses. Hydrolysis of casein after 6 months of storage was higher in probiotic cheeses with preference over α_s-CN than β-CN. As the concentrations of casein decreased, levels of lower molecular weight breakdown products of the caseins increased. Proteolytic activity, however, remained low for all cheeses.

Our results indicated that the addition of probiotic microorganisms in Cheddar cheeses increased proteolytic activity and changed flavour profile. Results also demonstrated that Cheddar cheese can be an effective vehicle for delivery of some health-promoting bacteria to the consumer.

Key Words: Probiotics, Proteolytic Patterns, Cheddar Cheese

365 Influence of calcium, phosphorus, residual lactose, and salt-to-moisture ratio (S/M) of Cheddar cheese on proteolysis during ripening. P. Upreti, P. S. Lehtola, and L. E. Metzger*, *University of Minnesota, St. Paul*.

Proteolysis in cheese is influenced by the state of proteins (protein-calcium-phosphate interactions), level of indigenous milk enzymes (plasmin), externally added milk-clotting enzymes (chymosin), and endogenous and exogenous enzymes from starter and non-starter lactic acid bacteria (NSLAB). The objective of this study was to determine how different levels of Ca and P, residual lactose, and S/M in cheese influences proteolysis during ripening. Eight cheeses with two levels of Ca and P (0.67 and 0.47% vs 0.53 and 0.39%), lactose at pressing (2.4 vs 0.78%) and S/M (6.4 vs 4.8%) were manufactured. The cheeses were analyzed for changes in pH-4.6 soluble-N, starter and NSLAB counts during 48-wk of ripening. Starter bacteria and NSLAB counts were measured by plating appropriate dilutions of cheeses on Bacto-Elliker and LBS agars respectively, and incubating at 30°C for 48h under aerobic and anaerobic conditions respectively. Cheeses at d1 were also analyzed for residual chymosin activity. A significant increase ($p<0.05$) in soluble-N was observed during ripening for all the treatments. Cheeses with low Ca and P, low lactose, and low S/M treatments exhibited higher levels of proteolysis ($p<0.05$) as compared to their corresponding treatments. Differences in the rate of proteolysis for cheeses with different levels of Ca and P were partly attributed to differences in residual chymosin in the cheeses. Cheeses with low Ca and P were manufactured by lowering the pH at set and drain, which led to a higher chymosin retention in cheeses with low Ca and P as compared to high Ca and P ($p<0.05$). All cheeses had a similar number of starter bacteria (~10^{10} cfu/g) in cheese curds before salting; which decreased significantly during ripening ($p<0.05$). However, the decrease was larger in the case of high S/M treatments as compared to low S/M treatments ($p<0.05$). In contrast, the number of NSLAB increased during ripening, and cheeses with low S/M had higher counts as compared to high S/M ($p<0.05$). Hence, differences in proteolysis due to S/M may be partially due to differences in the starter/NSLAB counts.

Key Words: Proteolysis, Cheese Ripening

366 Moisture retention and salt uptake in Cheddar curds made from milk preacidificed with carbon dioxide: a possible solution to the salt whey problem. B. Nelson* and D. Barbano, *Cornell University, Ithaca, NY*.

The high salt (NaCl) content of salt and press whey limits utilization of these cheese by-products. Consequently, these by-products become part of the plant effluent routed to a waste treatment facility. The salinity, fat content, and biological oxygen demand make these costly by-products. Decreasing or eliminating salt and press whey would be beneficial to the industry and the environment. Preacidifying milk with CO_2 before making cheese effectively decreased the loss of moisture during salting and pressing and increased the salt uptake. Salt uptake was enhanced so much that 29% less salt was added to the curds of the CO_2 treatment than the control while a similar salt content in the cheese was achieved. The salting rate of the CO_2 treatment was only 2.0% of the curd weight while our control salting rate was 2.8% of the curd weight. The salt contents of the CO_2 and control cheeses after 17 h of pressing was 1.71 and 1.68%, respectively. The total salt for the control and treatment was added in three equal portions. Not only was the moisture content of the control unsalted milled curd higher, but the curd lost more moisture after each salting than the CO_2 treatment curd. During the first 5 h of pressing, the control cheese lost more moisture than the CO_2 cheese. Because of the greater moisture loss of the control cheese the cheese had lower moisture (35.04%) than the CO_2 cheese (37.29%) and a higher salt in the moisture. The ability of the CO_2 cheese to retain moisture was also observed with less expressible serum being obtained from the curds and cheeses of the CO_2 treatment. Casein in the water phase appears to be the reason why the CO_2 treatment curd and cheese better retain moisture and have enhanced salt uptake. Salt and press whey will be reduced if cheese is manufactured from milk preacidified with CO_2.

Key Words: Cheese, Salt, Whey

367 Mathematical modeling of buffering properties of Cheddar cheese. P. Upreti*[1], P. Buhlmann[2], and L. E. Metzger[1], [1]*University of Minnesota, St. Paul,*, [2]*University of Minnesota, Minneapolis*.

The buffering capacity of cheese is an important determinant of cheese pH. It depends on several compositional factors including proteins, colloidal calcium phosphate (CCP), inorganic phosphate, and weak organic acids. The objective of this study was to quantitatively characterize the chemical species responsible for buffering properties of cheese. Eight cheeses with two levels of Ca and P (0.67 and 0.47% vs 0.53 and 0.39%), lactose at pressing (2.4 vs 0.78%) and salt-to-moisture ratio (6.4 vs 4.8%) were manufactured. The cheeses were analyzed for total Ca and P, proteins, water-soluble P, organic P, citric acid, and lactic acid. Titration curves were made by titrating cheese:water mixtures with HCl to reach pH 4.0 and subsequently adding NaOH to reach pH 8.5. To model buffering curves, 40 species were identified. These species can be classified into the following categories: free and protein-bound amino acids that have a pKa in the range of 4 to 8.5, acids (phosphoric, lactic, citric), complexes (phosphate, citrate, and lactate complexes of Na, Ca and Mg), and precipitates of Ca and Mg. The 40 corresponding equilibrium equations with known constants and measured parameters were solved to calculate the effect of pH on the concentration of the 40 species. The experimental and predicted buffering curves were divided into 3 regions (pH 4 to 5, 5 to 6, and 6 to 8) and compared. The mathematical model suggests that buffering in the pH range of 4 to 5 is predominantly due to protein-bound glutamate and aspartate, and lactic acid in the cheese. Buffering in the region from pH 5 to 6 is due to a precipitate of $Ca_3(PO_4)_2$. This is consistent with the observation that cheeses with high Ca and P had higher buffering capacity in this region as compared to cheeses with low Ca and P. Bufffering in the pH range from 6 to 8 was observed when cheeses were made alkaline with NaOH after the initial acidification to pH 4. Model suggests that the buffering peak in this region is partially due to protein-bound histidine and serinephosphate. In addition, there appears to be an additional component from kinetically delayed $Ca_3(PO_4)_2$ precipitation.

Key Words: Cheese, Buffering

368 Effect of emulsifying salts on the state of calcium in pasteurized process Cheddar cheese. N. Shirashoji*[1,2], J. J. Jaeggi[2], and J. A. Lucey[2], [1]*Food Research & Development Laboratory, Morinaga Milk Industry Co., Kanagawa, Japan*, [2]*University of Wisconsin, Madison*.

The amount of calcium associated with casein plays an important role in modifying the physical properties of cheese. However, there has been little research on the impact of different types of emulsifying salts (ES) on the state of calcium in process cheese. Pasteurized process cheeses were made from 4 mo old Cheddar cheese and trisodium citrate (TSC) and sodium hexametaphosphate (SHMP) (concentrations of ES ranged from 0.25-2.75%) were used as ES. Cheese was heated at 80°C for various holding times (0-20 min) using a Blentech twin-screw cooker. Hot melted cheese was poured into pouches and stored at 5°C for 7 d. The pH value of all cheeses was maintained at pH ~5.6. Serum phase of process cheese was extracted from cheese dispersions by ultrafiltration (5kDa cut-off) and concentration of calcium in this was called soluble calcium. Small amplitude oscillatory shear were used to determine the rheological properties of process cheese. Melting properties were analyzed using UW Melt profiler (degree of flow, DOF) and Schreiber test. Acid-base titrations were used to determine the state of calcium phosphate. Storage modulus increased as concentrations of ES increased in process cheese made with TSC or SHMP. Bound calcium increased as the concentrations of ES increased for both ES. Loss tangent values at 40 °C were positively correlated with DOF and Schreiber melt area ($r > 0.83$). Bound calcium was negatively correlated with loss tangent value at 40 °C and Schreiber melt area ($r > 0.63$). Titration curves of cheese made with TSC had a smaller buffering peak at pH ~$4.8 (which was caused by residual CCP) and an increase in buffering peak at pH ~3.8. The buffering peak at pH ~$4.8 shifted to a lower pH value with increasing concentration of added SHMP. This study indicated ES may not only chelate calcium but may form different types of calcium bridges in cheese systems that may influence the physical properties of process cheese.

Acknowledgements: Morinaga Milk Industry Co.

369 Use of cold microfiltration retentates for standardization of milks for pizza cheese: Impact on yield and functionality. S. Govindasamy-Lucey*, J. Jaeggi, M. Johnson, T. Wang, and J. Lucey, *University of Wisconsin*, *Madison*.

Non pasta-filata mozzarella (pizza) cheese was manufactured with milk (12.1% TS, 3.1% casein, 3.1% fat) standardized with cold microfiltered (MF) retentates. Non-ceramic MF membranes were used to process cold (<7°C) skim milk. MF and diafiltration resulted in at least ~35% of serum protein removal from the MF retentate. Cheesemilks were obtained by blending MF retentate (16.4% TS, 11.0% casein, 0.4% fat) with whole milk (12.1% TS, 2.4% casein, 3.4% fat). Control cheese was made with partially-skimmed milk (10.9% TS, 2.4% casein, 2.4% fat). Initial trials with MF fortified cheeses resulted in ~ 2-3% lower moisture (45%) than control cheese (~47-48%). Procedures were then altered to obtain similar moisture content in all cheeses. Two types of MF cheeses were produced; one with pre-acidification of milk to pH 6.4 (pH6.4MF) and another made from milk pre-acidified to pH 6.3 (pH6.3MF). Moisture content of MF cheeses was increased by using lower setting temperature, increasing curd size and lower wash water temperature. Cheese functionality was assessed using dynamic low-amplitude oscillatory rheology (DLAOR) and performance on pizza. The coagula were cut at the same firmness. Use of lower pre-acidification pH resulted in shorter coagulation time. Nitrogen recoveries were significantly higher in MF fortified cheeses. Fat recoveries were highest in the pH6.3MF cheese than the control or the pH6.4MF cheese. Moisture-adjusted cheese yield was significantly higher in the two MF-fortified cheeses. Maximum loss tangent (LTmax) values (from the DLAOR test) were not significantly different in the three cheeses and the LTmax value increased during ripening. Temperature for LTmax was highest in control and was lower in pH6.3MF cheese than pH6.4MF cheese. Temperature for LTmax decreased with age for all three cheeses. TCA-soluble nitrogen levels were similar in all three cheeses. Performance on pizza was similar for all cheeses.

Key Words: Cheese Yield, Texture, Functionality

370 The effect of cheese temperature on the texture and shredding of mozzarella. K. Lim*, A. Bostley, and C. Chen, *Wisconsin Center for Dairy Research*, *Madison, WI*.

For mozzarella the primary texture attributes related to acceptable shredding are firmness and adhesiveness. The firmer and less adhesive the mozzarella, the higher the Shred Grade (an indicator of shredded cheese quality). The objective of this study was to investigate if decreasing the cheese temperature at shredding would lead to higher shred quality. Mozzarella was manufactured at the WI Center for Dairy Research using a typical manufacturing methods, stored at 7.2°C and then tempered to -1.1, 1.7, 4.4 and 7.2°C prior to shredding and texture evaluations. Cheeses were shredded using an Urschell CC-D shredder and texture evaluated at 2 and 6 weeks of age. Shredded cheese quality was determined by Shred Grade which is derived from shredded cheese size distribution, size measurements and characteristics. The texture attributes of firmness and adhesiveness were determined using the Sensory Spectrum method (15-point product-specific reference scale, 11 trained panelists). Data were statistically analyzed using ANOVA. We observed a significant difference in firmness as cheese temperature decreased for 2 and 6-week old mozzarella. No differences were noted in the adhesiveness of cheeses at the temperatures evaluated. Although lowering cheese temperatures resulted in a firmer cheese, this did not guarantee greater shredded cheese quality. For 2-week old mozzarella, the cheeses shredded at lower temperatures (which were firmer) had significantly higher Shred Grade scores. At 6 weeks, cheese shredding quality did not differ with shredding temperature (even though cheese firmness did). Shredded cheese quality decreases at sensory adhesive scores above 5. The mean adhesive scores were 5.4 and 6.8 for 2 and 6 week old cheeses respectively. Authors speculate that at 2 weeks, shredded cheese quality increased with decreasing temperature due to the firmer texture and adhesive scores that did not surpass 5. At 6 weeks, adhesiveness values surpassed the critical value 5, thus overriding any benefits of a firmer texture.

Key Words: Mozzarella, Shredding, Texture

371 The use of fat replacers in low-fat fresh kashar cheese: composition, proteolysis and yield. N. Koca*[1,2] and M. Metin[1], [1]*Ege University*, *Izmir, Turkey*, [2]*The Ohio State University*, *Columbus*.

Kashar cheese is a semi-hard cheese produced by heating and stretching its curd and is one of the most consumed cheeses in Turkey. It is classified as fresh and mature in terms of ripening level. The low-fat fresh kashar cheeses (about 70% fat reduction) were produced by using two protein-based fat replacers (1.0% w/w Simplesse®D-100 and 1.0% w/w Dairy-Lo™) and one carbohydrate-based fat replacer (5.0% w/w Raftiline®HP) in order to determine their effects on the composition, proteolysis and yield. Cheese samples were analyzed for yield on the 1st day, for composition on the 7th day and for proteolysis on the 1st, 7th, 30th, 60th and 90th days of storage. Full-fat and low-fat cheeses were also produced as control. The moisture contents of the cheeses made with fat replacers were significantly higher than those of the low fat control cheese whereas protein contents were significantly lower ($P<0.01$). Although all fat replacers significantly increased the value of moisture in non-fat substance (MNFS) and the yield of cheese ($P<0.01$), the MNFS value for low fat cheese with Simplesse®100 (63.43%) was higher than that of full fat cheese (63.28%) and the yield (8.08%) was similar to that of full fat cheese (8.09%). About a 70% fat reduction for the low-fat control cheese resulted in a 24% decrease in yield compared to the full fat cheese. The use of Simplesse®100 and Raftiline®HP increased the water-soluble nitrogen content ($P<0.05$) whereas Dairy-Lo™ had no significant effect ($P>0.05$). However, the 12% TCA soluble nitrogen content was not significantly affected by using fat replacers ($P>0.05$). One of the most important strategies for improving the functional properties of low fat cheese is to increase its moisture content sufficiently to provide a moisture to protein ratio or MNFS value that is equal to or higher than its full fat counterpart. As a result, the use of Simplesse®100 for the production of low-fat fresh kashar cheese was found technologically the most successful due to its ability to increase both the moisture content and yield of cheese.

Key Words: Low Fat Cheese, Kashar, Yield

Extension Education: Cow Comfort on Commercial Dairy Operations

372 Maximizing cow comfort on dry lot dairies. D. Armstrong*[1], J. Smith[2], and M. VanBaale[1], [1]*University of Arizona*, *Tucson*, [2]*Kansas State University*, *Manhattan*.

Dry lot dairy farms are frequently built in hot semi-arid climates where in the summer months they experience 30 to over 150 days of heat stress annually. Although most of these areas experience low annual rainfall (less than 38 cm.), moisture can restrict dry lying area for animals. Corrals need to have a 2 to 2.5% slope to provide adequate drainage and depending upon the annual evaporation rate, an area of 46 to 70 sq. m/cow. To provide adequate cow comfort, corrals need to be maintained by removing excessive dry manure from the corral. The excess dry manure needs to be removed several times a year depending on when rain or snow is expected. Walking distance of cows from the corral to the milking parlor should be minimized in the dairy design. Observations in hot weather indicate one-way lane walking distances from the corral to the milking parlor should be less than 365m for 2X milking, 274m for 3X milking, and 183m for 4X. Methods of reducing heat-stress in different parts of the dairy farm will depend upon the number of heat-stress days in the area where the

farm is located. Shade should be provided for all milking cows, dry cows and replacement animals from 0 to 5 months of age. In areas of extreme heat-stress, shade should be provided for all replacement animals. In an AZ trial, a 6% increase in milk production was observed from providing 3.7 sq. m of solid shade/cow. An additional AZ trial indicated that shade over the feed line increased milking production 3% because feed intake increased. Adding evaporative type cooling systems under the shade has increased milk production 6 to 14% depending on the stage of lactation, level of heat-stress and the design of the cooling system. Evaporative cooling systems for corral cooling can vary from $150 to $450/cow. The use of spray line over the feed line in a 1980s CA trial increased milk production and reproductive efficiency. The recent use of soaker lines which decrease the effect of high natural air flow has increased the cooling response in free-stall barns, but there are no data for dry lot dairies. The cost and effectiveness of cooling cows in hot semi-arid climates will vary depending upon the number of days of heat stress.

Key Words: Cow comfort, Dry Lot, Heat stress

373 Practical methods for reducing heat stress on dairy operations. J. F. Smith*[1], D. V. Armstrong[2], M. J. Brouk[1], J. P. Harner[1], and M. J. VanBaale[2], [1]*Kansas State University*, *Manhattan*, [2]*University of Arizona*, *Tucson*.

Lactating dairy cows generate significant amounts of energy from digestion of feedstuffs and metabolic processes. When ambient temperatures increase above the thermal neutral zone the dry matter intake, milk production, health and reproduction of dairy cows is compromised. A trial completed in Missouri showed that lactating cows under heat stress decreased intake 6-16% as compared to thermal neutral conditions. In addition to a reduction in feed intake, there is also a 30 to 50% reduction in the efficiency of energy utilization for milk production. The dairy cow can be managed and cooled to minimize the impact of heat stress. Heat stress can be reduced by providing a cooler environment, by soaking the cow and evaporating water off her skin surface or using a combination of these two methods. Evaporative cooling can be used to cool the air around the cow. On dairies, producers have used tunnel ventilation with evaporative pads and combinations of fans and high-pressure sprayers to cool the air around the cow. This method works well in arid climates. As water is evaporated into the air, temperature will drop and humidity will increase. The use of low-pressure sprinkler/soaker and fan systems to effectively wet and dry the cows will increase heat loss from the cow. Evaporating water off the skin works well in humid and arid climates. Dairy cows can be soaked in the holding pen, exit lanes, and on feedlines. The goal should be to maximize the number of wet-dry cycles per hour. Recent research would indicate that a combination of using evaporative cooling to cool the air and a low pressure soaker system to soak the cow can be used to effectively manage heat stress in hot humid climates. Matching the cooling strategy with the climate is essential to manage the impact of heat stress in dairy cattle.

Key Words: Heat stress, Dairy cattle, Milk production

374 Maximizing cow comfort in free-stall facilities. D. Weary*, *University of British Columbia*, *Vancouver, BC, Canada*.

Recent research has shown that cow comfort in free-stall facilities can be assessed using measures of injuries, measures of preference, and measures of usage such as time spent lying down. For example, cows spend more time lying down in well-bedded stalls, and prefer to use these stalls when given a choice. When no choice is available, cows using stalls with little bedding have an increased risk of leg injuries. Poor stall maintenance and overstocking both lead to marked reductions in lying times in free-stall barns. Poor stall design also constrains cow movement when getting up and lying down, sometimes resulting in injuries from contact with stall structures such as the neck rail. Free-stall facilities should not only provide cows a comfortable place to lie down, but also comfortable environments for standing and feeding. To improve stall cleanliness, free stalls are often designed so as to prevent cows from standing fully in the stall. However, these design features increase the time cows spend standing outside of the stall, often on wet concrete. Increased exposure to hard and wet standing surfaces is known to increase the risk of hoof injuries and lameness. Cows prefer to stand on softer flooring surfaces, and these surfaces improve cow mobility. Softer flooring in front of feed bunk also increases the time cattle spend close to the feed. In summary, a number of scientific approaches are now available for assessing cow comfort, and a growing body of research has identified key methods of improving comfort for cows while lying, standing and feeding in free-stall facilities.

Key Words: Injuries, Lameness, Behavior

375 Factors influencing time budgets of dairy cattle. R. Grant*, *W. H. Miner Agricultural Research Institute*, *Chazy, NY*.

Increasingly, we need to incorporate dairy cattle behavioral data into herd management tools. Research must differentiate between individual cow response to a management routine and the economic return for adopting a routine on a whole-herd basis. Time budget analysis is an initial step in evaluating the impact of management on natural behavioral routines. The 24-h time budget represents net response of the cow to her environment, and deviations from benchmarked behavioral patterns represent departures from natural behavior. Consequently, measured differences between natural and observed behaviors serve as a basis for estimating performance, health, and economic loss due to poor management. This presentation provides recent data on major behaviors (eating, resting, and rumination), measured variability in these behaviors, and the key factors influencing them. The typical time budget differs substantially for lower and higher producing cows. Resting appears to be a key behavior and cows have a fixed requirement for resting as shown by several studies. Using available data, a spreadsheet has been developed that evaluates the time budget for cows housed in a free-stall environment that considers availability of resources, milking time, and stocking density. Potential loss in milk yield is calculated for average and superior milk production cattle. Changes in the time budget (primarily resting) are related to milk yield. Admittedly, this model simplifies complicated effects on herd health and productivity into a single estimate of milk loss. Ideally, we need a mechanistic approach to predicting economic consequences of variable resting and eating times. A long-term goal of this research is to incorporate behavioral data into tools such as Cornell Net Carbohydrate Protein System and CPM-Dairy models to better predict animal response to a diet as influenced by cow environment and management.

Key Words: Time budget, Resting, Dairy cattle

376 Animal welfare audits on dairy operations. J. Reynolds*, *University of California*, *Tulare, CA*.

The retail food industry in the US, in response to pressure from animal welfare groups and consumers, has developed a system of on-farm audits to certify farm animal care and welfare. This program has been developed by the Food Marketing Institute (FMI) and the National Council of Chain Restaurants (NCCR) at the request of their respective members, fast food restaurants and grocery stores. Together, FMI and NCCR members account for over 85% of the food sold in the US. FMI and NCCR member companies are expected to purchase products such as milk and meat from farms that have been audited under the FMI/NCCR Animal Welfare Audit Program (AWAP). The history of the program and the structure of the AWAP program will be discussed. The differences between on-farm welfare assessments and audits will be detailed. Other welfare assessments and audit programs will be described.

377 Essential oils in feed: Development of a quantification method. D. Bellenot[1], V. Hocde[6], J.-Y. Anizon[2], Y. Riou[3], C. Ionescu[9], C. Genouel[5], C. Langella[4], T. Banchereau[8], S. Oguey[13], V. Guitton[11], A. Guyonvarch[12], P. Metra[7], F. Recoquillay[10], S. Kerros[10], P. Schupfer*[14], [1]*ITEIPMAI*, *Chemillé, France*, [2]*ARCHIMEX*, *Vannes, France*, [3]*TECALIMAN*, *Nantes, France*, [4]*DGCCRF-Marseille*, *Marseille, France*, [5]*DGCCRF-Rennes*, *Rennes, France*, [6]*CCPA DELTAVIT*, *Janzé, France*, [7]*LAREAL*, *Saint-Nolff, France*, [8]*TECHNA*, *Coueron, France*, [9]*AXISS FRANCE S.A.S*, *Bellegarde-sur-Valserine, France*, [10]*PHYTOSYNTHESE*, *Saint Bonnet de Rochefort, France*, [11]*INZO*, *Paris, France*, [12]*EVIALIS*, *Vannes, France*, [13]*PANCOSMA*, *Genève, Switzerland*, [14]*INTERVET-CRINA*, *Gland, Switzerland*.

A working group was created in France in order to develop an analytical method ensuring a complete traceability of feed additives based on essential oils (eo) during the whole process of production.

For the development of the method, three kinds of feed additives (encapsulated, mineral, vegetable) containing five eo markers (1,8-cineole, thymol, carvacrol, cinnamaldehyde, eugenol) were incorporated through premixes into three commercial-type final feeds (turkey, piglet, rabbit), so that the theoretical concentration of each analyte was 10 ppm (parts-per-million). Pelleting of the resulting meals led to the feed matrices used for developing the method.

Several chromatographic methods (GC/FID, GC/MS, HPLC/UV) and extraction techniques (steam-distillation, Soxhlet, ASE, Lickens-Nickerson, etc) were considered, as well as different extraction solvents (acetone, pentane, dichloromethane, etc). After the choice and the optimization of the entire analytical process, a first ring test was carried out.

The method adopted was as follows, first Soxhlet extraction of ground feed (20 g) in n-pentane (200 ml) for 20 cycles, followed by addition of azulene (0.1 mg) used as an internal standard (IS) prior to GC injection. For the ring test, participants (n=8) received an IS solution, four calibrating solutions and three feed samples (turkey, piglet, rabbit). The results achieved were promising for phenols (4.4-5.5 ppm found with <20% of relative standard deviation, RSD), but unsatisfactory for cineole and cinnamaldehyde (1.5-2.5 ppm; >30%RSD).

Further developments and ring tests are underway.

Acknowledgements: This project was supervised by the Pôle Agronomique de l'Ouest (PAO) and carried out with financial support from région Bretagne and région Pays de la Loire.

Key Words: Essential Oil, Analytical Method, Feed

378 Orange pulp reduces growth of E. coliO157:H7 and *Salmonella* Typhimurium in pure culture and in vitro mixed ruminal microorganism fermentation. T. Callaway*[1], J. Carroll[2], J. Arthington[3], R. Anderson[1], T. Edrington[1], K. Genovese[1], and D. Nisbet[1], [1]*ARS/USDA, Food and Feed Safety Research Unit, College Station, TX*, [2]*ARS/USDA, Livestock Issues Research Unit, Lubbock, TX*, [3]*Range Cattle Research and Education Center, Univ. Florida, Ona, FL*.

Orange peel and orange pulp are by-products that are included in cattle rations in regions of the U.S. where citrus fruits are grown and processed. They are included in feedlot and dairy cattle rations due to their low cost, nutritional qualities, and palatability. The antimicrobial activity of citrus oil and other citrus-derived products have been previously reported. *Escherichia coli* O157:H7 and *Salmonella* spp. are human food borne pathogenic bacteria that can be carried in the gastrointestinal tract of cattle. Therefore, the present study was carried out to determine if these citrus by-products in a cattle ration exert antimicrobial effects on *E. coli* O157:H7 and *Salmonella* typhimurium populations. The specific growth rate of pure cultures (n = 3) of *E. coli* O157:H7 and *Salmonella* typhimurium were reduced ($P < 0.05$) by addition of 2% (w/v) orange pulp and orange peel. Ruminal fluid was collected from cattle (n = 2), diluted with growth medium containing 1 g/L soluble starch, and *E. coli* O157:H7 or *Salmonella* typhimurium were added to the ruminal fluid. The addition of orange pulp and peel to in vitro mixed ruminal microorganism fermentations (n = 2) demonstrated that both orange pulp and peel reduced *E. coli* O157:H7 and *Salmonella* typhimurium populations at least 2 log10 in mixed ruminal fluid fermentations. Other in vitro ruminal fermentations (n = 3) contained *E. coli* O157:H7 or *Salmonella* typhimurium and contained additions of: 0, 0.05, 0.1, 0.25, 0.5, 1.0, 2.0 % (w/v) of feed-grade orange pulp. Addition of orange pulp reduced ($P < 0.05$) *E. coli* O157:H7 populations from 10^5 to 10^2 CFU/ml and *Salmonella* typhimurium populations ($P < 0.05$) from 10^4 to 10^2 CFU/ml. These results indicate that orange pulp and/or peel included in ruminant rations could decrease ruminal populations of food-borne pathogenic bacteria. Further research is needed to determine if the antimicrobial activity of orange products against *E. coli* O157:H7 or *Salmonella* typhimurium continues in the lower gastrointestinal tract.

Key Words: Pathogen, Intervention, Food Safety

379 Effects of an experimental vaccine on *Escherichia coli* O157:H7 prevalence in the feces and colonized at the terminal rectum in beef feedlot cattle. R. Peterson*, D. Smith, R. Moxley, T. Klopfenstein, G. Erickson, and S. Hinkley, *Univeristy of Nebraska*, *Lincoln*.

A clinical trial was conducted to test the effect of vaccination against EHEC type III secreted proteins on the probability for feedlot steers to shed *E. coli* O157:H7 in the feces, and for animals to be colonized by this organism in the terminal rectum. Medium-weight steers (N=288) were assigned randomly to 36 pens (8 head/pen) and to vaccination treatment. Treatments included vaccination (3 doses at three-week intervals) or no vaccination. Steers assigned to the no-vaccination treatment received a dose of adjuvant at the same time as vaccinated steers. Fecal samples were collected (n=1,416) from each steer on d 0 (pre-treatment), and d 14, 28, 42, and 56 post-treatment by rectal palpation. Rectoanal mucosal samples were collected at slaughter (d 57 post-treatment) by scraping the mucosa of the terminal rectum 3-5 cm proximal to the rectoanal juncture. *E. coli* O157:H7 was isolated and identified from both types of samples using standard methods involving selective enrichment, immunomagnetic separation, agar plating, biochemical and immunological testing, and PCR confirmation. The outcome variables were recovery of *E. coli* O157:H7 from the feces or rectoanal mucosa. The outcome was analyzed using the GENMOD procedure of SAS accounting correlation of observations within pens and by repeated measures. Pre-treatment prevalence of *E. coli* O157:H7 differed ($P<0.10$) between treatments and averaged 6.4 and 1.4% in vaccinated and non-vaccinated pens, respectively. The probability for vaccinated or non-vaccinated steers to shed *E. coli* O157:H7 in the feces was not significantly different (OR=0.87, $P>0.10$). However, the probability for steers to be colonized by *E. coli* O157:H7 in the terminal rectum was greatly reduced (OR=0.02, $P<0.001$) for vaccinated (0.7%) compared with non-vaccinated (27.0%) cattle.

Key Words: Cattle, *Escherichia coli*, Vaccination

380 A novel concept for simultaneous deactivation of various mycotoxins in piglets. G. Schatzmayr*[1], D. Schatzmayr[1], V. Starkl[1], S. Nitsch[1], M. Forat[2], and E. Binder[3], [1]*Biomin GmbH*, *Herzogenburg, Austria*, [2]*Instituto Internacional de Investigacion Animal*, *Queretaro, Mexico*, [3]*Erber AG*, *Herzogenburg, Austria*.

Mycotoxins are secondary metabolites produced by many fungi under various conditions. In animal husbandry mycotoxins decrease productivity and increase disease incidence due to their immune-suppressive effects. In spite of all efforts to prevent formation of mycotoxins in feeds, significant contaminations still occur. Therefore strategies for detoxification have become very important. It has been known for years that clay minerals can be used for detoxification of

aflatoxins but also that these enterosorbents do not work on other mycotoxins. It has been reported that an anaerobic rumen bacterium (*Eubacterium BBSH 797*) is able to deactivate trichothecenes by biotransformation of the epoxide ring. Further a novel yeast strain (*T. mycotoxinivorans*) with the capability to deactivate ochratoxin A (OTA) and zearalenone (ZON) was recently isolated and characterized.

The objective of the presented study was to test the combination of minerals, *Eubacterium BBSH 797* and *T. mycotoxinivorans* (MTV) in a feeding trial with weaning piglets for detoxification of 500 µg/kg OTA and 200 µg/kg ZON. 96 weaning piglets (age 21 days, 50% male, 50% female) were assigned to 4 groups: A negative control group (A) neither receiving mycotoxins nor the deactivator, a toxin group (B) receiving the mycotoxins and 2 test groups (C, D) receiving mycotoxins and the deactivator at 2 different concentrations (0.5 kg/to feed; 1kg/to feed). After 42 days the piglets in group B were lighter than in group A (21.72 vs. 24.00 kg). Piglets in group C (0.5 kg of additive) weighed 23.08 kg and those in group B (1 kg of additive) weighed 24.39 kg. The average daily weight gain data showed a significant improvement in the test groups in comparison to the toxin group (A = 437 g, B = 380 g, C = 412 g and D = 443 g). Performance data were confirmed by clinical results (reduction of swollen vulvas, rectum prolapses and diarrhea in test groups) as well as by histopathological findings.

This trial revealed that a combination of minerals, *Eubacterium BBSH 797* and *T. mycotoxinovorans* is able to abolish negative effects of the mycotoxins ochratoxin A and zearalenone.

Key Words: Mycotoxins, Detoxification, Biotransformation

381 Assessing the relationship between ruminal perchlorate infusion in dairy cows and its concentration in milk. A. V. Capuco*, R. L. Baldwin, C. P. Rice, W. Hare, M. J. Paape, D. D. Bannerman, A. Kauf, G. W. McCarty, A. M. Sadeghi, J. L. Starr, L. L. McConnell, C. J. Hapeman, and C. P. Van Tassell, *USDA-ARS*, *Beltsville, MD*.

Perchlorate is a goitrogenic anion that is a competitive inhibitor of the sodium-iodide symporter. At sufficient concentration, perchlorate can reduce thyroid uptake of iodine and ultimately reduce the secretion of thyroxine and triiodothyronine. Perchlorate has also been perceived as an environmental contaminant of concern in regions of the country where it has been released during its manufacture or distribution for use in rocket fuel and other oxidative products. Recent studies have shown the presence of perchlorate in dairy cow feed components, such as alfalfa, and in milk samples collected from cows throughout the U.S. A comprehensive study was performed to determine the relationship between dietary perchlorate and concentrations of perchlorate in milk, as well as its effect on thyroid hormone secretion and general animal health. Sixteen Holstein cows were randomly assigned to receive 0, 0.4, 4 or 40 mg of perchlorate daily as a 22-h continuous infusion. The total mixed ration contained an average of 21 ppb perchlorate and 1.6 ppm of iodine. Concentrations of perchlorate in milk averaged 4.6, 7.7, 20.0 and 91.4 ng/ml for the 0, 0.4, 4.0 and 40 mg/d doses, respectively. The Pearson correlation coefficient of milk perchlorate vs. perchlorate intake was 0.99. The daily total output of perchlorate in milk, urine and feces was significantly less than that infused, suggesting that a large portion of the infused perchlorate was metabolized. Concentrations of thyroid hormones in the circulation were not influenced by perchlorate treatment during the 5-wk infusion period. Upon termination of perchlorate infusion, concentrations in milk, blood and urine returned to control values within 72 h. Overall, our data indicate that milk perchlorate is highly correlated with perchlorate intake and, within the confines of a 5-wk treatment, no demonstrable health effects on the cow were observed.

Key Words: Mammary Gland, Perchlorate, Thyroid Hormones

382 The effect of dried yeast culture on the carry over of aflatoxin in sheep milk. G. Battacone*[1], A. Nudda[1], M. Palomba[1], M. Pascale[2], A. Mazzette[1], P. Nicolussi[3], and G. Pulina[1], [1]*University of Sassari*, *Sassari, Italy*, [2]*CNR Istituto di Scienze delle Produzioni Alimentari*, *Bari, Italy*, [3]*Istituto Zooprofilattico Sperimentale della Sardegna*, *Sassari, Italy*.

A study was conducted to evaluate whether dried yeast culture (DYC) of *Kluyveromyces lactis*, a source of mannan oligosaccharides, reduced the carry over on aflatoxin M1 (AFM1) in sheep milk. Eighteen Sarda dairy ewes were divided in three groups fed 1.4 kg/d of TMR with different percentage of wheat meal (WM) naturally contaminated with aflatoxin B1 (AFB1, 11 µg/kg): Group 1 (G1) 18%, Group 2 (G2) 36%, and Group 3 (G3) 54%. The trial lasted 14 days. Between days 8 and 14 the three rations were supplemented with DYC (12 g/d). Individual milk yield was recorded and milk samples were collected at each milking. Blood was sampled on day 5 and 12 and analyzed for haematological and serum parameters, in order to assess the haematotoxicity. The AFM1 concentration in milk was determined using an immunoaffinity column-HPLC method. Milk production (1.17 ± 0.015 kg/d) was not affected by treatments. All hematological values were considered to be within the acceptable physiological range. The AFM1 concentration in milk increased as the AFB1 intake increased (30.3, 40.9, 70.2 ng/L; $P \leq 0.01$). The AFM1 concentration in milk tended to be higher in all experimental groups when the rations were supplemented with DYC ($P = 0.059$). Our preliminary results showed that the inclusion of DYC in the diets did not reduce the transfer of the AFB1 metabolite into milk.

Acknowledgements: Research funded by BENOLAT project (Mipaf).

Key Words: Aflatoxin, Sheep Milk, Dried Yeast

383 Detection of feed-ingested plant DNA fragments in salt-cured pork product. T. Reuter*[1,2], K. Aulrich[2], W. Schnäckel[3], and T. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Federal Agriculture Research Centre*, *Westerau, Germany*, [3]*Hochschule Anhalt*, *Bernburg, Germany*.

The use of genetically modified (GM) plants in animal nutrition is increasing, and feed related DNA-fragments are constantly exposed to the gastrointestinal cell wall and are able to enter the tissues of humans and animals. This leads to the possibility that, foreign DNA in food animals may survive food processing and be consumed. We used PCR techniques to track feed-ingested DNA fragments in a minimally processed salt-cured pork product. The presence of plant-specific DNA (a 140-bp fragment of chloroplast *rbcL*, encoding Rubisco) was confirmed in 53 of 144 muscle tissue samples collected from 48 pigs fed to slaughter on diets containing 70% parental or GM maize ($n = 12$; $n = 36$). Gammon was produced from 12 frozen vacuum-packed *rbcL*-positive *M. gluteus maximus* samples. Samples (800 g) were thawed at 6°C, then dry-salted, cured (14 d; 6°C), rinsed (2 h), dried (5 h), and smoked (7 d) at <20°C. Total DNA was extracted from 25 mg subsamples and PCR was conducted using the primer pair Rub01/Rub02 to amplify the *rbcL* 140-bp fragment with consideration for the appropriate positive and negative controls. Feasibility of the PCR was confirmed and the limit of detection was established at 0.8 pg/µL. Gel electrophoresis revealed substantial degradation of DNA during gammon production. However, the 140-bp fragment was detected in 6 of the 12 samples. To date, only native (i.e., non-GM) plant DNA has been detected in animal tissues or food products. Research suggests that foreign DNA in GM crops behaves similarly to endogenous DNA, thus rates of uptake and/or survival of foreign and endogenous DNA would presumably also be similar. The likelihood of uptake of a transgenic fragment will increase with the prevalence of GM feedstuffs, but low copy number of introduced genes in GM crops may continue to hinder their detection.

Key Words: GMO, Food, Pig

Forages and Pastures: Emerging Techniques for Predicting Forage Quality

384 Impact of cell wall lignification on forage digestibility. H. Jung*[1,2], [1]*USDA-ARS, St. Paul, MN*, [2]*University of Minnesota, St. Paul*.

The existence of a negative relationship between lignin concentration and digestibility of forages has been known for over 50 years; however, understanding the causal factors has proven difficult. Lignin is a polymer composed of phenylpropanoid units. The biosynthetic pathway for lignin precursor synthesis has been drastically revised with elucidation of the major flux route. Grasses have abundant ferulate esters on arabinoxylans, unlike legumes, and these ferulates act as nucleation sites where lignin deposition and growth occurs, with the ferulates acting as cross-linking agents of lignin to cell wall polysaccharides in grasses. Lignin concentration increases during forage maturation as more cell wall material is formed. In grasses virtually every tissue type undergoes secondary wall thickening and lignification whereas legumes deposit lignin in just a few tissue types. Lignified legume tissues are virtually indigestible. In contrast, lignified grass tissues can be extensively, but not completely, digested by rumen microbes. Measuring lignin concentration is problematic because all methods are empirical. Methods either hydrolyze the cell wall polysaccharides leaving a lignin residue (acid detergent and Klason) or oxidize lignin away (permanganate and acetyl bromide). In general, lignin concentration estimates range from Klason>acetyl bromide>permanganate>acid detergent methods. It has been proven that acid detergent lignin severely under-estimates lignin content of forages, particularly grasses. Fortunately concentration estimates are correlated among methods (r~0.75) and all methods are of similar accuracy in predicting digestibility. Lignin's value for predicting digestibility is greater when forages cover a maturity range. The lignin/digestibility relationship is weak or non-existent if forages are from a single species and similar maturity. Lignin composition and, in grasses, ferulate cross-linking have been proposed to modify the lignin/digestibility relationship; however, experiments examining these factors have been mixed. Lignin limits forage digestibility through an interaction of tissue localization and structural incorporation into specific cell wall layers.

Key Words: Forage, Lignin, Digestibility

385 New applications of near-infrared reflectance spectroscopy for forage quality assessment. S. Coleman*, *USDA ARS Subtropical Agricultural Research Station, Brooksville, FL*.

Near-infrared reflectance spectroscopy (NIRS) has now been used in agriculture, specifically for forage quality analysis, for about 30 yrs. Due to its speed, many new applications have been developed, including medicine and pharmaceuticals. It is a secondary technique that requires proper calibration with samples that adequately represent the population for which it is to be used. In agriculture, NIRS was first used to estimate moisture and oil in seeds. In 1976, crude protein, neutral detergent fiber, acid detergent fiber, in vitro dry (or organic) matter digestibility, in vivo apparent digestibility and in vivo intake were all estimated by NIRS. Routine use of NIRS over the next 25 years involved estimating chemical composition, which in turn was used to predict intake and in vivo digestibility. Several databases have now been developed in Europe and Australia in which NIRS was used to directly predict in vivo digestibility with acceptable accuracy and precision. Intake has been a bit more problematic due to non-forage factors that influence ad libitum intake. However, research demonstrates that NIRS contains the necessary information to predict potential intake. Routine use now includes prediction of in vitro cell wall digestibility and other chemical components needed to predict both in vivo digestibility and intake. Analysis of fecal samples for direct prediction of both intake and digestibility have been successful within the limits of the calibration database. The most recent application includes in situ analysis of forage quality with handheld units. This negates the necessity of clipping, drying and grinding pasture samples. Another advantage is non-destructive monitoring the processes of maturation of the same canopy. The method was applied to a grazing trial, and supplementation was recommended from analyses obtained in situ. Calves supplemented based on remote sensed data for crude protein gained more rapidly than those supplemented based on standard, time-based management.

Key Words: Forage Analysis, NIRS, Remote Sensing

386 The need for new approaches in predicting forage quality: challenging the conventional wisdom. J. Moore*, *University of Florida, Gainesville*.

Forage quality is defined as animal performance, or voluntary intake of digestible nutrients, when forage is fed alone and ad libitum. Indices of forage quality are based on in vivo intake and digestibility (e.g., nutritive value index [Crampton et al., 1960], and relative feed value [RFV] developed by the Hay Marketing Task Force of the American Forage and Grassland Council [AFGC] in 1978). Both intake and digestibility are required because, across a wide array of forages, they are not related closely. Although the concepts are sound, the challenge has been to predict intake and digestibility from laboratory analyses. The conventional wisdom of the last 40 years is that acid detergent fiber (ADF) and neutral detergent fiber (NDF) are acceptable predictors of digestibility and intake, respectively. These assumptions are based on papers by Van Soest and regression equations published by the AFGC task force. The intake prediction was revised to reflect the assumption that NDF intake is a constant 1.2% of BW. Publications on forage-only diets show, however, that voluntary intake of NDF (% of BW) varies widely among forages. Furthermore, publications relating ADF and NDF to digestibility and intake show unacceptable relationships when the sample population includes an array of forage genotypes and environments. A new index, relative forage quality (RFQ), has been proposed. It is based on voluntary intake of total digestible nutrients (TDN). The main value of the RFQ system is new multivariate prediction equations for intake, and summative equations for TDN based on the new Dairy NRC equations. In both cases, NDF digestibility is an important component, and it is estimated by either lignin concentration, in vitro NDF digestion, or Near Infrared Reflectance Spectroscopy (NIRS). Over the past 30 or 40 years, many studies have suggested the potential of predicting in vivo intake and (or) digestibility directly from lignin, fermentation rates, and NIRS. Finally, these techniques are receiving the attention they deserve, as per this symposium.

Key Words: Intake, Digestibility, Laboratory

387 Application of rates of fermentation to prediction of forage intake. M. Blummel*[1] and E. Grings[2], [1]*ILRI, Patancheru, Andhra Pradesh, India*, [2]*USDA-ARS, Miles City, MT*.

In vitro techniques used in ruminant nutrition can be classified into those that estimate digestibility/degradability gravimetrically by quantifying insoluble incubation residues and into those that measure appearance of products of fermentation, such as gases. While *in vitro* gas techniques have received much attention over the last two decades due to the ease with which fermentation kinetics can be measured, there is little evidence of their superiority over gravimetric techniques in the prediction of feed intake. Furthermore, a conceptual problem with *in vitro* gas measurements arises when rejecting proportional constancy between main products of microbial degradation: short chain fatty acids (SCFA), microbial biomass, and gases. While there is a close stoichiometrical relationship between SCFA and gas production, a potential competitive relationship for substrate utilization between these two products and microbial biomass can be demonstrated. This problem can be overcome by measuring *in vitro* true substrate degradability concomitantly with gas production. Intake predictions for a wide range of temperate and tropical roughages based on *in vitro* 1) gas production rates, 2) true degradability, and 3) combinations of both, show that the latter approach can result in more accurate prediction of intake than measurement of either alone.

Key Words: Gas Production, Intake, Degradability

388 Myostatin regulates MyHC isoform expression during myoblast differentiation in cattle. S. Hayashi*, K. Watanabe, Y. Miura, S. Hayashi, M. Miyake, H. Aso, S. Ohwada, and T. Yamaguchi, *Tohoku University*, *Sendai, Japan*.

Myostatin (MSTN) belongs to the transforming growth factor beta superfamily and has been shown to function as an inhibitor of skeletal muscle proliferation and differentiation. Spontaneous mutations of the myostatin gene in some cattle breeds are characterized by increased muscle mass (double-muscling: DM) resulting from both muscle hypertrophy and myofiber hyperplasia. To study the effects of MSTN during early differentiation of myoblasts, we prepared myoblast cultures from normal (NM) and DM Japanese shorthorn cattle by enzyme dissociation and examined mRNA expression of the myosin heavy chain (MyHC) isoforms (embryonic, fetal, fast 2a, fast 2x and slow) by semi-quantitative RT-PCR. Further, we established five myostatin deficient myoblast (MDMB) clones from DM myoblast primary culture by limiting dilution method and added 1 μg/ml recombinant MSTN (rMSTN) into the cloned myoblast cultures to investigate it's role in myoblast differentiation. Here, we found that the increasing in number of myoblasts and myotubes was detected in DM cultures as compared with that in NM ones. We also found that mRNA expression of fast 2a and 2x MyHC isoforms were greater in DM cultures than that in NM ones in fusion medium. In MDMB cultures, rMSTN inhibited myotube formation and the expression of fetal and fast 2x MyHC isoforms. Interestingly, there was no effect of rMSTN on the expression of embryonic, fast 2a and slow MyHC isoforms. Our findings suggest that MSTN plays a critical role in regulating the myosin isoform expression of myoblasts and myotubes. These results indicate that MSTN may associate with changes of skeletal myofiber types during bovine muscle development.

Key Words: Bovine, Myostatin, Myoblast

389 Influence of the IGF-II genotype on the calpastatin activity in three muscle in relation to age and development. K. Van den Maagdenberg*[1], A. Stinckens[2], E. Claeys[1], N. Buys[2], and S. De Smet[1], [1]*Laboratory of Animal Nutrition and Animal Product Quality, Department of Animal Production, Ghent University*, *Ghent, Belgium*, [2]*Centre for Animal Genetics and Selection, Department of Animal Production, K.U.Leuven*, *Leuven, Belgium*.

Recently a new QTN, located in the regulatory sequence of the paternally imprinted IGF-II gene was discovered in the pig. Effects of the IGF-II polymorphism on muscle growth and fat deposition have been reported. The aim of this study was to investigate the effect of the IGF-II paternal allele (Qpat/qpat) on early post mortem calpastatin activity in the pig in relation to age and development. Calpastatin was measured in three muscles (*Longissimus*, *Semimembranosus* and *Triceps brachii*) from respectively, 6/9, 7/3, 6/6 and 15/14 numbers of Qpat/qpat boars of 4, 8, 16 and 26 weeks of age from two lines (Rattlerow Seghers). Data were analysed with an univariate general linear model with IGF-II genotype (G), age group (A), muscle (M) and line number (L) as fixed factors and the two way interactions GxL and MxA.

Significant effects were found for IGF-II genotype, age group, muscle and the two way interactions GxL and MxA. There was no significant main effect for line number. Calpastatin activity was significantly higher in Qpat animals compared to qpat animals. Calpastatin activity was highest in the oxidative *Triceps brachii* and also the largest difference between Qpat and qpat animals was found in this muscle. Calpastatin activity decreased with age from the group of 4 weeks till the group of 16 weeks. Thereafter, calpastatin activity increased again in the group of 26 weeks. For the *Triceps brachii*, the calpastatin activity increased even to higher values compared to values of the group of 4 weeks.

The results show that the calpastatin activity changes with age and development. The higher calpastatin activity in pigs with the IGF-II genotype (Qpat) suggests a reduced proteolytic enzyme activity.

Key Words: IGF-II, Calpastatin, Muscle

390 Cardiac and skeletal muscle protein synthesis and activation of translation initiation factors are stimulated by leucine, but not isoleucine or valine, in neonatal pigs. J. Escobar*, J. Frank, A. Suryawan, H. Nguyen, and T. Davis, *USDA/ARS, Children's Nutrition Research Center, Baylor College of Medicine*, *Houston, TX*.

Protein synthesis in skeletal muscle of neonatal pigs increases in response to a physiological increase in plasma leucine. However, the effect of a physiological increase in plasma isoleucine and valine on skeletal muscle protein synthesis has not been investigated in neonates. In the pig, the left ventricular wall grows about 3 times faster than the right ventricular wall during the first 10 d of postnatal life due to increased hemodynamic workload of the left ventricle. Therefore, the effects of individual branched chain amino acids on protein synthesis in the left and right ventricular walls, as well as individual skeletal muscles, were determined. Fasted pigs (5 d of age) were infused intra-arterially with saline or 400 $\mu mol \cdot kg^{-1} \cdot h^{-1}$ of leucine, isoleucine or valine and protein synthesis was measured after 60 min. Infusion of leucine, but not isoleucine or valine, increased ($P < 0.05$) phosphorylation of eukaryotic initiation factor (eIF) 4E binding protein-1, and increased the amount and phosphorylation of eIF4G associated with eIF4E in skeletal muscles composed primarily of white (longissimus dorsi) and red (masseter) muscle fibers, as well as in the left and right ventricular walls. Leucine, but not isoleucine or valine, increased the phosphorylation of ribosomal protein (rp) S6 kinase and rpS6 in longissimus dorsi and masseter but not in the left or right ventricular walls. Phosphorylation of elongation factor 2 was unaffected by treatment. The stimulation ($P < 0.05$) of protein synthesis by leucine was similar in longissimus dorsi, masseter, and left and right ventricular walls. Isoleucine and valine did not increase protein synthesis in cardiac or skeletal muscles. Thus, leucine, but not isoleucine or valine, stimulates protein synthesis in cardiac and skeletal muscles of neonates by increasing eIF4E availability for eIF4F assembly without affecting elongation factor activation. (NIH AR 44474 and USDA 58-6250-6-001)

Key Words: Protein Synthesis, Branched-Chain Amino Acids, Translation Initiation Factors

391 Histochemical properties and meat quality traits of porcine muscles during growth: Effect of feed restriction in pigs slaughtered at the same age and varying weight. G. Bee*, M. Calderini, C. Biolley, G. Guex, and W. Herzog, *Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP)*, *Posieux, Fribourg, Switzerland*.

At birth porcine muscle fibers are oxidative and conversion towards white fibers occurs rapidly up to 4 months of age; thereafter, the proportion of white fibers keeps increasing at a slower rate. The aim of the study was to determine through feed restriction the effect of age (< or > 4 month) and weight on histochemical properties of myofibers and meat quality of the LM and light portion of the semitendinosus (**STL**). Swiss Large White barrows (n = 24) from six litters were given either ad libitum or restrictive access to a grower diet from 21 to 60 kg BW. At d 113 of age six pigs of the ad libitum (BW = 62 kg) and six siblings of the restricted group (BW = 51 kg) were slaughtered. The remaining 12 barrows were fed a finisher diet until slaughter at 154 d of age; the BW of the ad libitum and restricted group was 100 and 87 kg, respectively. Muscle fibers were stained and classified based on the stain reaction as slow-oxidative (**SO**), fast oxidative-glycolytic (**FOG**), and fast glycolytic (**FG**), and fiber area and distribution was determined. In addition percentages of cooking loss and shear force of teh LM and STL were assessed. Regardless of the age at slaughter, pigs of the restricted group had smaller SO (LM: 2245 vs. 2713 μm^2; STL: 2300 vs. 3294 μm^2), FG (LM: 3100 vs. 3573 μm^2; STL: 3953 vs. 4481 μm^2), FOG (STL: 3219 vs. 3856 μm^2) fibers, and the STL had more FOG (32 vs. 26%) and fewer FG (60 vs. 70%) fibers than pigs of the ad libitum group ($P \leq 0.04$ for each). The muscles of restricted pigs were less tender (shear force for LM: 4.7 vs. 3.5 kg; STL: 4.1 vs. 3.7 kg) and percentages of cooking loss were higher (LM: 18 vs. 14%; STL: 24 vs. 21%) than of pigs in the ad libitum group ($P \leq 0.08$ for each). Muscle fiber size of FOG (r = -0.32) and FG (r = -0.36) was

negatively ($P \leq 0.03$) correlated with shear force values. In conclusion, for pigs at the same age, when slaughter weight was lower (restriction) the selected porcine muscles were partly more oxidative and exhibited smaller myofibers which negatively affected meat tenderness.

Key Words: Age at Slaughter, Muscle Fibers, Meat Quality

392 Role of β-adrenoceptor signaling and AMP-activated protein kinase in the glycolysis of postmortem skeletal muscle. Q. W. Shen*, M. Du, and M. J. Zhu, *University of Wyoming*, *Laramie*.

Postmortem glycolysis is directly linked to the incidences of PSE (Pale, soft and exudative) and DFD (Dark, firm and dry) meats which cause significant loss to meat industry. However, mechanisms controlling postmortem glycolysis are largely unclear. The objective of this study is to show the role of β-adrenoceptor signaling and AMP-activated protein kinase (AMPK) in the postmortem glycolysis. Eighteen two-month old C57BL/6J female mice were randomly separated into three groups. Group I received an injection of saline solution only and served as control; Group II received a saline injection and then was forced to swim for 1 min; Group III received an injection of propranolol (1 mg/kg) in saline solution. In addition, 6 C57BL/6J female AMPK knockout mice were assigned to Group IV, which received a saline injection and was forced to swim for 1 min. The longissimus dorsi muscle was sampled at 0, 1 and 24 hr postmortem for pH and enzyme activity measurements. Results showed that AMPK activity had a major role in determining the ultimate muscle pH, while β-adrenoceptor signaling is essential for initial rapid glycolysis. Activation of β-adrenoceptor signaling due to pre-slaughter stress activates glycogen phosphorylase, resulting in a rapid glycogenolysis and glycolysis shortly following slaughter. On the other hand, the activation of AMPK is important for maintaining the activity of glycogen phosphorylase and pyruvate kinase in postmortem muscle, leading to a sustained glycolysis and a low ultimate pH.

Key Words: Postmortem Muscle, Glycolysis, AMP-Activated Protein Kinase

393 The fatty acid composition of Longissimus muscle from grazing cattle supplemented with sunflower oil and fishoil. E. Ermias[1,2], F. J. Monahan[2], and A. P. Moloney*[1], [1]*Teagasc, Grange Research Centre*, *Dunsany, Co. Meath, Ireland*, [2]*University College Dublin*, *Belfield, Dublin, Ireland*.

Effects of sunflower oil (S) and fish oil (F) supplementation of grazing cattle on the fatty acid profile of muscle, in particular the conjugated linoleic acid (CLA) and vaccenic acid (VA) concentrations were examined. Grazing Charolais crossbred heifers (initial bodyweight = 407 kg, s.d. 31.3) were offered (n = 12/treatment): grazing only(G), or an individual daily supplement of 2.5 kg concentrates that supplied 290 g S(S1), 415g S (S2), 290g S + 85g F (FS1) or 415 g S + 85 g F (FS2). Animals were slaughtered after 150 days and lipids from the Longissimus muscle were separated into neutral (N) and polar (P) fractions prior to methylation and separation by gas chromatography. Data were subjected to analysis of variance and "a priori" contrasts were used to test for effects of S level and F inclusion. Daily bodyweight gain and carcass weight averaged 834 g and 294 kg, respectively and did not differ ($P < 0.05$) between treatments. The N fraction of muscle from G, S1, S2, FS1 and FS2-fed cattle had 1.29, 1.80, 2.18, 2.32 and 2.44 (sem 0.132) g c9,t11CLA /100g fatty acids, respectively. The corresponding values were 2.78, 4.40, 4.96, 5.51 and 5.33 (sem 0.318) for VA, 1.29, 1.66, 1.49, 1.39 and 1.54 (sem 0.083) for linoleic acid and 0.66, 0.44, 0.42, 0.42 and 0.47 (sem 0.030) for linolenic acid. The P fraction of muscle from G, S1, S2, FS1 and FS2-fed cattle had 0.59, 0.88, 1.12, 1.35 and 1.20 (sem 0.101) g c9,t11CLA /100g fatty acids, respectively. The corresponding values were 1.10, 3.19, 3.77, 5.64 and 4.46 (sem 0.529) for VA, 12.0, 17.5, 17.5, 10.9 and 14.4 (sem 1.66) for linoleic acid, 4.61, 2.21, 2.35, 2.19 and 2.53 (sem 0.258) for linolenic acid, 3.76, 1.98, 1.75, 2.37 and 2.31 (sem 0.250) for eicosapentaenoic acid and 0.15, 0.06, 0.02, 0.35 and 0.61 (sem 0.053) for docosahexaenoic acid. It is concluded that (1) supplementing grazing cattle with S-enriched concentrates increased muscle CLA concentration in the N fraction in a dose-dependant pattern, and (2) F consumption increased the concentration of long-chain n-3 fatty acids in the P fraction but increased CLA concentration only when added to the lower S concentrate.

Key Words: Cattle, CLA, Fatty Acids

394 Effects of corn oil supplementation on carcass quality, rib composition, and tenderness of implanted Angus, Brangus, and Hereford Heifers. J. Long*[1], S. Duckett[1], G. Hill[2], and H. Crowe[1], [1]*University of Georgia*, *Athens*, [2]*University of Georgia*, *Tifton*.

Angus (A; n = 14), Brangus (B; n = 14) and Hereford (H; n = 14) heifers were used to determine the effects of breed and corn oil supplementation on carcass quality, rib composition and tenderness. Heifers within the three breeds were randomly assigned to one of two treatments, control or oil supplementation. All heifers were implanted on d 0 with Revalor-H and received same diets until day 57, when oil treatment allotted heifers were supplemented with 4.7% corn oil DM basis. Cattle were slaughtered and carcass characteristics were recorded. Ribs (IMPS 107) from A and B carcasses (n = 28) were shipped to UGA for color, rib composition, and tenderness determination. Data was analyzed using the GLM procedure with breed, treatment, time (when appropriate), and all interactions in the model. A and H heifers were similar in average live weight (ALW) and were heavier ($P < 0.05$) than those of B heifers. Hot carcass weights of A were heavier than B and dressing percentages for both A and B carcasses were greater ($P < 0.05$) than H. Carcasses from A had higher marbling scores, and quality grade than B and H ($P < 0.05$). B carcasses had lower yield grades (YG) than A and H ($P < 0.05$). Oil treated carcasses tended ($P < 0.10$) to have smaller ribeye areas and higher YG. A carcasses had lower pH values ($P < 0.05$), increased LM L* values and higher s.c. b* values ($P<0.05$). A carcasses had heavier whole rib, 9-10-11 rib, and LM weights ($P < 0.05$). Seam and s.c. fat weights were lower ($P < 0.05$) in B ribs. Oil supplementation increased ($P < 0.05$) the amount of s.c. fat in 9-10-11 rib section. Warner-Braztler shear values decreased with prolonged aging treatments ($P < 0.05$) but did not differ between breeds or oil treatments. This study showed that breed had the greatest impact on carcass quality and rib composition but these differences did not translate to decreased tenderness.

Key Words: Beef, Quality, Tenderness

395 Effect of castration of females on productive performance and carcass quality of Iberian pigs. M. P. Serrano[1], D. G. Valencia[1], R. Lázaro[1], M. Nieto[2], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Copese*, *Segovia, Spain*.

Cured products from Iberian pigs, the ancestral dark hairy pig original from Spain, are characterized for its high quality but the productivity of sows (less than 14 piglets weaned/year) and fattening pigs (average feed to gain ratio from 25 to 150 kg of 4.5) is low. A total of sixty crossbred (Duroc sire × Iberian dam) pigs was used to study the influence of castration on productive performance and carcass quality of females. Each treatment (castrated females; CF, and entire females; EF) was replicated five times (six pigs). The trial lasted 186 d and the pigs were sacrificed with an average live weight of 144 kg. At the end of the trial CF ate more feed (2740 vs 2629 g/d; $P \leq 0.05$), had higher carcass yield (81.3 vs 80.0%; $P \leq 0.01$), and were fatter (64.4 vs 57.0 mm at P_2 and 58.9 vs 47.6 mm at m. *Gluteus medius*; $P \leq 0.05$) than EF. The m. *semimembranosus* from CF presented higher pH at 2 and 24 h *post mortem* ($P \leq 0.05$) and higher temperature at 2 h *post mortem* ($P \leq 0.001$) than the same muscle from EF. Also EF had heavier shoulders at 24 h *post mortem* (16.9 vs 16.1 kg; $P \leq 0.05$) and after trimming (13.7 vs 12.9 kg; $P \leq 0.05$) than CF. Trimmed ham yield (18.9 vs 17.9% $P \leq 0.10$), shoulder yield (11.9 vs 11.1%; $P \leq 0.05$), and primal cuts yield ($P \leq 0.05$) were higher for EF than for CF. Also, depot fat from the coccyx was more saturated in CF than in EF (39.09 vs 38.22%; $P \leq 0.05$ for total saturated fatty acids; 8.80 vs 9.30%; $P \leq 0.10$ for total polyunsaturated fatty acids; 8.19 vs 8.61 %; $P \leq 0.10$ for linoleic acid content). We conclude that EF had less carcass yield but better productive performance and yield of primal cuts than CF. Therefore, when productive performance, cost of castration, and carcass

quality traits are considered, EF are a good alternative to CF for production of heavy pigs destined to the dry-cured industry.

Key Words: Iberian Pigs, Gilt Castration, Carcass Quality

396 Effects of pump rate and cooked temperature on pork loin instrumental, sensory descriptive and consumer-rated characteristics. R. T. Baublits*, J.-F. Meullenet, J. T. Sawyer, J. M. Mehaffey, and A. Saha, *University of Arkansas*, *Fayetteville*.

Fresh pork loins (n = 15; muscle sections, n = 30; arranged in an incomplete block design) were utilized to evaluate the effects of untreated muscles (0% pump rate), or muscles enhanced with a solution comprising 0.4% sodium tripolyphosphate and 1.0 % sodium chloride at either a 6% or 12% pump rate, and cooked to a 71°C or 82°C end-point internal temperature on meat quality, instrumental texture characteristics, sensory profiles, and consumer acceptance. Loins enhanced at a 12% pump rate had a higher ($P < 0.05$) pH than untreated loins. While there were no differences in Warner-Bratzler shear force due to cooked temperature, chops enhanced at a 12% pump rate had lower ($P < 0.05$) shear force values than untreated chops. Additionally, chops enhanced at 6% or 12% pump rates had lower ($P < 0.05$) razor shear force values than untreated chops. Descriptive sensory analyses revealed chops cooked to 71°C had a more intense ($P < 0.05$) blood serum flavor than chops cooked to 82°C. Untreated chops had less intense ($P < 0.05$) pork fat flavor, and more intense ($P < 0.05$) blood serum, livery, and cardboard or oxidized flavor characteristics than chops enhanced at 6% or 12% pump rates. Additionally, there were no differences ($P > 0.05$) in metallic intensity between enhanced and untreated chops. Sensory panelists reported chops enhanced at 6% or 12% pump rates to generally be more tender than untreated chops. Consumers reported a higher ($P < 0.05$) overall acceptability for chops enhanced at 6% or 12% pump rates. Overall acceptance scores were in average 2 points higher for the enhanced chops (mean =7.03) than for the untreated chops (mean =4.94) on the 9-point hedonic scale. Furthermore, both sensory panelists and consumers reported chops enhanced at 6% or 12% pump rates to be similar ($P > 0.05$) in juiciness characteristics, regardless of end-point temperature. However, untreated chops cooked to 82°C were less juicy ($P < 0.05$) than untreated chops cooked to 71°C, suggesting retained palatability when enhanced chops are cooked to more abusive temperatures.

Key Words: Pork, Enhancement, Cooked Temperature

Milk Protein and Enzymes: Milk Protein Interactions

397 Casein micelles and whey proteins: Physical interactions and functional properties. S. G. Anema*, *Fonterra Research Centre*, *Palmerston North, New Zealand*.

The functional properties of milk products are inextricably linked to the denaturation of the whey proteins and their interactions with other milk protein components. As the level of whey protein denaturation is easily measured, milk products are often classified by their level of whey protein denaturation. We examined the denaturation of the major whey proteins in milk, the factors affecting this denaturation, and the relationship between the level of denaturation and the functional performance of the milk in a simple acid gel system. From these studies, models to predict the degree of denaturation of the whey proteins at a range of temperature, heating time, and composition combinations were generated. However, the relationship between the level of denaturation and the functional performance of the milk in acid gels was rather poor.

An understanding of the denaturation reactions of the whey proteins provides information on only the initial steps of a complex series of aggregation reactions that occur when milk products are heated. Analysis and interpretation of these aggregation reactions are often difficult. In our further studies, we examined one specific aggregation reaction considered to be of importance to functionality: the interaction between the denatured whey proteins and the casein micelles. The effects of numerous factors (pH, concentration, composition, heating regime, etc.) on these interactions, and the relationship between these interactions and the functional performance of the milk in our simple acid gel system, were studied. We found that it was possible to substantially manipulate the degree of interaction between the denatured whey proteins and the casein micelles by altering the conditions of the milk at heating. These changes in interaction behavior had a marked effect on the physical properties of the milk and the functional performance in our acid gel system, allowing significant modification of the textural properties. These results exemplify the importance of the aggregation reactions of the denatured whey proteins in determining the properties of heated milk systems.

398 Process-induced intermolecular bonds in milk protein gels and their impact on rheological properties. J. Hinrichs*, *University of Hohenheim*, *Germany*.

The various texture properties in milk products are mainly determined by the protein content, the interacting protein fractions, the milieu conditions and the process technology applied. Furthermore, the kind of technology applied may force or enhance the formation of intermolecular interactions stabilizing the nano- and microstructure which on their part may correlate with the functional properties or texture of milk protein gels. An extraction test applying different buffering agents was established in order to quantify the stabilizing covalent and non-covalent bonds in milk gels. The texture properties were characterized by dynamic rheological measurements and penetration tests simultaneously. This enables us to study the process–structure–function relationship in pressure-induced, heat-induced, rennet-induced and acid-induced milk gels.

The combined characterization of the gel structure demonstrated that heat-induced and pressure-induced whey protein gels - predominantly stabilized by covalent disulphide bonds - appeared elastic, which is expressed by the low loss angle. In high pressure-induced whey protein gels, the loss angle declined when the amount of stabilizing disulphide bonds was increased by technological means. Contrary to that, the loss angle remained constant while the storage modulus increased when the amount of calcium bridges respectively the amount of hydrophobic interactions increased in rennet-induced respectively acid-induced gels via technological means. The gels appeared firmer but the viscoelastic properties remained unchanged.

In summary, the kind and quantity of the intermolecular interactions stabilizing milk protein gels can be determined by applying various buffer systems. It seems likely that analysis of process-induced covalent and non-covalent bonds will become an additional tool for texture analysis in scientific issues and for solving technological problems.

399 The 500 Myr story of the evolution of phosphoproteins that made milk possible. C. Holt* and R. A. Clegg, *Hannah Research Institute*, *Ayr, UK*.

Because of recent genome sequencing projects, casein genes are now recognised to have evolved as members of a paralogous group of secretory calcium (phosphate) binding phosphoproteins (SCPPs). The group's origins lie in ancient homologues of a protein called SPARC which gave rise to a SPARC-like protein (SPARCL1) and an osteopontin-like protein (OPN) at the end of the Cambrian period, about 500 Myr ago [1,2]. The earliest mineralised tissues (denticles) employing calcium phosphate emerged at this time, to be followed by external bony plates and scales and later endoskeletons. In extant mammals, members of the SCPP family are found in the biological fluids saliva and milk and in the mineralised tissues of bone, dentine and enamel. OPN, however has

a wider distribution in soft and hard tissues and many other biological fluids.

In previous work we have shown that a number of casein phosphopeptides can sequester amorphous calcium phosphate [3,4] to form a thermodynamically stable [5] nanocluster of radius 4nm. Calcium phosphate nanoclusters occur naturally as substructures in the colloidal casein particles of milk, known as casein micelles [6]. They allow a high concentration of an otherwise highly insoluble calcium salt to be achieved without danger of precipitation of a solid phase. Accordingly, we have suggested that the casein micelle is a solution to the problem of pathological calcification in the mammary gland.

We will consider the structural and thermodynamic requirements for the formation of nanoclusters and show that one other non-casein member of the group of SCPPs is able to sequester calcium phosphate and form nanoclusters. These findings suggest that calcium phosphate sequestration by phosphoproteins may be part of a general solution to the problem of the control of biocalcification.

1. Kawasaki, K and Weiss, K.M. (2003) Proc. Natl. Acad. Sci. (USA) 100, 4060-4065.

2. Kawasaki, K., Suzuki, T. and Weiss, K.M. (2004) Proc. Natl. Acad. Sci. (USA) 101, 11356-11361.

3. Little, E.M. and Holt, C. (2004) Eur. Biophys. J. 33, 435-447.

4. Holt, C. (2004) Eur. Biophys. J. 33, 421-434.

5. Holt, C. (2004) Biological and Bioinspired Materials and Devices, edited by J Aizenberg, WJ. Landis, C Orme, and R Wang (Mater. Res. Soc. Symp. Proc. 823, Warrendale, PA, 2004), W7.1.

6. Holt, C., De Kruif, C. G., Tuinier, R. and Timmins, P. A. (2003) Colloids and Surfaces. 213, 275-284.

400 HAMLET, an alpha-lactalbumin folding variant that induces tumor cell apoptosis. C. Svanborg*, *University of Lund*, *Sweden*.

HAMLET (**H**uman **a**-lactalbumin **M**ade **LE**thal to **T**umour cells) is a structurally defined protein-fatty acid complex derived from human milk. The complex kills cancer cells but leaves healthy differentiated cells intact. In the laboratory, HAMLET kills >40 different cancer cell lines, with leukemic cells being the most sensitive. The cells die by an apotosis like mechanism which is paradoxical as most tumour cells carry mutations that prolong their life span by allowing them to avoid apoptotic cell death. Thus, HAMLET appears to identify a death mechanism that is conserved in tumor cells, but lost as cells differentiate and mature. As the protein and lipid that form HAMLET occur naturally in human milk it may be speculated that HAMLET might contribute to the lowered cancer incidence in breast-fed children.

Since the discovery of HAMLET in 1995, we have studied

1. The **molecular characteristics of the compound**

2. **The mode of action on tumour cells.**

3. **The protective potential of HAMLET in tumor models** and human patients

HAMLET was used for brain tumour treatment in a human rat xenograft model. (Ref: ***Cancer Res** 64:2105, 2003*.) Infusion of HAMLET into the tumor was shown to delay tumor growth and prolong survival of immmunodeficient rats, carrying a human glioblastoma tumor. Apoptotic cells were detected in the tumor but not in surrounding healthy brain tissue.

HAMLET was also used for human skin papilloma treatment (Ref: ***N Engl J Med** 350:2663, 2004*.). A placebo controlled trial of topical HAMLET treatment was carried out and completed with a two-year follow-up. HAMLET was shown to reduce the volume of skin papillomas and to promote the resolution of the lesions.

The molecular, functional and therapeutic aspects will be discussed

Nonruminant Nutrition: Stable Isotope Tracer Techniques for Nonruminant Nutrition Research and Their Practical Applications

401 Mass isotopomer distribution analysis (MIDA) for studying intermediary nutrient metabolism. B. J. Bequette*, *University of Maryland*, *College Park*.

Functional genomic and proteomic investigations are beginning to characterize the metabolic controls and relationships between gene function and nutritional physiology. Still missing in this metabolic roadmap is characterization of the activities or fluxes through these integrated pathways that ultimately determines nutrient utilization. In the past 10 years, stable isotope (^{13}C, ^{15}N, ^{2}H) labeling (mass isotopomer) with mass spectrometric analysis has allowed fluxes through metabolic pathways to be measured in vivo and in vitro. MIDA refers to the measurement of the mass distributions in a molecule or molecular fragment that are characteristic of the unique biochemical pathway(s) of the nutrient's metabolism. This review will discuss the use of MIDA and how it can be used to dissect the integrative pathways of macronutrient (protein, carbohydrates, fat) metabolism. For example, in studies with laying hens, fish and chicks, MIDA has been applied to ascertain the nutritional essentiality, and thus metabolic inability for synthesis, of nucleic acids and some "non-essential" amino acids. Another application of MIDA has been the determination of the pathways and cycles of essential amino acid metabolism with regards to their metabolic roles other than for protein synthesis. When applied to the measurements of new gluconeogenesis and tissue utilization of glucose, MIDA has exposed the importance of amino acids as glucogenic substrates, and also highlighted the importance of the interconnectivity of the pathways of metabolism of carbohydrates, volatile fatty acids, amino acids and fatty acids to maintain anaplerosis and cataplerosis (metabolic balance) via the Krebs cycle. As gene and protein expression profiles begin to build the global roadmap of nutrient utilization, it will be necessary to determine the functional and quantifiable significance of these metabolic pathways that make up the roadmap. Here, the use of MIDA, when applied to the study of macronutrient metabolism, can provide the details of the biochemical networks of nutrient utilization.

Key Words: Stable Isotope, Amino Acid, Glucose

402 Measuring splanchnic amino acid metabolism by using stable isotope tracers. B. Stoll* and D. Burrin, *USDA-ARS Children's Nutrition Research Center, Baylor College of Medicine*, *Houston, TX*.

The splanchnic bed is comprised of the liver and the portal drained viscera (PDV). The PDV, which include the stomach, intestines, pancreas, and spleen, represent 4-6% of body weight, yet they account for 20-35% of whole-body protein turnover and energy expenditure. The high nutrient needs of the gut are met first as a result of first-pass metabolism. Consequently, the first-pass metabolism of dietary nutrients by the gut, especially amino acids, has a critical influence on their availability to peripheral tissues and whole body requirements. Moreover, the systemic availability of dietary amino acids is key determinant of lean body growth rate. A complicating factor in the measurement of gut nutrient utilization is that the intestinal mucosa receives nutrients from two sources, the diet and the arterial circulation. However, combining measurements of the net portal balance with enteral and intravenous infusions of stable isoto-

pically labeled amino acids provides an in vivo model that can distinguish the proportion of amino acids that are derived from the diet and arterial input. Using this technique in fed infant pigs, we found that 30-40% of the total amino acid intake is used by gastrointestinal tissues. The relative PDV utilization of individual amino acids from the diet and arterial inputs varies widely and dietary amino acids are the preferred fuel over dietary glucose. Stable isotopically labeled amino acids also enable the determination of the metabolic fate of individual amino acids. These studies have shown that insufficient protein supply or mode of feeding affects PDV amino acid utilization and consequently has a bearing on whole-body growth.

Key Words: Intestine, Swine, Nutrition

403 Mineral bioavailability and metabolism determined using stable isotope tracers. J. R. Turnlund*, *USDA/ARS/Western Human Nutrition Research Center, University of California*, *Davis*.

Definitive data on mineral bioavailability in humans and animals can be obtained by using isotopic tracers. The use of stable isotope tracers to study important issues in mineral nutrition has expanded rapidly in the past two decades, particularly in humans. Stable isotopes have a number of advantages over radioisotopes. There is no exposure to radiation with stable isotopes and some minerals have no radioisotope that can be used satisfactorily as a tracer. Multiple stable isotopes of one mineral and isotopes of multiple minerals can be administered simultaneously or sequentially. The analytical methods of choice for stable isotopes are thermal ionization mass spectrometry (TIMS) and inductively coupled plasma mass spectrometry (ICPMS). TIMS offers the highest precision and accuracy, but is slower, more labor intensive, and more costly than ICPMS. Bioavailability data are critical to establishing reliable dietary mineral requirements and recommendations. Combined with a computer program for compartmental modeling, mineral kinetics can be studied, including mineral turnover, pool sizes, and transfer rates between compartments. Our laboratory conducts studies using stable isotopes of zinc, copper, iron, calcium, magnesium, and molybdenum. We have studied the effect of the amount of dietary intake of minerals on bioavailability and utilization, pregnancy and aging, and interactions between minerals. The work resulted in establishing new dietary recommendations in humans for copper and molybdenum and compartmental models were developed for these minerals. While stable isotopes have been used more extensively to date in humans than in animals, the techniques applied to humans can be used to study a number of issues important to optimizing feeding strategies for animal production.

Key Words: Stable Isotopes, Mineral Bioavailability, Mineral Metabolism

404 Measuring nitrogen-containing polymer synthesis rates by using stable isotope tracers. M. Z. Fan*[1], L. I. Chiba[2], P. D. Matzat[3], and Y. L. Yin[4], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Auburn University*, *Auburn, AL*, [3]*Elanco Animal Health*, *Greenfield, IN*, [4]*The Institute of Subtropical Agricultural Research, the Chinese Academy of Sciences*, *Changsha, Hunan, China*.

The major nitrogen (N)-containing polymer compounds in the body include DNA, RNA, and proteins. The gastrointestinal endogenous secretions as well as the portal-drained visceral and the peripheral immune responses are of basic physiological functions. Elevated endogenous secretions and immune activities, as affected by developmental stages, diets and environmental factors, decrease the efficiency and availability of the major dietary nutrients for peripheral muscle synthesis and deposition. Measurements of in vivo fractional DNA (cell proliferation), RNA (transcriptional efficiency/mRNA stability) and protein (translational efficiency/metabolism) synthesis rates associated with the visceral organs, peripheral immune cells and skeletal muscles should, in principle, be the sensitive biochemical and cellular endpoints for studying factors affecting monogatric animal nutrition and metabolism. The selection of precursor stable isotope tracers, routes of tracer delivery and the gas chromatography-mass spectrometric (GC-MS) analyses of tracer enrichments are the major methodological considerations. Oral feeding the heavy water (^2H_2O) and intravenously continuous infusion of [U-^{13}C]glucose and [^{15}N]glycine for labeling the ribose and deoxyribose sugar moieties, de novo base synthesis, and non-essential amino acids have been established to measure in vivo fractional DNA, RNA, and protein synthesis rates. Flooding doses of tracer phenylalanine (Phe), e.g., L-[ring-$^2H_5$]Phe, via i.v. and i.p. routes, are reliable and cost-effective for measuring fractional protein synthesis rates especially for the visceral organs in suckling and weanling pigs. Therefore, measuring the major N-containing polymer fractional synthesis rates in the visceral organs and the peripheral immune cells through oral feeding ^2H_2O and/or ip flooding doses of tracer Phe are the emerging powerful tools for studying monogastric animal nutrition and metabolism under controlled experimental and field conditions.

Key Words: Stable Isotope Tracers, Fractional Synthesis Rates, Pigs

405 Factors affecting in vivo fatty acid and triglyceride synthesis rates measured by stable isotope tracers. E. Murphy*, *University of California*, *San Francisco*.

Synthesis of fatty acids (de novo lipogenesis) and triglyceride synthesis are important factors in body fat accumulation. Recently, new stable isotope methods using heavy water (^2H_2O) have made possible the safe, and relatively easy, measure of both of these processes in vivo in animals and humans. New methods also provide information on the preferential use of specific triglyceride synthesis pathways under different physiological settings. Data suggest that numerous dietary factors may affect de novo lipogenesis including nutrient composition, fructose intake, caloric content and fatty acid composition. Significant differences in de novo lipogenesis have also been seen across species. Rates of triglyceride synthesis have been shown to differ significantly between different adipose depots with metabolically active depots (e.g., visceral fat) having much more rapid triglyceride turnover than subcutaneous depots. Dietary fat, leptin deficiency and treatment with insulin sensitizers such as the PPAR-γ agonist rosiglitazone have all been shown to influence triglyceride synthesis rates. Application of these new techniques to nonruminant animals other than rodents will undoubtedly enhance our understanding adipose biology.

Key Words: Lipogenesis, Stable Isotope, Triglyceride Synthesis

Physiology and Endocrinology IV

406 Effect of postpartum nutrition of primiparous beef cows on concentration of insulin in follicular fluid and abundance of mRNA for binding proteins (IGFBP) -4 and -5 and aromatase in granulosa cells of dominant follicles. I. Rubio*, R. P. Wettemann, F. J. White, P. Y. Aad, and L. J. Spicer, *Oklahoma Agricultural Experiment Station*, *Stillwater, OK*.

Greater nutrient intake increased concentrations of IGF-I and IGFBP-4 and -5 in follicular fluid (FF) of postpartum anovulatory primiparous cows. This experiment evaluated the effect of nutrient intake on insulin in FF, and abundance of mRNA for IGFBP-4 and -5 and aromatase in dominant follicles (DF) at 56 ± 9 d postpartum in the same anovulatory Angus x Hereford cows. Body condition score (BCS) at calving was 4.8 ± 0.2. Cows (n=28) were blocked based on BCS and randomly assigned to one of two nutritional treatments at calving; moderate (M), 2.3 kg/d of a 40% CP supplement and ad libitum hay, or high (H), ad libitum access to a 12% CP-50% concentrate diet and hay. Growth of DF was evaluated daily by ultrasonography for 5 d before aspiration. When growth of DF plateaued, FF was obtained by transvaginal ultrasound-guided aspiration. Data were analyzed using the MIXED procedure of SAS and Pearson correlations coefficients. Concentrations of insulin in FF were greater ($P < 0.05$) for H (1.59 ± 0.22) than M (0.97 ± 0.17 ng/ml) and H cows had greater ($P < 0.01$) insulin in plasma (1.61 ± 0.17) than M (0.97 ± 0.17 ng/ml). Concentrations of IGF-I in FF were greater ($P < 0.01$) for H than M cows. Abundance of

mRNA for IGFBP-4 and -5 and aromatase were not affected by treatment. Postpartum interval to luteal activity was longer ($P < 0.05$) for M cows (95 ± 24) than for H (80 ± 11 d). Postpartum interval to luteal activity was negatively correlated ($P < 0.01$) with BCS at aspiration. Although concentrations of IGFBP-4 and -5 in FF were greater in H than M cows, treatment did not influence mRNA for IGFBP-4 and -5. Concentrations of insulin and IGF-I in FF, and abundance of mRNA for aromatase and IGFBP-4 and -5 in DF of anovulatory cows at 56 d after calving were not related to the interval from calving to the onset of luteal activity. These results suggest that changes in FF IGFBP concentrations rather than local translational regulation may have a role in dietary-induced changes in postpartum follicular growth.

Key Words: Beef Cows, Follicle, Ovary

407 Accessing the impact of faults in body condition score on reproductive performance in large commercial dairies. D. Caraviello*[1], K. Weigel[1], M. Florent[1], C. Rawson[2], N. Zwald[2], and M. Wiltbank[1], [1]*University of Wisconsin*, *Madison,*, [2]*Alta Genetics*, *Calgary, Alberta, Canada*.

The impact of body condition score (BCS) on 3 reproductive variables (conception at first service, conception at second service, and pregnancy status at 150 d postpartum) was evaluated. A total of 8,036 Holstein cows on 63 farms were scored on a 1 to 5 scale by a single, trained evaluator. A system was developed such that an individual cow's BCS was considered to be a "fault" if it fell below a predetermined threshold. These thresholds were 3.25, 2.75, 2.5, and 2.75, for cows that were -60 to 30, 30 to 50, 50 to 180, and 180 to 200 days postpartum, respectively. Only animals evaluated before 200 days postpartum were included in the analysis. In addition, the percentage of BCS faults was computed for each herd; this system allowed characterization of the BCS status of each herd in a single visit. Reproductive data were obtained close to the time of BCS evaluation, between March and September 2004, from dairy records processing centers and from on-farm computers using Dairy Comp 305, DHIPLUS, and PCDART. Data were precorrected for lactation number and temperature (using weather station data). The logistic regression model showed that there was a linear decrease in conception rate and pregnancy status at 150 d postpartum on herds with >25% BCS faults. Mean conception rates were approximately 23% for herds with <25% BCS faults and less than 20% for herds with >45% BCS faults. Likewise, 74% of cows were pregnant by 150 d postpartum in herds with <25% BCS faults, and less than 60% were pregnant in herds with >45% BCS faults. These results were confirmed by the "cow level" evaluation, with probabilities of conception at first service of 25% and 19% ($p = 0.04$), and probabilities of being pregnant at 150 d postpartum of 74% and 61% ($p < 0.0001$) for animals without and with a fault, respectively.

Key Words: Body Condition Score, Conception, Reproductive Performance

408 Prediction of reproductive performance on large commercial dairies. D. Caraviello*[1], K. Weigel[1], C. Rawson[2], N. Zwald[2], D. Gianola[1], and M. Wiltbank[1], [1]*University of Wisconsin*, *Madison*, [2]*Alta Genetics*, *Calgary, Alberta, Canada*.

Data from Holstein cows in large commercial herds that participated in the Alta Genetics' Advantage progeny testing program were analyzed to explain factors affecting conception at first, second, and third services, pregnancy status at 150 days in milk, and days open. Test day production records and reproductive events were obtained from a total of 127 herds that participated in the DHI milk recording program and used DHIPLUS, Dairy Comp 305, or PCDART software for herd management purposes. In addition, body condition scores (BCS) were measured directly on 63 farms. A survey regarding management factors that could affect reproduction was completed in 104 herds, with the help of Alta Genetics' consultants. Maximum daily temperature on each day of insemination was obtained from weather stations within 25 miles of each farm (via the National Climatic Data Center). A hash map implemented in JAVA was used as data structure to construct a merged data set including 604 explanatory variables and reproductive and milk yield data from 65,849 lactation records of 56,943 cows calving from January 2000 to August 2004. Stepwise model selection, partial least squares, Bayesian information criteria, and machine learning techniques were used to construct models explaining reproductive performance on these farms. The most important ($p < 0.0001$) explanatory variables affecting these response variables included milk yield, maximum temperature at day of the service, BCS, pens included on BCS evaluation, use of clean-up bull, use of bull fertility evaluations, amount of training of the technicians, method used to thaw semen, synchronization protocols used, number of pens holding the open cows, barn type, bedding type and renewing frequency, cleaning and disinfection of the maternity pen, who formulates the diets, benefits provided to full-time employees, and hoof trimming frequency.

Key Words: Conception, Model Selection, Reproductive Performance

409 Individual variation in production efficiency of beef and dairy cows. A. Brosh* and Y. Aharoni, *Newe Yaar Research Center, Beef Cattle Section, Institute of Animal Science, A.R.O Israel*, *Newe Yaar Israel*.

Most of the metabolizable energy (MEI) consumed by cattle is lost as energy expended (EE) as heat. The energy balance of animals is presented by the following equation: MEI=EE+Retained Energy (RE). Knowledge of any two of the above variables allows the solution of the equation and calculation of energy efficiency. The objective of this presentation is to characterize the repeatability of differences in energy efficiency among cows, measured repeatedly in four experiments (Exp). The EE (kJ/(kgBW0.75*day)) in all experiments was measured by means of the heart rate (HR) method, i.e. HR that was measured throughout 3-4 days was multiplied by the oxygen consumption (VO2) per heartbeat, measured throughout 10-15 min, and by 20.47 kJ per liter VO2. In Exp 1, EE and MEI were measured nine times in six beef cows in confinement during one year of their reproductive cycle. In Exp 2, EE and MEI were measured in six non-lactating, non-pregnant beef cows on six diets varying in ME content. In Exp 3, EE and MEI were measured in five grazing seasons on differing herbage quality in16 cows. The data were analyzed by the ANOVA procedure with correction by covariance to MEI, to analyze differences among cows on an equal MEI basis. The differences in EE among cows in all experiments were significant (P range from 0.006 to 0.037), with range of individual variation of 20% to 28% of the average EE. In Exp 4 we used 19 Holstein dairy cows. Their EE and the energy in their secreted milk were measured four times during four months. The predicted EE of these cows was calculated from their energy in milk and their BW, assuming 0.57 MJ/kgBW0.75 for maintenance and efficiency of 64% of ME for milk production, and was subtracted from their measured EE to calculate their residual EE (REE). Thus, an efficient cow has a negative REE (predicted EE higher than measured EE). The repeatability of the REE among cows was significant ($P<0.001$). The REE ranged from -17% to +13% of the measured EE, i.e., a range of 30%. We conclude that lower EE in relation to MEI or predicted EE is a repeatable trait that should be considered as a tool to select cows of higher energy efficiency.

Key Words: Energy Expenditure, Heart Rate, Efficiency

410 Fatty acid composition of the porcine conceptus in response to maternal omega-3 fatty acid supplementation. A. E. Brazle*[1], B. J. Johnson[1], E. C. Titgemeyer[1], S. K. Webel[2], and D. L. Davis[1], [1]*Kansas State University*, *Manhattan*, [2]*United Feeds, Inc.*, *Sheridan, IN*.

Maternal omega-3 fatty acid supplementation is reported to increase litter size in pigs. Therefore we evaluated the hypothesis that omega-3 sources would affect the fatty acid composition of pig conceptuses and that the effects would differ with the omega-3 source. Diet treatments were control, corn-soybean meal diet; PFA, control plus a protected fish source of polyunsaturated omega-3 fatty acids (Fertilium®, 1.5% of diet); and flax, control diet plus ground flax (equivalent in total omega-3 fatty acids to PFA). Supplements replaced corn and soybean meal in the PFA and flax diets. When gilts reached 170 d of age PG600® was injected to induce puberty and dietary treatments initiated. At approximately 190 d of age gilts began a 14-d treatment with Matrix® to synchronize

their estrous cycles. When detected in estrus gilts were artificially inseminated. Experimental diets continued until d 40 to 43 of gestation when gilts were slaughtered and reproductive tracts removed to collect conceptuses. Pregnant gilts (7/8, 8/8, 5/8 for control, PFA, and flax, respectively) provided tissues to examine the fatty acid composition. Dietary treatments did not affect linolenic ($P > 0.39$) and arachidonic ($P > 0.10$) acid in conceptuses. However, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) composition of fetuses was affected by flax and PFA. Flax increased EPA 32% (control: 0.73 mg/g dry tissue) in fetuses ($P < 0.05$) but only numerically increased EPA in the chorioallantois ($P = 0.14$) compared to the control diet. Gilts receiving PFA had 16% more ($P < 0.006$) DHA in their fetuses than fetuses in controls (control: 4.9 mg/g dry tissue). Therefore, initiating supplementation approximately 40 d before breeding with these omega-3 sources affected conceptus composition and the two sources affected fatty acid composition differently. Flax selectively increased EPA and PFA increased DHA. These results are relevant to other data indicating PFA increases prenatal survival in pigs.

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

411 Effects of stress on performance and the immune response in pigs infected with porcine reproductive and respiratory syndrome virus. M. Sutherland*[1], S. Niekamp[1], W. Van Alstine[2], and J. Salak-Johnson[1], [1]*University of Illinois*, *Urbana*, [2]*Purdue University*, *West Lafayette, IN*.

Changes in the thermal environment (e.g., heat) can invoke a stress response in pigs. Initiation of a stress response often leads to an increase in glucocorticoids, thus impacting the immune system. The objective of this experiment was to determine the effect of heat stress on the immune response and performance of pigs infected with porcine reproductive and respiratory syndrome virus (PRRSV). At 7 wk of age (d 0) Landrace × Yorkshire cross pigs were assigned to each of four experimental treatments: (1) PRRSV+, 24°C (n = 8); (2) PRRSV+, 32°C (n = 8); (3) PRRSV-, 24°C (n = 8); or (4) PRRSV-, 32°C (n = 8). Pigs were subjected to thermal stress for 14 d. Blood samples were taken prior to intranasal inoculation of the PRRSV or vehicle (baseline, d 0), and at d 7 and 14 post-inoculation to measure white blood cell counts (WBC), differentials, cortisol, lymphocyte proliferation (LPA), and natural killer cytotoxicity (NK). Body temperature and feed intake were recorded on a daily basis. Total WBC were decreased ($P < 0.005$) by d 7 in infected pigs, regardless of temperature and returned to baseline levels by d 14. The LPA response was greater ($P < 0.01$) in PRRSV+ pigs at 24°C than non-infected pigs. At 7 d, non-infected pigs kept at 32°C had lower ($P < 0.05$) NK compared to PRRSV+ pigs at 32°C and PRRSV- pigs at 24°C, but there was no differences by d 14. At 7 d, body temperature was greater ($P < 0.05$) in PRRSV- pigs kept at 32°C than in those infected and kept at 24°C, but by d 14 PRRSV- pigs kept at 24°C had the lowest ($P < 0.05$) body temperatures. Feed intake increased ($P < 0.05$) in non-infected pigs over the course of the experiment, but did not change among infected pigs. Body weight gain was reduced in PRRSV+ pigs kept at 32°C ($P < 0.05$). These results suggest that PRRSV can reduce body weight gain and influence the immune response of pigs but these effects can be affected further when thermal stress is applied.

Key Words: Immune, Pigs, Stress

412 Effects of albuterol on the physiology of finishing pigs. D. Lay*[1], J. Marchant Forde[1], B. Richert[2], R. Marchant Forde[1], and K. McMunn[1], [1]*USDA-ARS; Livestock Behavior Research Unit*, *W. Lafayette, IN*, [2]*Purdue University*, *W. Lafayette, IN*.

Several growth promoters for swine have been tried with variable success and there has been concern about compound efficacy and alterations of behavior or physiology. This experiment examined the physiological effects of a proposed growth promoter, albuterol - a beta-2 agonist. The study used 192 pigs (88.8±0.9 kg BW) housed in groups of six in 32 pens (1.4m x 4.1m) and assigned to one of four treatments: 1) Control - standard finishing ration, 2) ALB-R2 - diet with 2 ppm of the pure R-enantiomer of albuterol, 3) ALB-R4 - diet with 4 ppm of pure R-albuterol, or 4) ALB-RS8 - diet with 8 ppm of a racemic mix of R- and S-enantiomers. All diets supplied 18.3% CP, 1.1% lysine and 3534 kcal ME/kg and were offered ad libitum. One pig from each pen was chosen randomly and blood was collected four times: Week 0 - prior to treatment, Week 2 - at 10 days on treatment, Week 4 - at 24 days on treatment and, SAC - at exsanguination. All pigs were fed control diet for 24h (50% of pigs) or 48h (50% of pigs) prior to exsanguination. Blood was analyzed for NEFA, CK, glucose, lactate, BUN, ammonia, insulin, cortisol, norepinephrine, and epinephrine. Data for Weeks 0 to 4 were analyzed together using a repeated analysis of variance with Week 0 as a covariate. SAC data were analyzed separately as these data represent the difference in the 24h or 48h clearance. There were no treatment differences in epinephrine or norepinephrine concentrations at any point. During Week 4, Control pigs had lower CK ($P<0.02$) and greater BUN ($P<0.005$) compared to pigs fed all the albuterol treatments. A gender effect was found for CK and BUN ($P<0.05$) indicating that males had greater concentrations of CK and BUN than females. The ALB-R4, male pigs had greater concentrations of insulin than male pigs in the other three treatments during Week 2 ($P<0.001$). Control female pigs had lower concentrations of cortisol compared to female pigs in the other three treatments during Week 2 ($P<0.02$). Taken together these data indicate that albuterol altered protein metabolism, without altering catecholamine levels, at the doses administered in this experiment. Gender-specific effects of albuterol should be explored further.

Key Words: Albuterol, Pigs, Physiology

413 Evidence for coordinated regulation of IGFBP-5, four and a half lim (FHL) 2, and a disintegrin and metalloprotease (ADAM) 9 expression in osteoblasts. K. E. Govoni*[1], A. Kramer[1], E. Winter[1], D. J. Baylink[1,2], and S. Mohan[1,2], [1]*MDC, JL Pettis VAMC*, *Loma Linda, CA*, [2]*Loma Linda University*, *Loma Linda, CA*.

The role of IGFs in regulating growth and their modulation by six IGFBPs are well established. IGFBP-5, the most abundant IGFBP stored in bone, is an important regulator of bone formation and acts via IGF-dependent and -independent mechanisms. Two new proteins, FHL2, a transcription modulator that interacts with IGFBP-5, and ADAM9, an IGFBP-5 protease, have been identified as potential regulators of IGFBP-5 action in bone. We tested the hypothesis that agents which modulate bone formation by regulating IGFBP-5 expression would also regulate FHL2 and ADAM9 expression in a coordinated manner. We evaluated the expression of IGFBP-5, FHL2, and ADAM9 by real-time PCR during osteoblast differentiation of mouse bone marrow stromal cells and in response to treatment with bone formation modulators in osteoblast cells (LSaOS and MG63). IGFBP-5 and FHL2 increased 4.3 and 3.0 fold ($P \leq 0.01$), respectively, during osteoblast differentiation. Dexamethasone (Dex), an inhibitor of bone formation, decreased IGFBP-5 and FHL2 and increased ADAM9 in LSaOS cells ($P \leq 0.05$) and decreased FHL2 in MG63 cells ($P \leq 0.05$). Bone morphogenic protein (BMP) 7, a stimulator of bone formation, increased IGFBP-5 and decreased ADAM9 in LSaOS and MG63 cells, respectively ($P < 0.01$). To determine if BMP7 would eliminate Dex inhibition of IGFBP-5, cells were treated with Dex+BMP7. The BMP7-induced increase in IGFBP-5 was reduced, but not eliminated, in the presence of Dex ($P \leq 0.01$), indicating that BMP7 and Dex may regulate IGFBP-5 via different mechanisms. TGFβ, a stimulator of bone formation, increased IGFBP-5 and FHL2 ($P \leq 0.01$) in LSaOS cells. In summary: 1) Expression of IGFBP-5 and FHL2 increased while no change in ADAM9 was observed during osteoblast differentiation; 2) Treatment with BMP7 and TGFβ increased IGFBP-5 and FHL2 expression, whereas Dex decreased IGFBP-5 and FHL2 and increased ADAM9 expression. In conclusion, our findings are consistent with the hypothesis that FHL2 and ADAM9 are important modulators of IGFBP-5 actions and are regulated in part, in a coordinated manner in bone.

Key Words: IGFBP, IGF, Bone

414 Immunization of pigs against chicken (c)GnRH-II and lamprey (l)GnRH-III: Effects on gonadotropin secretion and testicular function. A. Bowen*[1], S. Khan[2], L. Berghman[3], J. Kirby[4], and J. Vizcarra[1], [1]*Texas Tech University*, *Lubbock*, [2]*Clark Atlanta University*, *Atlanta, GA*, [3]*Texas A&M University*, *College Station*, [4]*University of Arkansas*, *Fayetteville*.

The objective of this experiment was to evaluate the effects of active immunization against two GnRH isoforms on gonadotropin secretion and testicular function in pigs. Synthetic cGnRH-II and lGnRH-III peptides, where the common pGlu-His-Trp-Ser sequence at the N-terminal was suppressed, were conjugated to BSA. Forty-eight male piglets were randomly assigned to 4 treatments. Pigs on treatment 1 were actively immunized against cGnRH-II, while pigs on treatment 2 were actively immunized against lGnRH-III. Pigs on treatment 3 were actively immunized against the carrier protein (BSA), and pigs on treatment 4 were castrated and actively immunized against BSA. The BSA conjugate was emulsified in Freund's incomplete adjuvant and diethylaminoethyl-dextran. The primary immunization was given at 13 weeks of age (WOA), with booster immunizations given at 16, 19, and 23 WOA. Body weight and plasma samples were collected weekly beginning at 11 WOA. Treatments did not affect BW during the experimental period. Titers were significantly increased in animals immunized against cGnRH-II and lGnRH-III ($P < 0.01$). Cross-reactivity of the antisera to mammalian GnRH or between cGnRH-II and lGnRH- III was minimal. At 26 WOA, pigs (n = 3/trt) were randomly selected, and serum samples were collected at 10 min intervals for 10 h. Concentrations of LH ($P<0.01$), FSH ($P=0.137$), and FSH pulse frequency and amplitude ($P<0.10$) appeared to be differentially regulated in immunized animals. At the end of the experiment, intact pigs were exsanguinated. Testes were immediately removed; Leydig cells were isolated and treated with 0, 1, or 10 ng/ml of LH. There was a LH x GnRH treatment effect on testosterone concentrations ($P<0.01$), indicating that Leydig cells were sensitive to the immunization protocol and LH doses. Taken together, these data suggest that gonadotropin secretion is differentially regulated in pigs immunized against GnRH isoforms. Additionally, immunization against cGnRH-II and lGnRH-III significantly reduced the ability of Leydig cells to respond to LH challenges.

Key Words: GnRH, LH, FSH

415 Application of glycerol as an optical clearing agent to enhance photonic transference and detection of *Salmonella typhimurium* through pig skin. K. Moulton*[1], F. Lovell[1], E. Williams[1], P. Ryan[1], A. Karsi[1], M. Lawrence[1], D. Lay[2], E. Jansen[3], and S. Willard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA-ARS Livestock Behavior Research Unit*, *West Lafayette, IN*, [3]*Vanderbilt University*, *Nashville, TN*.

The objective of this investigation was to evaluate glycerol (GLY) and GLY+DMSO (dimethyl sulfoxide) as agents to optically clear pig skin and increase photonic transference and detection of photon emitting *Salmonella typhimurium* (*S. typh* -lux; transformed with plasmid pAKnlux1), in a laboratory model for *Salmonella* detection in swine. Shoulder pig skin obtained after harvest and hair removal was further processed to remove the subcutaneous fat, and skin measured for thickness. A 96-well plate containing *S. typh*-lux was imaged for 5 min using a photon counting camera (Berthold/Nightowl) as a control reference. Skin (3 mm thick) was then placed over the plate containing *S. typh*-lux and imaged for 5 min. The skin was then treated with varying ratios of GLY, DMSO and PBS in a dose- and time-dependent manner and the plate imaged again for 5 min. The percent of photonic emissions (skin / no skin control x 100 was calculated and used for statistical analysis (n=8). Treatment for 4 h with 50% GLY-PBS and 50:30:20% GLY:DMSO:PBS increased ($P<0.05$) photonic emissions (4.9±0.8% and 6.5±0.9%, respectively) compared to untreated skin (0.24±0.05%), 100% PBS (0.20±0.03%) or 30:70% DMSO:PBS (0.50±0.08%). Altering the ratios of DMSO (10, 20, 30, 40, and 50%) in the presence of 50% GLY demonstrated that DMSO at 20 and 40% (13.8±1.2% and 14.4±1.1%, respectively) increased ($P<0.05$) photonic emissions compared to 10% DMSO (10.8±1.3%) and 50% GLY:PBS alone (10.4±1.0). Treatment of skin with 50% GLY and 50:30% GLY:DMSO did not differ ($P>0.10$) in photonic emissions at 30 min, 1, 2, 4, or 8 h post-treatment; and both treatment groups exhibited greater ($P<0.05$) photonic emissions than no treatment, DMSO alone, or PBS at 2, 4, and 8 h. These data indicate that GLY and GLY+DMSO may be used as effective optical clearing agents on pig skin when treated for 4 or 8 h to allow for an increased detection of emitted photons from *S. typh*-lux through the skin. [USDA-NRI grant # 2003-35201-13841; USDA-ARS funded Biophotonic Initiative # 58-6402-3-0120]

Key Words: Biophotonics, *Salmonella*, Glycerol

416 Factors affecting days open and days to first breeding in Iranian Holsteins. A. Heravi Moussavi*[1], M. Danesh Mesgaran[1], and R. Noorbakhsh[2], [1]*Ferdowsi University*, *Mashhad, Khorasan, Iran*, [2]*Institute of Standards and Industrial Research*, *Mashhad, Khorasan, Iran*.

Effects of several factors on days open (DO) and days to first breeding (DFB) in Iranian Holstein cows were evaluated. Data covered 10 years from 1994 to 2003. The period of evaluation was from 40 to 180 d after calving. After editing, the data set had 6000 and 6500 cows for days open and days to first breeding, respectively. Data were analyzed by mixed models. The model included lactation number, calving season, calving year, first 100 d cumulative milk production, sex of calf and postpartum health situation. The result showed that DO and DFB were impacted by year ($P<0.001$). While DO (109.5±6.9 vs. 114.4±6.9 d, respectively for years 1994 to 1998 and 1999 to 2003) was increased ($P<0.001$), DFB (75.6±3.5 vs. 70.7±3.6 d, respectively for years 1994 to 1998 and 1999 to 2003) was decreased during the recent years ($P<0.001$). First 100 d cumulative milk yield (2904±38, 3050±33, 3162±33, 3217±33, 3132±34, 3346±32, 3427±34, 3487±35, 3244±35, 3472±35 kg, respectively for years 1994 to 2003) was different among the years ($P<0.001$) and had impact on DO ($r = 0.08$; $P=0.018$) and DFB ($r = -0.02$; $P<0.001$). DO was not affected by season but DFB (75.8±1.3, 67.0±1.4, 72.7±1.4 and 79.1±1.5 d, respectively for spring, summer, autumn and winter) was affected by season ($P<0.001$). DO and DFB were increased due to metabolic and/or reproductive disorders ($P<0.001$). Sex of calf had no effect on DFB but impacted DO as cows with male calves had greater ($P<0.01$) DO than cows with female calves (103.1±1.4 and 98.7±1.4 d, respectively). DFB (75.4±3.6, 68.9±3.5, 70.6±3.5, 71.3±3.6, 75.7±3.7, 75.5±3.7, 78.8±3.7 d, respectively for lactation number from 1 to 7 and higher) was impacted by lactation number ($P<0.001$). DO was similar among different lactation numbers. In conclusion, DO was affected by year, postpartum disease, sex of calf, and milk yield, whereas DFB was affected by year, season, postpartum disease, lactation number and milk yield.

Key Words: Reproductive Efficiency, Days Open, Days to First Breeding

Production, Management and the Environment: Nutrition, Management, and Environment

417 Assessment of dairy farm management practices through internet connections. G. Licitra*[1,2], J. D. Ferguson[3], G. Azzaro[1], M. Caccamo[1], and A. Cappa[4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A., University of Catania*, *Catania, Italy*, [3]*University of Pennyslvania,*, *Kennett Square*, [4]*APA*, *Vicenza, Italy*.

A major challenge in the dairy industry is transfer of information and technology to dairy farms. Extension systems have been reduced in size due to costs to maintain extensive systems. This reduces the ability to deliver technical assistance to many local dairy farms. The internet provides an opportunity to integrate farm records on health, reproduction, production, and costs. In addition digital video and photos can be used to form a visual data base of cows and farm facilities. Experts can then visit the farm virtually and have access to data to help troubleshoot and evaluate farm management. The system can be used to

support, educate and train local service providers and dairy farm managers. In addition video imaging could provide diagnostic support for potential high risk diseases such as foot and mouth disease where reduction in movement of people and animals is critical to control measures. This project will describe the components of a web based system developed by CoRFiLaC in collaboration with APA in Vicenza, Italy. In brief the system incorporates records on cow production, reproduction, and genetics from the herd record system, ration specification from CPM DAIRY^{R}, forage analysis and their automatic insertion in the feedbank used by CPM DAIRY^{R}, health records for each cow (input from the producer), milk laboratory information, microbiology data on milk cultures, cost of production spreadsheet, and video images of cows and facilities. Data can be accessed through password protected portals by the producer and indentified consultants.

Key Words: Management, Records, Dairy Cattle

418 Evaluation of models to predict phosphorus (P) excretion of dairy cattle fed a range of P concentrations during different stages of the dry period and lactation. Z. H. Myers and D. K. Beede*, *Michigan State University*, *East Lansing*.

Objective was to evaluate published models to predict P excretion using data from a new set of balance trials with 73 pregnant, non-lactating nulli- and multiparous Holstein animals, and 140 lactating primi- and multiparous Holstein cows at 97, 183 and 294 average DIM, with different cows at each stage. Three datasets were constructed: full dataset (FD) with all animals, lactating cow dataset (LD), and non-lactating animal dataset (ND). Dietary P% was 0.19, 0.28, and 0.38 for non-lactating animals and 0.27, 0.36, 0.42, 0.46, and 0.52 for lactating cows. Total range in P excretion in FD was 12.1 to 108.7 g/animal per d. Eight published models were evaluated from accuracy, bias, and precision using the new datasets. Excretion of P was most appropriately predicted by Model 1: (g/d) = (intake P - milk P, g/d)]; and, Model 2: (g/d) = 0.741 x (intake P - milk P, g/d) + 5.92. In contrast, the least appropriate model was that of the ASAE Standards (1996). To further evaluate Model 1 measured P excretion from the new datasets was regressed on the difference of intake P - milk P. New P excretion model for FD was: (g/d) = 1.19 ± 0.059 x (intake P - milk P, g/d) + (1.43 ± 2.670, g/d); linear ($P < 0.01$; $R^2 = 0.68$); y-intercept was different from zero ($P < 0.05$), but slope was not different from one ($P > 0.05$). New P excretion model for LD was: (g/d) = 1.22 ± 0.055 x (intake P - milk P, g/d) - (2.11 ± 2.747, g/d); linear ($P < 0.01$; $R^2 = 0.80$); y-intercept of regression equation was not different from zero ($P > 0.05$), but slope was different from one ($P < 0.05$). New P excretion prediction for ND was: (g/d) = 1.26 ± 0.160 x (intake P - milk P, g/d) + (2.05 ± 6.148, g/d); linear ($P < 0.01$; $R^2 = 0.46$); y-intercept was not different from zero and slope was not different from one ($P > 0.05$). These models should be evaluated for accuracy, precision, and bias with other independent datasets.

Key Words: P Excretion, Dairy Cows

419 Effect of stall surface on the prevalence and severity of hock lesions in dairy cows housed in free stall barns. M. I. Endres, L. A. Espejo*, and J. A. Salfer, *University of Minnesota*, *St. Paul*.

A total of 5,538 cows in 50 randomly selected dairy farms in Minnesota were scored for hock lesions using a standardized scoring system in a scale of 0 to 3 with 0 = no signs of hair loss or swelling on either hock region (no lesion), 1 = evidence of hair loss (mild lesion), 2 = one or more swollen hocks but no evidence of hair loss (moderate to severe lesion), 3 = one or more swollen hocks with evidence of hair loss (severe lesion). Free stall surface was either deep-bedded sand or rubber-filled mattresses. Thirty-four percent of the dairies used sand and 66% used mattresses. In each dairy, cows in one or more high producing pens were scored. On the average, 90% of cows in each group were scored. Number of cows per group varied from 34 to 304 with an average group size of 118. Number of milking cows in each herd varied from 104 to 1,250 with an average milking herd size of 423 cows. Lactation number, days in milk, and milk production per cow in the scored group averaged 2.6, 169.7 days, and 38.6 kg/d, respectively. Fifty-eight percent of the cows scored had hock lesions. Stall surface affected ($P \leq 0.001$) the prevalence of hock lesions with 29.4% of cows in sand barns having lesions compared to 71.3% of cows in mattress barns. Severity of lesions was also greater ($P \leq 0.001$) for cows in mattress herds than cows in sand herds. For the statistical analysis of severity of lesions, scores 2 and 3 were combined. In mattress herds, the percent of cows with hock lesion score of 1 was 57.2% and 2 or 3 was 14.1%. In sand herds, the percent of cows with hock lesion score of 1 was 27.6% and 2 or 3 was 1.8%. The effect of lactation number (age) and DIM (stage of lactation) on the prevalence and severity of hock lesions was also investigated. Both prevalence and severity increased with age and DIM ($P \leq 0.05$). There was no relationship ($P \geq 0.05$) between daily milk production and either prevalence or severity of lesions. In conclusion, the prevalence and severity of hock lesions were greater on dairy farms using mattress stalls than on dairy farms using sand-bedded stalls.

Key Words: Hock Lesion, Stall Surface, Dairy Cows

420 Effects of winter feeding systems on cow performance, feeding site soil nutrients and pasture growth. H. Lardner*[1], P. Jungnitsch[2], J. Schoenau[2], and T. Highmoor[1], [1]*Western Beef Development Centre*, *Saskatoon, Saskatchewan, Canada*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*.

An experiment was conducted to determine the effect of winter feeding systems on beef cow performance, feed site soil nitrogen (N) and phosphorous (P) levels and pasture production (DMY) the following summer. The study site was a Russian wild ryegrass (*Psathyrostachys juncea*) pasture situated on an Orthic Black soil. Crossbred pregnant beef cows (n = 96) (range 594 to 663 kg) were allocated to one of three replicate (n = 2) wintering systems. Feeding systems included (1) field bale grazing (BG), round straw + grass-legume hay bales fed *ad libitum* every 3 d; (2) field bale process feeding (BP), round straw + grass-legume hay bales processed and windrow fed *ad libitum* every 3 d; and (3) drylot feeding (DF), round straw + barley greenfeed bales processed bunk fed in drylot daily. Cows were weighed at start, every 30 d and end of feed period. Body condition scores [(5-point scale (1 = thin, 5 = fat)] were taken at start and end of each feeding period. Fresh (FM) and composted (CM) manure from the DF system was fall applied on replicated (n = 4) plot areas. In the spring, 15 cm soil samples (n = 20) were taken from each feeding site, manure treatment and control (CO) area. DMY was estimated by sampling (n = 45) feeding site, manure treatment and control areas using 0.25 m2 quadrats. Cow body weight ($P = 0.56$) and condition ($P = 0.17$) over 2 yr was not affected by feeding systems. While soil N levels were similar between CO, FM and CM sites, N levels were higher ($P < 0.05$) on both BG and BP sites (127 and 181 kg ha^{-1}, respectively). Phosphorous was lower ($P < 0.05$) on BG and FM sites (24.1 and 23.5 kg ha^{-1}, respectively) compared to CO area (28.4 kg ha^{-1}). Pasture DMY was greater ($P < 0.05$) from the BP and BG sites (6990 and 5506 kg ha^{-1}, respectively) than from the FM, CM or CO sites measured the following summer. Results indicate that benefits from nutrients deposited on feeding sites can be managed to increase pasture fertility and production.

Key Words: Winter Feeding System, Soil Nutrients, Pasture Yield

421 Effects of feeding varying concentrations of dry distillers grains with solubles to finishing steers on performance and odorant emissions. C. Benson*, K. Tjardes, and C. Wright, *South Dakota State University*, *Brookings*.

Distillers grains are becoming more prevalent as a feedstuff, with dried distillers grains plus solubles (DDGS) being the predominant form. This trial was designed to determine if feeding increasing concentrations of DDGS affects finishing steer performance and odor emissions. One hundred ninety-nine steers (wt = 386 ± 8 kg) were blocked by source, stratified by weight, and allotted to 16 dirt floor pens (14.7 m x 34.7 m). The pens were then randomly assigned to one of four dietary treatments. The control diet (CON) contained 82% cracked corn, 10% alfalfa hay, 4% molasses, 3.2% supplement, and 0.8% urea. In the

remaining three diets, all of the urea and some of the cracked corn was removed and replaced with DDGS at 15% (D15), 25% (D25), and 35% (D35) of the diet DM. The diets were balanced to provide similar levels of CP for CON and D15 (13.2 and 13.3% CP, respectively) and a stepwise increase in CP for D25 and D35 (15.4 and 17.6%, respectively). Weights were recorded prior to feeding on d 0 and 105, and every intermediate 28 d. Over the entire trial, DMI was greater ($P < 0.05$) for D25 compared to all other treatments (10.77, 10.94, 11.25, and 10.91 kg/d for CON, D15, D25, and D35, respectively). There were no differences in final weight between treatments, but D35 steers tended to have a higher dressing percent ($P< 0.10$), which resulted in D35 having greater carcass weights ($P < 0.05$; 358.9, 362.8, 359.5, and 375.2 kg for CON, D15, D25, and D35, respectively). No differences were detected between treatments for marbling, backfat, ribeye area, or yield grade. Air samples were collected via wind tunnel at 3 locations per pen over a 3-d period prior to animal introduction and on d 78-80. Hydrogen sulfide levels were greatest ($P < 0.05$) in pens containing cattle consuming the D35 treatment compared pens with cattle consuming the remaining treatments. Odor was analyzed using dynamic, triangular, forced choice olfactometry. No differences in odor characteristics were detected between treatments.

Key Words: Distillers Grains, Hydrogen Sulfide, Odor

422 Factors influencing ammonia emissions from beef cattle feedlots using forced-air wind tunnels. D. Sherwood*, G. Erickson, T. Klopfenstein, and D. Schulte, *University of Nebraska*.

Ammonia emissions transport N into the air, but the factors that slow down or speed up this transport and actual emission amounts for beef feedlots are not well known. Open chamber wind tunnels were used to measure ammonia emissions from the surface of 12 open feedlot pens during two feeding trials where N mass balance was conducted evaluating diets. No diet effects were observed and will not be presented. The pens were identical between the two trials having the same treatment and number of animals. Ammonia emissions were measured weekly during the last six weeks of each feeding period (March 25 - April 29, 2004 and July 23 - August 27, 2004 from 9 AM to approximately 2 PM) using wind tunnels and a .2 M sulfuric acid trap for 30 minutes in each pen. The total volume of the wind tunnel is 0.064 m^3 with air flow of 0.024 m^3/s. One inch core samples were taken from the feedlot surface at all four corners of the tunnel to be analyzed for pH, N concentration and DM. At the beginning of each 30 minute measurement a surface temperature and soil temperature taken 2 inches below the surface were recorded. N loss averaged 42.5 g/d/steer across the spring and summer collection periods. In the spring period, N loss averaged 28.6 g/d/steer with pen surface samples averaging 3.85% N, 74.7% DM and 19.5° C. In the summer sampling period, N loss averaged 56.5 g/d/steer with pen surface averaging 4.8% N, 78.6% DM and 25.0° C. Combining all sampling periods, N loss was significantly correlated with N concentration on the pen surface ($r = 0.25$, $P<0.01$), and soil temperature ($r = 0.20$, $P<0.02$). No correlation was observed between N loss and pH. Ammonia losses were variable but may be related to N in manure and temperature as observed with N mass balance techniques.

Key Words: Ammonia, Cattle Feedlot, Emissions

423 Assessment of strategies to reduce ammonia, methane, and nitrous oxide emissions from gestating and lactating sows. C. Piñeiro*[1], G. Montalvo[2], and M. Bigeriego[3], [1]*PigCHAMP Pro Europa, S.A.*, *Segovia, Spain*, [2]*Tragsega, S.A.*, *Madrid, Spain*, [3]*Spanish Ministry of Agriculture, Fisheries and Food*, *Spain*.

During the last decade, the approach to environmental issues related to animal production is changing, including concepts such as emissions to soil, water and air and proper use of energy and water. Latest regulations have been developed under this concept such as the Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control in intensive pig and poultry production. The objective of the directive is to achieve a high level of protection of the environment as a whole. In the EU Reference Document on Best Available Techniques (BAT) for Intensive Rearing of Poultry and Pigs (BREF) several techniques are proposed for emissions abatement. The Spanish Ministry of Agriculture, Fisheries and Food has implemented a three years plan to evaluate the BAT proposed by the European Commission under Spanish conditions. In these studies, two BAT candidates for gestating sows (weekly slurry removal and manure channel reduction) and one for lactating sows (board on a sloped in the pit) were compared with the BREF reference system (monthly slurry removal and underlying deep collection). The concentration of NH_3, CH_4, and N_2O in the air, and the ventilation rates were semi-continuously measured with an Innova 1312 infrared photo-acoustic system (SIR, S.A., Tres Cantos, Madrid, Spain). In gestating buildings, frequent slurry removal reduced ($P<0.001$) the average CH_4 and N_2O emissions by 19% and 83%, respectively. However, the average NH_3 emissions increased by 15% ($P<0.001$) due to the picks of ammonia concentration in the emptied. Manure channel reduction abated ($P<0.001$) the average NH_3, CH_4, and N_2O emissions by 49%, 28%, and 68%, respectively. In lactating sows, the implementation of a slope in the pit reduced ($P<0.001$) the average NH_3, CH_4, and N_2O emissions by 32%, 65%, and 43%, respectively. In conclusion, BAT proposed in the BREF for gestating and lactating sows were shown to be effective under Spanish practical conditions.

Acknowledgements: Spanish Ministry of Agriculture, Fisheries and Food

Key Words: Gas Emissions, Sows, Best Available Techniques

424 Improving estimates of enteric methane emissions from cattle in Canada. K. Ominski*, D. Boadi, and K. Wittenberg, *University of Manitoba*, *Winnipeg, Manitoba, Canada*.

Currently, Canadian inventories of methane (CH_4) emissions from enteric fermentation in livestock are estimated using the International Panel on Climatic Change (IPCC) Tier-1 methodology (T1M) which calculates CH_4 emissions for each animal category by multiplying the animal population by the average emissions factor for a given category (IPCC 1997). This methodology is limited as factors such weight, age, gender, and feeding system are assumed similar within each category. Further, it does not include regional differences in animal genetics or feeding/management strategies. According to IPCC (2000), countries that employ IPCC Tier-2 methodology (T2M), which accounts for the above parameters, can improve emission estimates. The objective of this study was to estimate CH_4 emissions of cattle in Canada using IPCC T2M. Estimates were then compared with IPCC T1M and data from Canadian research studies (CRS). Cattle population data was obtained from Statistics Canada to characterize cattle into eight categories for each province. Information regarding cattle performance and feeding practices were obtained from scientific literature and survey data. Calculated CH_4 emissions for 2001 were 173,030.4 t yr^{-1}(3.6 Mt CO_2 eq) and 763.852.0 t yr^{-1} (16.0 Mt CO_2 eq) for Canadian dairy and beef cattle, respectively. Tier-1 emission factors (kg CH_4 yr^{-1}) were 6.4 to 25.3% lower than those obtained using T2M. Further, the Tier-2 emission factors were 7.6 to 30.7% lower than values published by CRS. This study suggests that use of T2M reduces some of the uncertainties associated with T1M, however, a discrepancy exists between these values and those reported by CRS. There is a need to further measure methane emissions in production scenarios characteristic of those used in Canada. In addition, further characterization of the Canadian cattle population, and the associated feeding/management strategies are required, on a regular basis, to account for changes in management practices that occur as a consequence of economic viability.

Key Words: Enteric Emissions, Tier-1 Methodology, Tier-2 Methodology

425 Effects of ractopamine on growth performance and carcass characteristics of feedlot steers differing in biological type. S. L. Gruber*[1], J. D. Tatum[1], T. E. Engle[1], M. A. Mitchell[1], S. B. Laudert[2], A. L. Schroeder[2], and W. J. Platter[2], [1]*Colorado State University*, *Ft. Collins*, [2]*Elanco Animal Health*, *Greenfield, IN*.

Effects of ractopamine hydrochloride (RAC) supplementation on growth performance and carcass characteristics of feedlot steers differing in biological

type (TYPE) were investigated using British, Continental crossbred, and Brahman crossbred calf-fed steers (n = 420). Steers were weighed at re-implantation and sorted into seven weight blocks, each block consisting of two pens (ten steers per pen) per TYPE. Pens within a block × TYPE subclass were randomly assigned to one of two RAC treatments (0 mg·hd^{-1}·d^{-1} vs. 200 mg·hd^{-1}·d^{-1}) fed during the final 28 days of the finishing period. The TYPE × RAC interaction did not affect ($P > 0.05$) any of the growth performance and carcass traits evaluated in this study. Feeding RAC improved ($P < 0.001$) ADG (1.50 vs. 1.73 ± 0.03 kg) and G:F (0.142 vs. 0.167 ± 0.003), but did not impact ($P > 0.05$) DMI of steers. Dressing percentage, adjusted fat thickness, KPH fat percentage, and yield grade were not affected by RAC supplementation. Carcasses of steers fed RAC had heavier ($P < 0.05$) hot carcass weights (359 vs. 365 ± 1.4 kg), larger ($P < 0.05$) LM areas (81.9 vs. 83.9 ± 0.71 cm^2), and tended ($P = 0.07$) to have lower mean marbling scores (Slight^{87} vs. Slight^{77} ± 3.5) than carcasses of control steers. Brahman crossbred cattle had the lowest DMI and produced carcasses that were the lightest and had the lowest mean marbling score ($P < 0.05$). British cattle produced carcasses with the highest ($P < 0.05$) mean marbling score. Continental crossbred steers had the heaviest live weights, highest dressing percentages, and produced the heaviest carcasses with the largest LM areas ($P < 0.05$). Results from this study suggest that, despite inherent differences in growth performance and carcass characteristics of steers differing in biological type, diverse biological types would be expected to respond similarly to supplementation of ractopamine hydrochloride at 200 mg·hd^{-1}·d^{-1}.

Key Words: Beef, Ractopamine, Breed

426 Effects of ractopamine hydrochloride (Optaflexx) on feedlot heifers. M. Quinn*, J. Drouillard, E. Loe, B. Depenbusch, A. Webb, and M. Corrigan, *Kansas State University*, *Manhattan*.

An experiment was conducted to determine the effects of ractopamine HCl (Optaflexx) on live performance, carcass quality, and meat characteristics when fed to heifers (n = 302, 479±3 kg initial BW) during the final 28 days of feedlot finishing. Heifers were fed diets (dry basis) consisting of steam flaked corn (79.6%), ground alfalfa hay (6%), corn steep liquor (6.2%), dry supplement (6%), and a premix (2.2%) that provided 300 mg monensin, 90 mg tylosin, and 0.5 mg melengesterol acetate per heifer daily. Cattle were blocked by weight and assigned to dirt surfaced pens (12 to 13 heifers/pen, 12 pens/treatment). Treatments consisted of 0 or 200 mg per heifer daily of ractopamine HCl. After finishing, heifers were shipped to a commercial abattoir and carcass data were collected following a 24-h chill. Loins were obtained from three animals randomly selected from each pen for determination of Warner-Bratzler shear force values, fatty acid profile, weight loss during cooking, purge loss during retail display, and L*, a*, and b* color measurements. Average daily gain and DMI for the Optaflexx and control cattle were not different (P>0.17), but heifers fed Optaflexx tended (P=0.06) to be more efficient (G:F = 0.183 and 0.167 for Optaflexx and Control groups, respectively). Live weight gain for the Optaflexx heifers was 56.8 kg compared to 54.1 kg during the 28-d period (P=0.09). Treatments did not differ with respect to slaughter weight, hot carcass weight, dressing percent, longissimus muscle area, fat thickness, marbling score, USDA yield grade, or USDA quality grade (P>0.19). Warner-Bratzler shear force values, weight loss during cooking, purge loss during retail display, and fatty acid profiles were similar for the two treatments (P>0.2). Feeding Optaflexx to finishing heifers resulted in modest improvements in live weight gain and gain efficiency, but did not affect carcass characteristics or meat quality.

Key Words: Ractopamine, Heifers, Finishing

Ruminant Nutrition: Dairy—Fiber and Digestion

427 Validation of propionate challenge test methodology. B. J. Bradford*, A. D. O'Toole, A. S. Nash, and M. S. Allen, *Michigan State University*, *East Lansing*.

Two experiments were designed to validate methods used to investigate physiological responses to propionate during propionate challenge tests (PCT). In experiment 1, the dose-reponse to jugular propionate infusion was assessed in a duplicated 4 x 4 Latin square experiment with 8 lactating dairy cows. Sodium propionate (4.5 M, pH 7.4) was infused in an intrajugular bolus at 0 (saline), 50, 100, or 150 mg/kg bodyweight, and jugular blood was sampled over the following 2 hours. Data for both experiments were analyzed by mixed effects models using autoregressive covariance structures for repeated measures. Peak propionate concentration increased quadratically at an increasing rate as propionate dose increased, while area under the curve (AUC) for plasma glucose increased linearly with increasing propionate dose. Plasma NEFA concentration was elevated by all propionate treatments at 20 and 30 min post-infusion (P < 0.05), which may have been caused by a stress response; infusion of 150 mg/kg propionate tended to increase plasma norepinephrine concentration by 53% (P = 0.09) relative to pre-infusion values. Experiment 2 was designed to study the impact of short-term fasting on responses to propionate infusion. Eight lactating dairy cows were included in a duplicated 4 x 4 Latin square design with a 2 x 2 factorial arrangement of treatments. Sodium propionate (100 mg/kg bodyweight) or saline was infused either prior to feeding (900) or 2 h after feeding (1300). Fed cows consumed 4.4 ± 1.4 kg DM prior to the PCT. While fed cows had significantly higher plasma propionate concentration, fed state did not influence post-infusion changes in plasma propionate, glucose, insulin, glucagon, or NEFA concentrations. Liver glycogen concentration decreased significantly after propionate, but not saline, infusion (P < 0.001). Short-term differences in fed state do not significantly alter physiological responses to PCT. However, insulin and glucagon release following jugular administration of propionate are likely super-physiological, and post-infusion lipolysis suggests that stress responses may alter PCT measurements.

Key Words: Propionate Challenge, Dairy Cow, Stress

428 Effects of dietary forage and non-fiber carbohydrate content on B-vitamin intake, duodenal flow, and apparent synthesis in dairy cows. E. Schwab*[1], R. Shaver[1], C. Girard[3], C. Schwab[2], D. Putnam[4], and N. Whitehouse[2], [1]*University of Wisconsin*, *Madison*, [2]*University New Hampshire*, *Durham*, [3]*Dairy and Swine R&D Center*, *AAC, QC, Canada*, [4]*Balchem Encapsulates*, *New Hampton, NY*.

Eight Holstein cows fitted with ruminal and duodenal cannulae were used in a replicated 4×4 Latin square design with a 2×2 factorial treatment arrangement to evaluate effects of dietary forage (F) and NFC concentrations on intake, duodenal flow, and apparent synthesis (AS) of B-vitamins in lactating cows. Each square contained two multiparous and two primiparous cows and periods were 21 d in length. Diets with 35 or 60% (DM basis) F (corn silage, alfalfa hay, and grass hay) were formulated to contain 30 or 40% NFC (DM basis). Dietary concentrates were composed of varying proportions of ground shelled corn, rolled barley, soybean hulls, beet pulp, soybean meal, blood meal, Smartamine-M®, minerals, and vitamins. B-vitamin AS was estimated as the difference between duodenal vitamin flow and vitamin intake. This estimate does not account for potential microbial use or destruction, or ruminal absorption of the vitamins. Increased dietary F increased riboflavin intake and decreased DMI, niacin intake and flow, and biotin intake. Increased dietary NFC increased DMI, niacin AS, and biotin flow and decreased niacin intake. For biotin AS, negative least square means and a SEM of about 75% of means averaged across diets indicate that ruminal microbial synthesis of biotin is minimal and highly variable.

Item	Dietary F,NFC				SEM	Effect		
	35,30	35,40	60,30	60,40		F	NFC	F´NFC
DMI, kg/d	21	22	18	20	1	†	†	NS
Riboflavin, mg/d								
Intake	98	95	111	116	7	†	NS	NS
Flow	344	351	320	358	24	NS	NS	NS
AS	245	256	209	242	19	NS	NS	NS
Niacin, mg/d								
Intake	2027	1330	1190	581	83	†	†	NS
Flow	2447	2910	1981	1946	209	†	NS	NS
AS	398	1580	812	1365	186	NS	†	NS
Biotin, mg/d								
Intake	134	140	121	132	9	†	NS	NS
Flow	121	133	109	131	8	NS	†	NS
AS	-14	-7	-11	-0.4	6	NS	NS	NS

† = (P£0.05), NS = not signficant

Key Words: B-Vitamin, Duodenal, Cow

429 Impact of alfalfa hay neutral detergent fiber concentration and digestibility on Holstein dairy cow performance: I. Hay analyses and lactation performance – USDFRC. D. R. Mertens*[1], H. G. Jung[2,3], M. L. Raeth-Knight[3], and J. G. Linn[3], [1]*US Dairy Forage Research Center*, *Madison, WI*, [2]*USDA Agricultural Research Service*, *St. Paul, MN*, [3]*University of Minnesota*, *St. Paul*.

Our objective was to evaluate the impact of amylase-treated NDF (aNDF) and 48-h in vitro NDF disappearance (NDFD) of alfalfa hay on milk production when fed as 15% or 30% of ration DM at the Univ. of Minnesota (UMN) and US Dairy Forage Research Center (DFRC), respectively. Samples of 22 commercial hays were evaluated to identify four alfalfa hays that differed in aNDF and NDFD based on chemical, in vitro and NIRS analyses. After delivery, core samples were taken at each location and analyzed for aNDF and NDFD at the DRFC. Composite hay samples were made for each location during lactation trials. Sixty-eight cows were assigned to one of four TMR, each containing one of the hays. Ration DM consisted of 30% alfalfa hay, 16.1% corn silage, 25.3% ground corn, 2.7% molasses, 5% roasted soybeans, and 20.9% concentrate mixture, which contained soybean meal, soybean hulls, distiller's grains, minerals and vitamins. Cows averaged 46.5 kg milk/d and 86 days in lactation at the beginning of the trial. Cows were fed a covariate diet for two weeks, followed by experimental diets for 12 weeks. Production trial means were analyzed with covariance using Proc GLM in SAS. Initial samples indicated the aNDF of hays low in fiber and high in digestibility (LFHD), low in fiber and digestibility (LFLD), high in fiber and digestibility (HFHD) and high in fiber and low in digestibility (HFLD) were 37.2, 36.4, 41.7 and 40.8%, respectively. The NDFD of initial samples were 41.3, 37.9, 44.6 and 41.1% of NDF for LFHD, LFLD, HFHD and HFLD, respectively. The 4 to 5 %-unit difference between high and low aNDF and NDFD was similar between locations and among bale core and experimental composite samples. However, variation was observed between laboratories and methods in aNDF and NDFD determinations. Least-squared means for milk production were 43.8, 45.0, 46.9 and 45.4 for LFHD, LFLD, HFHD and HFLD, respectively (P = 0.07). We concluded that small differences in aNDF and NDFD among the alfalfa hays have limited impact on milk production when included as 30% of the diet DM.

Key Words: NDF, Digestibility, Alfalfa Hay

430 Impact of alfalfa hay neutral detergent fiber concentration and digestibility on Holstein dairy cow performance: II. Lactation performance ~ St. Paul. M. L. Raeth-Knight*[1], J. G. Linn[1], H. G. Jung[1,2], D. R. Mertens[3], and P. R. Peterson[1], [1]*University of Minnesota*, *St. Paul*, [2]*USDA Agricultural Research Service*, [3]*US Dairy Research Center*, *Madison, WI*.

Sixty multiparous lactating Holstein cows were fed one of four diets, containing alfalfa hays selected for low (L) and high (H) neutral detergent fiber concentration (NDF) and low (l) or high (h) 48-h in vitro NDF digestibility (IVNDFD) within NDF levels. Diets, fed as a TMR, contained 14.8% alfalfa hay, 35.0% corn silage, 26.5% grain mix, 15.5% corn, 5.2% roasted soybeans and 3.0% molasses (DM basis). Cows were blocked by calving date and randomly assigned to diets following calving. Data was collected during the first 133 days in milk and analyzed as weekly averages using PROC MIXED. Alfalfa hay NDF and IVNDFD did not significantly impact dry matter intake, milk production or energy corrected milk (ECM) production. Milk true protein percentage was significantly lower for the Lh treatment (2.7 %) as compared to the Hl treatment (3.0 %); however, fat, protein and lactose yields were not affected by hay NDF or IVNDFD. Feed efficiency (FE) was similar across treatments, averaging 1.7 kg of 4% fat-corrected milk (FCM) per kg of DM intake. Fiber concentration and in vitro digestibility of alfalfa hay did not have a significant impact on the lactation performance of Holstein cows when included at 15% of the diet dry matter.

Treatment	**Lh**	**Ll**	**Hh**	**Hl**		
NDF, % DM	37.2	36.4	41.7	40.8		
IVNDFD, % of NDF	41.3	37.9	44.6	41.1		
Item					**P-Value**	**SE**
DMI, kg/d	22.8	21.7	22.1	22.8	.77	.80
ECM, kg/d	34.2	35.4	36.3	36.3	.48	1.2
Fat, kg/d	1.3	1.4	1.5	1.4	.44	.06
Protein, kg/d	1.1	1.1	1.1	1.2	.18	.03
Lactose, kg/d	1.9	1.8	1.9	1.9	.89	.06
FE	1.6	1.8	1.7	1.7	.52	.09

Key Words: NDF, NDF Digestibility, Alfalfa Hay

431 Impact of alfalfa hay neutral detergent fiber concentration and digestibility on Holstein dairy cow performance: III. Diet digestibility ~ St. Paul. M. L. Raeth-Knight*[1], J. G. Linn[1], H. G. Jung[1,2], D. R. Mertens[3], and P. R. Peterson[1], [1]*University of Minnesota*, *St. Paul*, [2]*USDA Agricultural Research Service*, [3]*US Dairy Forage Research Center*, *Madison, WI*.

Multiparous Holstein cows were fed 1 of 4 treatment diets, containing alfalfa hay varying in neutral detergent fiber concentration (NDF) and 48-h in vitro NDF digestibility (IVNDFD). In study 1, 60 early lactation cows were randomly assigned to treatments; containing approximately 15% alfalfa hay (DM basis). Diet composition was detailed in Part II (lactation performance). In study 2, 20 late lactation cows were randomly assigned to treatments; containing 95.8% alfalfa hay and 4.2% molasses (DM basis). Apparent total tract DM and fiber digestibility were measured using the acid insoluble ash technique. In study 1, alfalfa hay NDF and IVNDFD did not result in any difference in apparent total tract DM digestibility (DMD) or NDF digestibility (NDFD). However, within low NDF hays, there was a trend for lower IVNDFD to increase DMD; and within the high NDFD hays, high NDF hay increased DMD. In study 2, cows fed hay with higher IVNDFD had increased DMD within low NDF hays and decreased DMD within high NDF hays. Alfalfa hay IVNDFD did not impact apparent total tract NDFD in high NDF hays. However, in low NDF hays, higher hay IVNDFD increased apparent total tract NDFD. Alfalfa hay NDF and IVNDFD did not affect diet in vivo DMD or NDFD when included at 15% of the diet DM. Alfalfa hays included at 96% of the diet dry matter resulted in an interaction between hay NDF and IVNDFD for in vivo digestibility.

Treatment[1]	Lh	Ll	Hh	Hl		
NDF, % DM	37.2	36.4	41.7	40.8		
IVNDFD, % of NDF	41.3	37.9	44.6	41.1		
Study 1					**P-Value**	**SE**
DMI, kg/d	20.6	19.2	20.3	20.6	.90	1.5
DMD, %	65.5	72.1	68.6	65.9	.10	2.1
NDFD, %	49.3	56.3	52.0	51.9	.23	2.5
Study 2						
DMI, kg/d	17.4[ab]	22.2[a]	19.6[a]	13.1[b]	.03	2.0
DMD, %	80.8[a]	66.1[b]	65.8[b]	76.9[a]	<.01	2.4
NDFD, %	74.2[a]	55.8[b]	65.0[c]	71.1[ac]	<.01	2.7

[1]low NDF, high IVNDFD (LH); low NDF, low IVNDFD (LL); high NDF, high IVNDFD (HH); high NDF, low IVNDFD (HL)

Key Words: NDF, NDF Digestibility, Alfalfa Hay

432 Effects of the number of cycles at suboptimal pH on rumen bacterial fermentation in a dual flow continuous culture system. M. Cerrato*, S. Calsamiglia, and A. Ferret, *Universitat Autonoma de Barcelona*, *Bellaterra, Spain*.

Suboptimal pH (5.5) has deleterious effects on ruminal fermentation. However, ruminal bacteria may resist short periods of time at low pH. Eight 1325-ml dual flow continuous culture fermenters were used in two consecutive periods to examine if the effects of prolonged periods (12 h) at pH 5.5 can be reduced by splitting it in 2 periods of 6 h or 3 periods of 4 h at pH 5.5. Temperature (39°C) and solid (5%/h) and liquid (10%/h) dilution rates were mantained constant. Fermenters were fed 96 g/d of a 60 to 40 forage to concentrate diet (18.9% CP, 31.0% NDF). Treatments were a constant pH 6.4 (CTR); 1 period of 12 h at pH 5.5 (P1x12); 2 periods of 6 h at pH 5.5 (P2x6); 3 periods of 4 h at pH 5.5 (P3x4). Data were analyzed using PROC GLM of SAS (1996) and differences declared at P<0.05 using the Dunnett's test. Differences were declared at P < 0.05. Compared to CTR, treatment P1x12 reduced neutral detergent fiber (21.5% vs 32.7 %) and acid detergent fiber digestion (25.7% vs 38.6 %), and increased branch-chained volatile fatty acids proportion (3.8 vs 1.9 mol/100 mol) and the acetate to propionate ratio (2.3 vs 4.6). There were no differences in these estimates between P1x12 vs P2x6 and P3x4. Treatment P2x6 reduced true dry matter (48.3% vs 57.9%) and true organic matter (44.1% vs 50.4%) digestion compared with P1x12. There was no difference in these estimates between P1x12 vs P2x6 and P3x4. There was no treatment effects on ammonia nitrogen concentration, crude protein degradation, microbial protein synthesis (gN/kg OM truly digested) and the flow of dietary, bacterial and nonammonia nitrogen. Results suggest that the negative effects of prolonged periods (12 h) at pH 5.5 on ruminal fermentation are dependent on the total amount of time (h) that ruminal pH is suboptimal, but were not reduced by splitting it into various cycles.

Acknowledgements: Funded by CICYT (Spanish Government), project AGL2002-01642

Key Words: pH, Acidosis, Rumen Fermentation

433 Acidosis in dairy cows. E. Bramley[1], I. J. Lean*[2], N. D. Costa[3], and W. J. Fulkerson[1], [1]*University of Sydney*, *Camden, NSW, Australia*, [2]*Bovine Research Australasia*, *Camden, NSW, Australia*, [3]*Murdoch University*, *Murdoch, WA, Australia*.

A cross-sectional survey examined acidosis and rumen function in one hundred dairy herds selected from five areas of Australia. Rumen fluid was obtained by both rumenocentesis (RC) and stomach tube (ST) from eight fresh cows < 100 DIM; three primipars and five multipars; randomly selected from within each herd. Samples (RC) were tested for pH and ST rumen fluid samples were analysed for VFA, ammonia and D-lactate concentrations. Cows were allocated into three distinct groups containing 10.2%, 29.9% and 59.9% of cows (n = 797) using cluster analysis.

Table 1 shows F-values and significance of measures used in group definition and means for groups. Group 1 cows had higher valerate, propionate, D-lactate and lower pH and ammonia concentrations than groups 2 and 3. Group 1 cows were considered to be acidotic. Cows in category 2 had high ammonia concentrations and group 3 had lower VFA concentrations than other groups. Major determinants of differences between groups were valerate, propionate, whereas pH and D-lactate concentrations, while significant were not major determinants of groups.

Table 1

Measure (mM/L)-Mean±SD	Group1	Group2	Group3	F-ratio (P value)
Valerate	2.6(1.2)	1.3(0.4)	0.8(0.4)	332.6*
Propionate	34.2(10.2)	19.5(6.2)	14.4(4.9)	332.4*
Butyrate	9.1(3.5)	12.4(2.9)	6.9(2.3)	291.9*
Isobutyrate	0.7(0.2)	0.9(0.2)	0.5(0.2)	243.5*
Isovalerate	1.1(0.4)	1.4(0.5)	0.9(0.3)	130.6*
Acetate	52.5(12.4)	59.2(12)	39.2(10.7)	226.2*
Ammonia	2.5(2.0)	7.8(3.8)	3.6(2.0)	203.9*
Caproate	0.6(0.6)	0.3(0.2)	0.1(0.2)	116.6*
pH	5.7(0.5)	6.2(0.4)	6.3(0.4)	55.0†
D-lactate	0.3(0.9)	0.3(0.9)	0.1(0.5)	5.0 †

*P<0.0001; †P<0.05.

Key Words: Dairy Cows, Acidosis

434 Effects of graded levels of wheat-barley concentrate on subacute ruminal acidosis (SARA), lipopolysaccharide endotoxins (LPS) and acute phase proteins in steers. G. N. Gozho*, J. C. Plaizier, and D. O. Krause, *University of Manitoba*, *Winnipeg, MB, Canada*.

The objective was to determine if inducing SARA increases the concentrations of LPS in rumen fluid and of the acute phase proteins serum amyloid-A and haptoglobin in peripheral blood. This was achieved by feeding diets with increasing levels of concentrate to three rumen fistulated Jersey steers during a 5-wk experimental period using a time series design. Changes over time were tested for significance using the SAS mixed models procedure. Forage and concentrate consisted of chopped alfalfa hay and 50:50 wheat barley pellets, respectively. Forage to concentrate ratios in the diet were 100:0, 80:20, 60:40, 40:60 and 20:80, during wk 1 to wk 5, respectively. Animals were fed ad libitum during week 1 and feed intakes were measured to determine the level of feed intake for weeks 2 to 5. Rumen fluid and peripheral blood were collected every 3 hours for two days during each week. Rumen pH was monitored continuously using indwelling pH probes. Average dry matter intakes were 5.76, 5.72, 5.91, 5.98 and 5.38 kg DM/d for wk 1 to 5, respectively. Average daily pH decreased (P < 0.01) from 6.7 to 6.1 between wk 1 and wk 5. Time below pH 6 increased (P < 0.01) from 0 to 785 min/d between wk 1 and wk 5. Time below pH 5.6 increased numerically from 0 to 219 min/d between wk 1 and wk 5. This indicates that SARA was induced during wk 5. LPS in rumen fluid increased (P < 0.0001) from 6542 EU/mL during wk 1 to 32,275 EU/mL during wk 5. There was a diurnal variation in LPS. The highest concentration of LPS was detected 6 h after the initial morning meal. Serum amyloid-A increased (P < 0.0001) from 36.5 μg/mL during wk 1 to 131.3 μg/mL during wk 5. Haptoglobin concentration increased (P < 0.0002) from 0.54 mg/mL during wk 1 to 2.39 mg/mL during wk 4. Results show that inducing SARA was accompanied by increases in LPS endotoxin in rumen fluid and acute phase proteins in peripheral blood, suggesting that inducing SARA through grain feeding activates an inflammatory response.

Key Words: Subacute Ruminal Acidosis, LPS Endotoxin, Acute Phase Response

435 Method to measure feed particles by image analysis. G. Licitra[1,2], M. Caccamo*[1], I. Schadt[1], J. D. Ferguson[3], G. Gennuso[1], and G. Azzaro[1], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A., Catania University*, *Catania, Italy*, [3]*University of Pennsylvania*, *Philadelphia*.

A method to measure the surface area of single feed particles by "image analysis" was developed in order to determine a precise particle size distribution in TMR samples. Briefly, the sample was first processed through a 1.6 mm sieve. The particles retained on the sieve were treated with acetone, tert-butanol and NDF reagent in order to reduce particle adhesion. The sample was collected on a white cloth with 0.39*0.77mm pores through which reagents are passed and particles retained. The wet sample particles were distributed and separated into four quarters over a maximum total surface of about 58*41cm. This area was sufficient for samples of 10g. A digital camera was placed at a height of 51cm, a ruler was added to the quarters, and pictures of each quarter were taken. Particle sizes and distribution were calculated by image analysis using the Matlab® image processing module. In the image, 1 cm of the ruler was highlighted, and the number of pixels corresponding to 1 mm was calculated. The image was sub-divided into unities of different dimension in order to improve distinction of particles from the background. The distribution of pixel intensity, the mean and standard deviation was calculated for each unity and threshold was determined to binarize the image selection. The binarized image was processed to identify each particle, and corresponding to pixel number, particle surface area was calculated. Matlab® elaboration was tested on TMR samples of four different farms. Inside one randomly chosen quarter 15 particles were considered. The maximum distance of two points of the particles was measured by hand using a caliper, as well as calculated by Matlab®. Particles' dimension varied from 0.2 up to 18.6 cm. The mean difference between the two methods was 0.08 mm (std ± 0.07). The Matlab® method was not statistically different from the manual measurement (P = 0.98). Three replicates each of 10g, 20g, 40g and 80g of sample were processed to examine the influence of sample size on estimate of particle distribution. Image analysis can be used to evaluate more precisely the effect of feed particle size on cow performance and production.

Key Words: Feed Particle Size, Image Analysis

436 Effect of replacing forage fiber with non-forage fiber in lactating dairy cow diets. J. Cyriac*, M. M. Abdelqader, K. F. Kalscheur, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University*, *Brookings*.

Eight primiparous and eight multiparous lactating Holstein cows were used in a replicated 4 × 4 Latin square design to evaluate the effect of replacing forage fiber with non-forage fiber source on the performance of dairy cows. Four diets were formulated to replace corn silage with dried corn distillers grains with solubles (CDG) at 0, 7, 14, and 21% (DM basis). The control diet contained 40% corn silage, 15 % alfalfa hay, and 45 % concentrate (DM basis). Soybean meal was replaced with soybean hulls as the percentage of CDG increased in the diets. Alfalfa hay (15% DM) was equal for all diets. All dietary treatments were formulated to contain 16.8% CP, 30.7% NDF, and 4.8% fat. Results showed that dry matter intake increased linearly (P < 0.001) from 19.2 to 22.8 kg/d as CDG increased in the diet. Replacing forage with CDG did not affect (P > 0.10) milk yield (33.6 kg/d). However, milk protein percentage increased (P < 0.001) from 2.82 to 3.04% when the percentage of CDG increased in the diet. Consequently, milk protein yield increased (P < 0.007) from 0.93 to 1.03 kg/d as CDG increased in the diet. In contrast, there was a linear reduction (P < 0.001) in milk fat percentage (3.34, 3.25, 3.04, and 2.85) and milk fat yield (1.09, 1.09, 1.03, and 0.97 kg/d; P < 0.004) as the percentage of CDG increased in the diet. A linear increase (4.90, 4.90, 4.92, and 4.96%; P < 0.01) in milk lactose percentage was observed as CDG percentage increased in the diet. Energy-corrected milk and milk urea nitrogen were not altered due to diet. Feed efficiency (energy-corrected milk/DMI) decreased as CDG increased in the diet (1.67, 1.57, 1.49 and 1.37; P < 0.001). Increasing CDG in the diet resulted in a linear decrease (P< 0.001) in molar proportion of acetate (65.0, 63.6, 61.5, and 59.6) and a linear increase (P < 0.001) in propionate (21.9, 23.3, 25.0, and 27.3) in rumen fluid. Ruminal butyrate was not affected by diet. Milk production was not affected by the replacement of corn silage with CDG; however, milk fat percentage and yield were depressed indicating lack of effective fiber in the diet as CDG was increased.

Key Words: Corn Distillers Grains, Milk Fat Sepression, Replacement of Forage

437 Pretrial intake affects relative intake, digestion, and production responses of lactating cows to alfalfa and grass silages. J. A. Voelker Linton* and M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of pretrial DMI on relative responses of DMI, digestion kinetics, and milk yield and composition to alfalfa silage versus grass silage were evaluated using 8 ruminally and duodenally cannulated Holstein cows in a crossover design experiment with a 14 d pretrial period and two 15 d experimental periods. Cows were 178 ± 111 (mean ± SD) DIM at the beginning of the pretrial period. During the 14 d pretrial period, milk yield ranged from 24.5 to 46.0 kg/d (mean = 37.0 kg/d) and pretrial DMI (pDMI) ranged from 11.4 to 21.0 kg/d (mean = 17.5 kg/d). Treatments were two diets with either alfalfa silage (diet AL) or grass silage (diet GR) as the sole forage. Alfalfa silage contained 43% NDF (DM basis) and grass silage contained 48% NDF; diets contained ~23% forage NDF and 27% total NDF, so forage:concentrate was 53:47 for AL and 49:51 for GR. Data were analyzed by a mixed-effects model. Digestibility of NDF was lower for AL in the rumen ($P < 0.0001$) and whole tract ($P < 0.0001$), and milk fat concentration was greater for GR than for AL ($P = 0.03$). Mean 3.5% fat-corrected milk yield (FCMY) and DMI were not different between AL and GR ($P > 0.15$), but individual FCMY and DMI responses to AL over GR ($Y_{AL} - Y_{GR}$) were positively related to individual pDMI values (FCMY: r = 0.84, $P = 0.02$; DMI: r = 0.87, $P < 0.01$). A more positive DMI response to AL over GR among high-pDMI cows was permitted by a more positive response in ruminal NDF turnover rate for AL over GR as pDMI increased (r = 0.72, $P < 0.05$). This response in NDF turnover rate was because of a differential response in rate of passage rather than digestion; indigestible NDF passage rate response ($Y_{AL} - Y_{GR}$) tended to increase with increasing pDMI (r = 0.69, $P = 0.06$), but NDF digestion rate response ($Y_{AL} - Y_{GR}$) did not change as pDMI increased ($P = 0.47$). Therefore, the effects of alfalfa and grass forages on intake, fiber digestion, and milk production are dependent on the extent to which fill limits intake in an individual animal.

Key Words: Grass vs. Legume, Digestion Kinetics, Feed Intake

438 Effects of dietary NDF concentration on milk yield, bacterial protein syntheses and endocrine-metabolic status in dairy sheep in late lactation. A. Cannas*, G. Bomboi, F. Boe, and B. Floris, *University of Sassari*, *Sassari, Italy*.

The effect of dietary NDF and non-fiber carbohydrates (NFC) on production and hormonal status was studied in ten high producing (mean milk yield 1995±353 g/d) Sarda ewes in the 5th month of lactation. The ewes were kept in individual metabolic cages and divided in two groups. One was fed a high NDF-low NFC diet (H-NDF diet = 46.2% NDF, 31.7% NFC, DM basis), the other received a low NDF-high NFC diet (L-NDF diet = 32.2% NDF, 45.9 NFC; DM basis). Both diets were fed ad libitum and included 57% of DM of chopped dehydrated alfalfa. The remaining part was composed mostly by soybean hulls (H-NDF diet) or cereal grains (L-NDF diet). Purine derivatives were used to estimate intestinal microbial protein absorption. At the end of the 30-d experimental period, the blood of the ewes was sampled every 30 minutes for 6 h, starting 30 min after the withdrawal of the diet. Compared to the preliminary period, when the ewes were fed a mix of the two experimental diets, during the experimental period DMI and NEL intake increased in the L-NDF group and decreased in the H-NDF group (variations for H-NDF and L-NDF, respectively: -287 vs. 27 g/d of DMI, P< 0.002; -0.60 vs. 0.19 Mcal of NEL/d, P< 0.002). Despite this, milk yield decreased less in the H-NDF compared to the L-NDF group (-202 vs. -370 g/d, P<0.01), while the BCS tended to increase more in the L-NDF group (0.10 vs. 0.25 units/30 d; NS). The H-NDF group synthetized more bacterial protein than the L-NDF group (150 g/d vs 99 g/d; P< 0.001). The ewes fed the H-NDF diet had higher hematic concentration of GH (1.43 vs. 1.23 ng/ml; P< 0.02), IGF-1 (71.8 vs. 66.4 ng/ml; P<0.01) and NEFA (109.4 vs. 74.0 μEq/ l; P<0.001) and lower concentration of insulin (17.6 vs. 27.0 μU/ ml; P<0.001) and glucose (68.9 vs. 71.2 mg/dl; P<0.013) than those of the L-NDF group. Leptin (2.37 vs. 2.28 ng/ml; P>0.37) and urea (44.2 vs. 45.5 mg/dl; P > 0.23) did not differ between the two groups. In conclusion, the H-NDF diet induced an endocrine and metablic status more suitable for milk production, as confirmed by the productive results, compared to the L-NDF diet.

Key Words: Sheep Milk, Dietary NDF, Hormones

439 An evaluation of the calf and heifer models within the 2001 Dairy NRC publication. M. Van Amburgh*, *Cornell University*, *Ithaca, NY*.

The objective of this abstract is to evaluate the applicability and biology of both the calf and heifer chapters and software found in the Nutrient Requirements of Dairy Cattle, 7th Ed. publication. The chapter on calves has been well received. New body composition data was generated that allow for refinements to the calf model (Bartlett, 2001; Blome et al, 2003; Diaz et al., 2001; Tikofsky et al., 2001). The equation used to estimate the net energy (NE) requirements for calves (Toullec, 1989) was based on heavier calves fed lower protein diets than dairy replacement calves; thus the predicted NE required is higher than the current data sets. Also, the efficiency of use of metabolizable energy to NE was set at 0.69 based on the Toullec data, but re-evaluation using the current data suggests a value 0.60 consistent with less mature calves accreting less fat and greater tissue protein. The committee used the Blaxter-Mitchell equation that uses the biological value (BV) of protein to estimate the absorbed protein required. The committee adopted the value of 0.80 for the BV, however, if a static value is applied, a more reasonable value appears to be 0.72. Also, immunological and growth data indicated modifications should be made to the requirements for vitamins A and E. The heifer model has received more stringent reviews from both academics and industry professionals. New terminology and substantial changes in the biology were implemented which slowed adoption primarily because of inadequate information about how to apply biology. Evaluations of the NE predictions indicate the equations are reasonable when compared to slaughter data (Moallem et al., 2004), however, application to whole animal growth demonstrate that heifers grow more rapidly than predicted which leads to over-conditioning. Using 0.086 Mcal of NEm per kg metabolic BW might be too high despite some references to the contrary and that 0.077 might be applicable to Holsteins. The protein system applied to heifers appears to underestimate requirements and over-estimate supply in heifers lighter than puberty and this might be due to using data derived from lactating dairy cattle.

Key Words: Calf, Heifer, Evaluation

440 Feeding neonatal calves starters with different protein concentrations in conventional and high protein milk replacer feeding regimes. M. Hill*, J. Aldrich, and R. Schlotterbeck, *Akey*, *Lewisburg, OH*.

Our objective was to re-evaluate the effect of CP in a starter offered to calves less than 63 d and fed either a 20% CP, 20% fat milk replacer (MR; trial 1) at 454 g daily or a 26% CP, 17% fat MR at 681 g daily (trial 2). All values in abstract are on an as-fed basis. In each trial, 48 calves less than one week of age were offered the MR at a fixed rate. Water and starter was fed free choice from 0-56 d. In trial 1, calves were weaned at either 28 or 42 d (factor 1) and fed starters containing 15, 18, or 21% CP (factor 2). This was analyzed as a CRD with 2X3 factorial arrangement. Initial BW and serum protein averaged 41 kg and 5.7 mg/dl and did not differ. The effects of increasing starter CP increased gain, gain to feed (efficiency), and hip width change linearly ($P < .05$) from 0-42 d, but quadratically ($P < .05$) from 0-56 d (calves fed starters with 15% CP had the lowest values). Starter protein did not affect starter intake, body condition score change, and health related measurements. Weaning age did not affect gain from 0-56 d, however, calves weaned at 28 d tended ($P < .1$) to grow slower from 28-42 d, but faster from 42-56 d. Calves weaned at 28 d consumed more ($P < .05$) starter from 0-56 d than calves weaned at 42 d. Calves weaned at 42 d were more efficient from 0-42 d. There were no differences in body condition score change, hip width change, and health related measurements between weaning at 28 and 42 d. In trial 2, the MR was fed from 0-42 d. Starters containing 18 or 21% CP were fed in a RBD design. Initial BW and serum protein averaged 40 kg and 5.3 mg/dl and did not differ. There were no differences for gain, starter intake, efficiency, fecal scores, hip width change, and body condition score. Starters containing 18% CP are adequate, consistent with previous trials from our research nursery, other published trials, and the dairy NRC (2001, 1989).

Key Words: Protein, Starter, Calf

441 Effects of continuous versus periodic milk availability on the behavior and performance of dairy calves. F. Wolf[1], M. Hotzel[1], M. von Keyserlingk*[2], and D. Weary[2], [1]*Univ. de Santa Catarina, Brazil*, [2]*Animal Welfare Program, University of British Columbia*, *Vancouver, Canada*.

Previous work has shown that dairy calves fed milk ad libitum engage in feeding activity throughout a 24-h period. However, providing calves with continuous access to milk can present practical problems with milk quality, particularly during warm weather. One way to maintain milk quality would be to limit the time that milk is available, but to date no research has addressed the effects of limiting the time that milk is available. The objectives of this study were to quantify the effects of continuous access (24 h/d) versus access to milk during only part of the day on milk feeding behavior and performance. Thirty-four Holstein calves were randomly assigned to 1 of 3 treatments at 5 ± 3 d of age and monitored for 21 d. In each condition, calves had ad libitum access to milk delivered through a teat, and free access to water from a bowl and to calf starter. Treatments were: 1) access to milk for 24 h/d (24 h); 2) access to milk for 2 feedings/d each of 2 h, with water available through the teat the remainder of the day (4hW) and, 3) access as described in 4hW, but with no water available through the teat (4hD). Milk intake did not differ between the 4hW and 4hD treatments, averaging 9.9 ± 0.3 kg/d, but was higher for calves given 24 h access to milk (11.1 ± 0.4 kg/d; $P = 0.03$). However, there was no difference in ADG between calves fed on the different treatment, with gains averaging 1.1 ± 0.04 kg/d. In total calves in the 24-h treatment spent more time on the teat than those calves on the 4-h treatments (26.4 ± 1.8 vs. 18.8 ± 1.2 min/d, respectively; $P < 0.002$), but during the 4 h/d when milk was available to all calves, calves in the 4-h treatments spent more time on the teat (11.3 ± 1.1 vs. 16.4 ± 0.8 min/d, respectively; $P = 0.001$). These results show that calves fed ad libitum milk for only 4 h/d compensate by changing their milk feeding behavior and achieve similar weight gains to animals fed milk continuously.

Key Words: Milk Feeding, Calves, Feeding Behavior

442 Effects of weaning age and milk feeding frequency on calf growth, health and rumen parameters. S. I. Kehoe* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

Recommended strategies for feeding calves attempt to improve performance while decreasing labor requirements. Two trials were conducted to determine effects of age at weaning and feeding frequency on calf growth, health and rumen development. For each trial, 60 Holstein calves were weaned at 3, 4, 5 or 6 wk of age. During trial 1, milk replacer was fed at 10% BW (12.5% DM; 22% CP, 15% fat) in two feedings until 1 wk prior to weaning when intake was reduced to 5%. During trial 2, calves were fed 10% BW in two feedings until 14 d at which milk replacer was fed at 10% BW once daily until 1 wk prior to weaning when it was reduced to 5% BW. Blood glucose, blood urea nitrogen (BUN), rumen VFA and ammonia, and growth parameters, including BW, heart girth, hip height and wither height were obtained weekly. Trial 1: Growth and structural parameters were not different between treatments by wk up to 8 wk of age ($P>0.05$). BW at 8 wk were 73±3.1 kg. BUN concentrations were lower for treatments 3 and 4 at weaning than treatments 5 and 6. Glucose concentrations were higher for treatments 3 and 4 at weaning than treatments 5 and 6. Major rumen VFA concentrations as well as health parameters were not different between treatments. Weaning does not affect growth and measured rumen parameters indicating equal performance for calves weaned early. Trial 2: Growth and structural parameters were not different between treatments by wk up to 8 wk of age. BW at 8 wk were 76±3.1 kg. BUN concentrations were lower for treatments 3 and 4 at weaning than treatments 5 and 6. Glucose concentrations were higher for treatments 3 and 4 at weaning than treatments 5 and 6. Major rumen VFA and health parameters measured were not different between treatments. Feeding once daily does not have adverse effects on weaning age indicating producers can utilize this option for feeding calves. Similar growth and performance between treatments in both trials through 8 wk of age indicates that producers can save labor costs by weaning early and feeding once daily while maintaining calf performance.

Key Words: Weaning, Once Daily Feeding

443 Effect of Apex botanicals on calves fed pasteurized milk or milk replacer (MR) during the nursery phase and subsequent grower phase until four months of age. M.k Hill*, J. Aldrich, and R. Schlotterbeck, *Akey*, *Lewisburg, OH*.

The objective of this trial was to evaluate 0 or 227 mg Apex (BFI Innovations) added to the liquid diet of 48 individually penned calves during d 0-42. Subsequently, 0 or .026% Apex added to calf grower diet during d 57-112 was fed to the same 48 calves in 8 pens of 6 calves each. From 0-42 d, either 3.8 L (530 g DM, 131 g CP, 152 g fat) of pasteurized whole milk (72º C for 15 seconds) or 681 g (660 g DM, 176 g CP, 118 g fat) of a 26% milk protein, 17% fat MR powder was fed daily in two equal feedings. Starter (18% CP) and fresh water were offered ad lib from 0-56 d. Data were analyzed as a CRD with factors of liquid diet and Apex. Data from the 57-112 d grower phase were analyzed as a CRD for carry-over effects from feeding Apex in the liquid diet during d 0-42 (factor 1) and for the effect of feeding Apex during the grower phase of d 57-112 (factor 2). In the nursery phase, calves fed MR grew 25% faster (529 vs. 421 g/d), had a greater gain to feed efficiency, greater change in body condition score, and greater change in hip width from 0-42 d than calves fed milk ($P < .05$). In the nursery phase, calves fed Apex gained 13% faster (505 vs. 445 g/d; $P < .05$) during d 0-42, tended to gain 16% faster ($P < .1$) during d 43-56 after the calves were weaned from the liquid diet, and gained 15% faster (628 vs. 546 g/d; $P < .05$) from 0-56 d. Calves fed milk with Apex grew 21% faster from 0-42 d than calves fed milk without Apex. Calves fed MR with Apex grew 7% faster from 0-42 d than calves fed milk without Apex. During the 57-112 d grower phase, there was a carry-over effect from the nursery phase for Apex to increase (1.09 vs. 1.02 kg/d; $P < .05$) gain by 6% and a trend ($P < .1$) to decrease gain to feed efficiency by 5%. Calves fed Apex during the grower phase gained 7% faster (1.10 vs. 1.02 kg/d; $P < .05$). Apex improved calf gain during both the nursery/liquid and weaned/grower phases from 0-112 d.

Key Words: Botanicals, Milk, Calf

444 Influence of starter protein content on growth of dairy calves in an enhanced early nutrition program. J. A. Stamey*, N. A. Janovick Guretzky, and J. K. Drackley, *University of Illinois*, *Urbana*.

Our objectives were to determine the effect of starter crude protein (CP) content on growth of Holstein calves from birth to 10 wk of age in an enhanced early nutrition program, and to compare the enhanced program to a conventional milk replacer program. A total of 89 calves (64 female, 25 male) were assigned to three treatments in a randomized block design: 1) conventional milk replacer (20% CP, 20% fat) plus conventional starter (19.6% CP, DM basis), 2) enhanced milk replacer (28.5% CP, 15% fat) plus conventional starter, and 3) enhanced milk replacer plus high-CP starter (25.5% CP, DM basis). Calves began treatments (n = 29, 31, and 29 for treatments 1 to 3) at 3 d of age. Conventional milk replacer was reconstituted to 12.5% solids and fed at 10% of birth weight daily in two feedings from wk 1 to 5 and at 5% of birth weight once daily during wk 6. Enhanced milk replacer was reconstituted to 15% solids and fed at 1.5% of BW as DM during wk 1 and 2% of BW as DM during wk 2 to 5, divided into two daily feedings. During wk 6, enhanced milk replacer was fed at 1% of BW as DM once daily. Calves were weaned at d 42. Starter was available ad libitum starting on d 3. Over the 10-wk study, average daily gain of BW (0.65, 0.74, and 0.81 kg/d) was greater for calves fed enhanced milk replacer ($P<0.001$), and tended to be greater ($P=0.07$) for calves fed high CP starter. Rates of change in wither height, body length, and heart girth were greater for calves fed enhanced milk replacer ($P<0.05$) but did not differ between starter CP concentrations. The BW for enhanced treatments was unaffected by starter CP content at weaning (62.8, 73.1, and 73.4 kg; $P=0.88$) and 10 wk (91.3, 96.0, and 99.4 kg; $P=0.27$). Additionally, starter CP content did not affect height, length, or heart girth at weaning or 10 wk (all $P\geq0.25$) within enhanced milk replacer treatments. Starter with 25.5% CP (DM basis) provided only modest benefits in growth for dairy calves in an enhanced early nutrition program compared with a conventional starter (19.6% CP).

Key Words: Calves, Growth, Milk Replacer

445 Influence of starter protein content on growth and body composition of dairy calves in an enhanced early nutrition program. J. A. Stamey*, F. K. McKeith, N. A. Janovick Guretzky, and J. K. Drackley, *University of Illinois*, *Urbana*.

Our objectives were to determine the effect of starter crude protein (CP) content on body composition of male Holstein calves from birth to 10 wk of age in an enhanced early nutrition program and to compare the enhanced program to a conventional milk replacer program. Calves (n = 46) were purchased on the day of birth and assigned to a randomized block design. Eight calves were harvested at baseline and remaining calves were divided among three dietary treatments: 1) conventional milk replacer (20% CP, 20% fat; 10% of birth weight) plus conventional starter (21.5% CP, DM basis); 2) enhanced milk replacer (28.5% CP, 15% fat; 1.5% of BW as DM for wk 1, 2% of BW as DM wk 2-5, 1% of BW as DM wk 6) plus conventional starter; and 3) enhanced milk replacer plus high-CP starter (26% CP, DM basis). Calves began treatments on d 2 or 3 of age. Calves were weaned at d 42. Starter was available ad libitum starting on d 3. Calves from each treatment were harvested at 5 and 10 wk of age and divided into three fractions: carcass; viscera; and head, hide, feet, and tail. Fractions were analyzed for energy, N, lipid, and ash. Average weekly starter intake did not differ ($P=0.81$) between enhanced treatments. Plasma urea N concentration differed among all treatments (7.6, 9.8, and 12.1 mg/dl; $P<0.0001$). Plasma glucose was lower ($P<0.05$) for conventionally fed calves. Gain of BW (0.46, 0.72, and 0.74 kg/d; $P<0.001$) was greater for enhanced treatments but was unaffected by starter CP ($P=0.78$). Body length and heart girth were greater for enhanced treatments ($P<0.01$) but did not differ between starter CP content. Carcass weights at 5 wk (31.6, 41.3, 39.3 kg) were greater for enhanced treatments but did not differ between starter CP content. At 10 wk, carcass weights were heavier for enhanced calves and heavier for high CP starter (41.6, 50.6, 52.0; $P=0.05$). Carcass lipid percentage did not differ among treatments ($P\geq0.48$). A high CP starter had minimal impact on dairy calves in an enhanced early nutrition program.

Key Words: Calves, Growth, Body Composition

446 Using mixture enzyme as feed additive in growing diets of young Holstein calves. A. Naserian[1], B. Saremi*[2], and M. Sari[1], [1]*Ferdowsi University*, *Mashhad, Khorasan Razavi, Iran*, [2]*2-Animal Science Department, Education Centre of Khorasan Jihad-Agriculture*, *Mashhad, Khorasan Razavi, Iran*.

In order to investigate effects of enzyme addition to young calves diet and its effects on their performance, eighteen female Holstein calves (birth weight 39.5±5.1 kg) were placed in different treatments after weaning: 1) control 2) 0.5% enzyme 3) 1% enzyme. The commercial enzyme (NATUZYME, Bioproton, Au) was a mixture of cellusase, xylanase, B-glucanase, A-amylase, protease, pectinase and phytase and was used for non-ruminants up to now. Calves were fed 10% birth weight milk up to weaning at 60 days old and they had free access to water and feed. Diets were formulated according to NRC 2001 to meet calves requirement. Calves were weighed and body measurements (wither height, hip height, body length, pin width, hip width, stomach size, heart girth, metacarpus size and metatarsus size) were taken periodically (60, 80, 100 and 120 days old). Intake of calves was measured daily. Feed to gain ratio was determined. Rumen (pH) and blood samples (glucose, BUN) were taken at sampling dates. Data were analyzed using completely randomized design with SAS 6.12. Means were compared using Duncan test. Results showed that daily dry matter intake was reduced using enzyme as feed additive ($P<0.01$) but daily gain of calves was increased non significantly so that feed to gain ratio was improved with enzyme increase up to 1% ($P>0.05$). Body measurements were improved with enzyme addition to calves diet that in some cases there were significant differences between treatments ($P<0.01$) like wither height at 120 days old and body length increased during 60 day trial. Rumen pH, blood glucose and BUN were not affected by enzyme addition. Data showed that increasing level of enzyme up to 1% could improve performance of calves without side effects on rumen characteristics and blood metabolites during weaning to 4 months old.

Key Words: Young Calves, Mixture Enzyme, Performance

447 Nutrient digestibility and excretion of dairy heifers fed diets with increasing concentrations of corn distillers grains. K. F. Kalscheur*, P. Exbrayat, and A. D. Garcia, *South Dakota State University*, *Brookings*.

The objective of this experiment was to determine nutrient utilization of dairy heifers fed increasing concentrations of dried corn distillers grains with solubles (CDG). Six Holstein heifers (387 ± 17 kg body weight) were used in a replicated 3 × 3 Latin square design with 2-wk periods. Dried distillers grains were included in diets at three concentrations: 0, 12.5, and 25% of the diet DM. Bromegrass hay and corn silage remained constant across diets (54.2 and 15% of the diet DM), and corn and soybean meal was replaced by CDG as its inclusion rate increased. Diets (DM basis) were formulated to be similar in CP (13.2%), NDF (49.2%) and ADF (26.9 %). Dietary fat increased from 1.5 to 3.9% and phosphorus (P) from 0.30 to 0.45% (DM basis) as CDG increased in the diet from 0 to 25%. Urine and feces were collected for 4 days at the end of each period to calculate nutrient digestibility and excretion. Dry matter intake was restricted according to NRC recommendations and did not differ as CDG increased in the diets (8.3, 8.1, and 8.3 kg/d). Average daily gain increased linearly as CDG was increased in the diets (0.88, 1.10, and 1.64 kg/d; $P < 0.07$). Total tract digestibility of DM, NDF, and ADF was not affected by diet. Total tract digestibility of CP decreased (68.9, 67.8, and 63.8%; $P < 0.003$) as CDG in the diet increased. Although nitrogen (N) intake was not different (178, 172, and 173 g/d), fecal N increased (55, 55, and 63 g/d; $P < 0.001$) and urinary N decreased (102, 96, and 86 g/d; $P < 0.001$) as CDG increased in the diets. As P intake increased (25, 27, and 38 g/d; $P < 0.001$) with increased dietary CDG, fecal P output also increased (20, 22, and 28 g/d; $P < 0.001$). Increasing CDG in dairy heifer diets resulted in decreased CP digestibility and increased fecal N excretion. Urinary N excretion however was reduced, which resulted in similar total N excretion across diets. Phosphorus excretion increased at higher CDG concentrations as a result of feeding in excess of the requirement of growing dairy heifers.

Key Words: Corn Distillers Grains, Nutrient Digestibility and Excretion, Dairy Heifers

448 The effects of altering dry matter intake on rumen digestion and turnover in dairy heifers. G. I. Zanton* and A. J. Heinrichs, *Pennsylvania State University*, *University Park*.

The objective of this experiment was to elucidate the effects of differing intakes of dry matter on ruminal parameters of growing, postpubertal dairy heifers. A grass-based, total mixed ration (49.1% NDF, 13.0% CP) was fed to eight rumen cannulated Holstein heifers (340 +/- 5 kg) in a replicated 4x4 Latin square design at levels of intake formulated to equally span the region between approximately maintenance and ad libitum consumption for 35 days per period. Treatments consisted of one ration fed at 1.25, 1.50, 1.75, and 2.00 kg per 100 kg body weight twice daily with energy being the first-limiting dietary component. Rumen fluid was collected every two hours for 24 hours on one day each period. In situ incubations of the TMR were conducted each period for each heifer and analyzed for DM, CP, and NDF. Rumen contents were evacuated midway between the morning and evening feeding on one day per period. Data were analyzed as a Latin square design and linear and quadratic contrasts were tested. Rumen pH was linearly reduced and total VFA concentration linearly increased as DMI increased ($P<0.05$), but molar proportions of acetate, propionate, and butyrate and rumen concentrations of ammonia were unaffected by treatment and were not differentially affected by time after feeding ($P>0.05$). Rate and extent of in situ DM degradability was not significantly different between the different levels of intake ($P>0.05$). The weight of wet rumen contents, dry rumen contents, and rumen content DM percentage were linearly increased by increasing DMI ($P<0.05$), while NDF percentage was not altered by treatment. Apparent turnover of rumen DM was linearly decreased by increasing levels of DMI from 26.9 to 23.0 hours ($P<0.05$), likely due to an increase in rate of passage owing to similar rates of digestion. Likewise, NDF turnover was linearly decreased by increasing DMI from 37.1 to 33.2 hours ($P<0.05$) indicating an increased potential for ruminal digestion of dietary NDF. These results highlight the importance that DMI has on the ruminal availability of DM and NDF for dairy heifers.

Key Words: Dairy Heifers, Rumen Turnover, Rumen Digestion

Wednesday, July 27, 2005

POSTER PRESENTATIONS

Animal Behavior and Well-Being: Dairy Cattle, Housing Management and Stress

W1 The effect of social hierarchy on lactating cows during relocation. K. J. Pence*, K. F. Knowlton, F. C. Gwazdauskas, R. E. Pearson, C. S. Wilson, L. Harris, C. O. Wilkes, S. R. Hill, and A. M. Hurt, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to determine the effect of social hierarchy on plasma cortisol concentration, milk yield (MY), and behavioral changes in lactating cows during relocation. Social hierarchy was determined by forced competition in 17 lactating Holsteins 1 mo prior to relocation. Each of the cows was paired once with each of the other cows over a 4-d test period. The pair of cows were offered a bucket with 0.5 kg of grain for 3 min. The total amount of time each cow had access to the grain over the 4-d test period was analyzed to determine dominance rank. The 8 cows that had the longest total access time were classified as the dominant cows, while the 9 cows that had access for the shortest total time were classified as the subordinate cows. Days in milk (DIM), BW, MY, or age were not different between dominant and subordinate animals. Blood samples were collected on d -7, -1, 0, 1, 2, 7, 14, and 21 relative to relocation. Milk production was analyzed in three periods; PD1 = pre-move, PD2 = wk 1-2 following relocation, and PD3 = wk 3-4 following relocation. Also, three 24 h observation periods (5 d prior to relocation, 1 d following relocation, and 12 d following relocation) were conducted to determine behavioral differences. Behaviors recorded included location, primary activity, urinations, defecations, and stereotypies. The effects of dominance rank, period and their interaction were evaluated with Proc MIXED of SAS. Plasma cortisol concentration (mean = 4.5 ng/ml) and observed behaviors were not influenced by dominance rank, period or the interaction. Milk yield was reduced following relocation in subordinate cows (PD1 = 26.3 kg/d, PD2 = 25.6 kg/d, PD3 = 21.6 kg/d), but not dominant cows (mean = 25.9 kg/d). Changes in post-move MY indicate that subordinate cows did not adapt to relocation as well as dominant cows.

Key Words: Social Hierarchy, Relocation, Lactation

W2 Effect of freestall size and surface on frequency and type of use by lactating dairy cows. K. Cummins*, L. Carlson, J. Grubbs, and B. Rickman, *Auburn University*, *Auburn*.

A study was done to compare 5 different commercially available freestall mats and two different stall sizes. Stall sizes were: Small, 1.22 m wide, 1.14 m height mattress to neck rail, and 1.68 m curb to brisket board, and Large, 1.27 m wide, 1.27 m height mattress to neck rail, and 1.78 m curb to brisket board. Cows were randomly assigned to one of three groups, two with the large

and one with the small freestall size, each with access to stalls using each of the mat types. Equal numbers of mature Holstein cows (n=40) were in each group. Each group had access to 35 stalls (7 mats of each type) approximately 12 h per day in two 6 h periods. Cows were observed from 1100 to 1300 h eachof 5 consecutive days. At this time, cows were in the freestall barn, had eaten freshly-offered feed,and were resting before milking at 1330 h. Every 5 minutes the stalls were observed and those in use recorded and the type of use (posture) noted: lying down, standing, or standing half in and half out with just the front feet in the stalls. Data was analyzed using the PROC CHISQ procedure of SAS for chi-square analysis of differences in frequency distribution of type of use and type of mat. Mattress type had no effect on stall use (P>.1). Cows used all mattress types with the same frequency. There was a significant effect of stall size on frequency of use. Total stall use was increased by stall size (92.9, 97.6 percent use for large stalls vs. 49.6 for small stalls, P<.05) Posture adopted by the cows was affected by stall size. (P<.05). Cows in large stalls adopted a lying posture more frequently than in small stalls (69.0, 57.3 vs.24.1 percent of stall use, P<.05). Standing postures, whether half in and half out or fully in the stall were not significantly affected by stall size (P>.1). We conclude that mattress type had no effect on stall use, but that stall size had a significant effect on both frequency and manner of stall use. Changes as small as 0.1 m can significantly alter cow useage.

Key Words: Behavior, Freestall

W3 Regrouping dairy cattle and subsequent effects on dominance rank and milk production. B. Sandmann*, J. Swanson, J. Shirley, and J. Smith, *Kansas State University*, *Manhattan*.

Dairy producers commonly regroup cattle for milk production, reproduction, sickness and/or injury purposes. Eighty Holstein cows (40 multiparous and 40 primiparous) were used to determine the effect of regrouping on dominance rank and milk yield. Cows were regrouped both within and across parity. Dominance rank was determined from the number of interactions between animals, via a two way matrix. Three regroupings were done at three week intervals and cows were observed for the first two weeks after each regrouping, twice daily for one hour following milking. Animals in each pen were classified as either moved animals (n=9), that moved to another pen, or remaining animals (n=11), that remained in a home pen. Moved groups contained three most dominant rank, three middle rank and three most subordinate rank cows from each pen. Upon regrouping, a new dominance rank was determined for each new pen. Regrouping disrupted the social hierarchy; an increase in agonistic activity was seen in all pens following regrouping until the formation of a new social hierarchy. Change in dominance rank was observed for animals that moved as well as animals that remained in the home pen. Dominant individuals had the most notable decrease in milk production during each phase and across the study (phase 1 $P < 0.01$; phase 2 $P < 0.01$; phase 3 $P < 0.01$). Milk yield from middle rank cows decreased after the first ($P < 0.01$) and second ($P < 0.04$) regrouping but subordinate cows experienced decreased milk yield only during the second regrouping ($P < 0.01$). Regrouping affected dominance ranking but not milk yield in primiparous cows. Our results indicate that regrouping disrupts the social hierarchy and has a negative effect on milk yield by multiparous cows, particularly in dominant cows.

Key Words: Regrouping, Milk Production, Dominance Rank

W4 The effect of diet on lactating dairy cows during relocation. K. J. Pence*, K. F. Knowlton, F. C. Gwazdauskas, R. E. Pearson, C. O. Wilkes, A. M. Hurt, S. R. Hill, M. Hollmann, and C. S. Wilson, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to determine dietary effects on stress in lactating dairy cows during relocation to a new dairy facility. Twenty-three lactating

Holsteins were assigned to one of three dietary treatments 3 wk prior to and 9 wk following relocation. The three treatments consisted of a basal total mixed ration consisting of alfalfa and corn silage, ground corn and barley, soybean meal, and pressed brewer's grains (TMR); the TMR plus orchard grass hay as 10% of the DM offered; and the TMR plus alfalfa hay as 10% of DM offered. All cows were fed in Calan doors. Plasma cortisol concentrations, lameness scores, DMI, and milk yield (MY) were monitored. Blood samples were collected between 1400 and 1600 h on d -7, -1, 0, 1, 2, 7, 14, and 21 relative to relocation. Lameness scores, DMI, and MY data were analyzed in three periods; PD1 = pre-move, PD2 = wk 1-4 following relocation, and PD3 = wk 5-9. The effects of diet, period and their interaction were evaluated with Proc MIXED of SAS. The interaction of diet by period was significant ($P < 0.01$) for plasma cortisol and lameness score. Plasma cortisol concentrations were affected by diet on the day of relocation only. On that day, plasma cortisol was lower in cows offered the TMR than cows offered the orchard grass hay or alfalfa hay diets (6.7, 12.1, and 12.7 ng/mL). Lameness scores increased following relocation for cows on the TMR (PD1 = 1.5, PD2 = 1.6, PD3 = 2.0) and alfalfa hay (PD1 = 1.5, PD2 = 1.7, PD3 = 2.6) diets, but did not change in cows fed grass hay (PD1 = 1.5, PD2 = 1.6, PD3 = 1.8). No interaction of diet and period was observed for DMI and MY, but cows offered grass hay had lower DMI than cows offered alfalfa hay ($P < 0.03$). Offering lactating cows orchard grass hay during relocation may decrease lameness while cows are adapting to a new facility, but offering alfalfa hay did not improve production or measures of well-being.

Key Words: Relocation, Cortisol, Lactation

W5 The effect of relocation on milking parlor behavior and stress in dairy cows. C. O. Wilkes*, F. C. Gwazdauskas, M. L. McGilliard, K. J. Pence, A. M. Hurt, and O. Becvar, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to examine how relocation affects cow behavior and measures of stress in the milking parlor. In an attempt to assess stress cows at the Virginia Tech Dairy Center were allocated to 3 groups in separate pens: 1) access to a rubber mat in the feedbunk area (MAT; n = 18); 2) no access to a mat in the feedbunk area (NOMAT; n = 22); and 3) two breeds (BREED; n = 22 Holsteins housed with 22 Jerseys). Parity was balanced across groups. Milking parlor behaviors observed were reaction to milk claw fitting (RMCF), latency to enter the parlor (LAT), and plasma cortisol (CORT). RMCF was a numeric scale (0 = ideal milker to 3 = steps and kicks frequently) to define behavior during udder preparation and claw fitting. LAT was the time necessary for each cow to enter the milking parlor. CORT was assessed by RIA. Data were grouped by period with d -14 and -7 as pre-move; d 0 as relocation day; d 1 and 2 as the immediate post-move; and d 5, 7, and 14 as the final period. Data were analyzed using the Mixed Model procedures of SAS. MAT had RMCF of 0.37 ± 0.09, while NOMAT had a mean of 0.65 ± 0.08 ($P < 0.05$). Relocation caused an increase ($P < 0.05$) in RMCF among all groups, however there was a decline on d 1 and 2. There was an increase ($P < 0.05$) in LAT the day of relocation in all groups, but the NOMAT cows older than first lactation had greater LAT the day of relocation and were more hesitant to enter the parlor in subsequent periods than first parity cows ($P < 0.05$). LAT was 9.2 ± 0.5 for Holsteins vs. 6.2 ± 1.0 s for Jerseys ($P < 0.05$). Holsteins averaged 5.8 ± 0.3 vs. 4.2 ± 0.5 ng/mL CORT for Jerseys ($P < 0.05$). Treatment by period interaction indicates that MAT had a less dramatic change in RMCF on the day of relocation with respect to NOMAT. MAT adapted easier to relocation, older cows were more reluctant to enter the new facility, and Holsteins were more stressed than Jerseys during relocation.

Key Words: Relocation, Parlor Reactivity, Stress

Animal Behavior and Well-Being: Sow Housing, Management and Stress

W6 Analysis of the association between farrowing and lactation factors and sow removal. S. S. Anil*[1], L. Anil[1], J. Deen[1], S. K. Baidoo[2], and R. D. Walker[2], [1]*University of Minnesota*, *Saint Paul*, [2]*SROC, University of Minnesota*, *Waseca*.

Farrowing performance and body condition affect sow removals in breeding herds. A study was conducted at the University of Minnesota, Southern Research and Outreach Center, Waseca, MN with 507 sows (GAP, English Belle, BW 220.69 ± 1.12 kg) of parities 1-8. The objective of the study was to assess the association of farrowing and lactation factors on the likelihood for removal of sows from the herd before next parity. The farrowing factors considered were parity, litter birth weight, mummies and stillborn. The lactation factors included lactation length, average lactation feed intake and body condition in terms of body weight and backfat thickness at day 108 of gestation. Removal from the herd was defined as cull, death or euthanasia. Data were obtained from the sow records and the PigCHAMP database of the research unit. Logistic regression analysis with removal as the binary outcome variable (full model, Proc Logistic, SAS) was performed to analyze the data. For analysis, parity was categorized into three as parities 1 and 2, 3 to 5 and ≥6 and mummies and stillborn were categorized as either present or absent. Average lactation feed intake, body weight and backfat at day 108 of gestation, lactation length and litter birth weight were included in the model as continuous variables. The likelihood for removal decreased ($P \leq 0.05$) with increase in backfat thickness at day 108 of gestation (Odds Ratio: 0.846, Confidential Interval: 0.783 and 0.915). As the average lactation feed intake increased, the likelihood for removal from the herd decreased (Odds Ratio: 0.543, Confidence Interval: 0.424 and 0.695, $P \leq 0.05$). Body weight at day 108 of gestation, lactation length, litter birth weight, parity and presence of mummies and stillborn did not have significant association with the likelihood for removal. The results indicated that sows with low backfat thickness at the time of farrowing and low lactation feed intake were more likely to be removed from the herd before next farrowing.

Key Words: Lactation Feed Intake, Sow Removal

W7 Evaluation of the effect of group size and structure of gestation housing on production performance and removal of sows in pens with electronic sow feeders (ESFs). L. Anil*[1], S. S. Anil[1], J. Deen[1], S. K. Baidoo[2], and R. D. Walker[2], [1]*University of Minnesota*, *Saint Paul*, [2]*SROC, University of Minnesota*, *Waseca*.

Group size and structure of gestation housing may affect the production performance and removal of sows. The objective of the study was to compare production performance and removal of sows housed during gestation in dynamic (D), two-time mixing (TM) and static (S) groups of different group sizes in pens with electronic sow feeder (ESF). The study was conducted at Southern Research and Outreach Center, of the University of Minnesota. A total of 400 pregnant sows (GAP, English Belle; BW 224±1.87 kg; parities 0-7) were used. Sows were weaned after 18.8±0.2 d lactation, every 2 weeks. Each weaned batch consisted of 20-30 sows and was allotted to pens with ESF. Four weaning batches of 20-30 sows were introduced at bi-weekly intervals to a large pen (12.75×13.5 m with 2 ESFs) to form the D group (total 98 sows). The TM treatment was formed by adding 2 batches to a pen (12.75×6.75m with 1 ESF) at bi-weekly interval and 2 such pens were maintained (total 109 sows). A single batch of S group was housed in one half of a pen by regulating access to an ESF and 4 such groups were maintained (total 103 sows). All sows were moved to their respective housing systems prior to implantation (day 5 of gestation) and

all were exposed to aggression associated with grouping and feeder access. The data were analyzed using descriptive statistics, ANOVA and 2-sample proportion tests. The percentage of sows farrowed (82, 80 and 88 % respectively for D, TM and S groups) and removed (11.2, 7.4 and 8.7 % respectively for D, TM and S groups) were not different (P≥0.05) among the housing systems. There was no difference (P≥0.05) in farrowing performance in terms of number born alive, piglets weaned, stillborn, mummies, preweaning mortality, litter weights at birth and weaning, lactation length and wean to service interval. The grouping prior to implantation may be the reason for no difference in the reproductive performance of sows in different grouping treatments observed in this study.

Key Words: Electronic Sow Feeders, Group Structure, Farrowing Performance

W8 Evaluation of the effect of group size and structure on welfare of gestating sows in pens with electronic sow feeders (ESFs). L. Anil*[1], S. S. Anil[1], J. Deen[1], S. K. Baidoo[2], and R. D. Walker[2], [1]*University of Minnesota*, *Saint Paul*, [2]*SROC, University of Minnesota*, *Waseca*.

The welfare of 400 pregnant sows (GAP, English Belle; BW 224±1.87 kg; parities 0-7) housed in dynamic (D), 2-time mixing (TM) and static (S) groups of different group sizes in pens with ESF was evaluated to study the effect of group size and structure on welfare. The study was conducted at SROC, University of Minnesota. Four weaning batches of 20-30 sows were introduced at bi-weekly intervals to an existing group in a large pen (12.75×13.5 m, 2 ESFs) to form the D group. The TM group was formed by adding 2 batches to a pen (12.75×6.75m, 1 ESF) at bi-weekly interval and 2 such pens were kept. A single batch of S group was housed in one half of a pen by regulating access to an ESF and 4 such groups were maintained. Behavior data and saliva samples were collected from 15 randomly identified sows from each newly added batch. Injuries of all sows were assessed. Saliva collection and injury level assessment were performed on the day before and after and 2 weeks after introduction. Behavior data were collected on the day, day after and 2 weeks after introduction. Data were analyzed using repeated measures of ANOVA and Spearman correlations. The weaning batch was considered as experimental unit. The D group had the highest (P<0.05) total injury scores (TIS). The cortisol and TIS were higher (P≤0.05) at day after mixing than at 2 weeks post-mixing. The TIS was different (P≤0.05) among the treatments at 2 weeks post-mixing with the D group having higher (P≤0.05) score than the S. The number of queuing for access to ESF was higher (P≤0.05) in the TM group. The number of non-agonistic social interaction was lower (P≤0.05) in the D group (P≤0.01). The proportion of time spent queuing was less (P≤0.01) at mixing day among the treatments. Cortisol and TIS were positively correlated (P≤0.05) in D and TM groups. Total aggression was positively correlated (P≤0.05) with queue number and duration in all groups. The higher TIS and lower number of non-agonistic social interactions indicated that the welfare of sows in the D group was compromised. Results on cortisol and TIS suggest that sow welfare is compromised by mixing, among the treatments.

Key Words: Sow Welfare, ESF

W9 Effects of a modified farrowing pen on sow maternal behavior. N. Devillers*[1], M.-C. Meunier-Salaün[2], and C. Farmer[1], [1]*AAFC, Dairy and Swine R &D Centre*, *Lennoxville, QC, Canada*, [2]*INRA, UMR Système d'Elevage Nutrition Animale et Humaine*, *Saint Gilles, France*.

A modified farrowing pen (MOD) designed as a standard farrowing crate (STD) with a 1.5 x 1.6 m pen in the back, equipped with rubber floor mats and accessible to sow and piglets was used to assess if more space and comfort favor sow-piglets interactions and nursing behavior. Primiparous Yorkshire x Landrace sows were randomly allocated between STD crates (n = 10) or MOD pens (n = 13). Litter size was standardized to 10 or 11. Direct observations of two successful nursings and one inter-nursing period (INP) were done between 12:00 and 18:00 on days 5 and 17 of lactation. Duration and interruption of nursing bouts, as well as localization, posture and activity of the sow and sow-piglets interactions during INP were recorded. Data were analyzed with SAS (MIXED procedure). In MOD pens, 74% of observed nursings occurred in the back pen. The total duration of nursing bouts was not affected by the pen type (MOD: 5.1 min, STD: 4.6 min, $P = 0.1$), but the milk ejection phase was longer in MOD pens compared to STD pens (20.9 sec vs. 19.0 sec, $P < 0.05$). Sows interrupted more nursings in MOD than in STD pens (42% vs. 15%, $P < 0.05$). The duration of INP ranged from 16 to 73 min and did not differ between pen types ($P = 0.9$). During INP, sows in MOD pens spent 80% of their time in the back pen, spent more time rooting (3.3% vs. 1.1%, $P < 0.05$) and stood up and lay down more often (2.7 vs. 1.1 times/h, $P < 0.05$) than sows in STD pens. Seventy percent of sow-piglets interactions occurred during the first half of INP. Sows in MOD pens tended to initiate more interactions with their piglets (26.4% vs. 14.8%, $P = 0.08$) and showed more piglet-directed motor acts per interaction (2.1 vs. 1.6, $P < 0.05$) than sows in STD pens. In conclusion, sows housed in MOD pens were more active and expressed more piglet-directed behaviors. This suggests enhanced welfare by enabling maternal behavior expression.

Acknowledgements: Sincere thanks to Ontario Pork and Équipements Laliberté for financial assistance

Key Words: Farrowing Pen, Maternal Behavior, Nursing Behavior

Animal Behavior and Well-Being: Swine Handling, Transportation and Stress

W10 The fatigued pig syndrome. M. Ritter*[1], M. Ellis[1], M. Benjamin[2], E. Berg[3], P. DuBois[4], J. Marchant-Forde[5], A. Green[6], P. Matzat[7], P. Mormede[8], T. Moyer[9], K. Pfalzgraf[10], M. Siemens[11], J. Sterle[12], T. Whiting[13], B. Wolter[14], [1]*University of Illinois*, *Urbana*, [2]*ELANCO Animal Health*, *Canada*, [3]*University of Missouri*, *Columbia*, [4]*Cargill*, *KS*, [5]*USDA-ARS*, *IN*, [6]*USDA-APHIS*, *CO*, [7]*ELANCO Animal Health*, *MO*, [8]*Lab Neurogenetique et Stress*, *France*, [9]*Hatfield Quality Meats*, *PA*, [10]*Tyson Fresh Meats*, *AR*, [11]*Smithfield Foods, Inc.*, *VA*, [12]*Texas A&M University*, *College Station*, [13]*Agriculture & Food*, *Canada*, [14]*The Maschhoffs*, *Carlyle, IL*, [15]*National Pork Board*, *IA,*.

A National Pork Board sponsored workshop reviewed the literature relating to fatigued pigs, defined as a non-ambulatory, non-injured animal that, without obvious injury, trauma, or disease, refuses to walk at any stage of the marketing channel from loading at the farm to stunning at the plant. Workshop objectives were to identify the causes and economic impact of this syndrome as well as factors potentially associated with fatigued pigs. Intervention strategies were reviewed and key gaps in the scientific literature identified. Potential mechanisms for the etiology of this syndrome include acute stress resulting in acidosis and chronic stress resulting in glycogen depletion and physical exhaustion. Several studies have found elevated plasma ammonia concentrations in fatigued pigs, but the importance of this is not understood. Economic impact of the syndrome is currently unknown; national statistics for its incidence are not available and losses associated with product-quality defects (i.e., pork quality, carcass trim loss, and pig/carcass disposal costs) are not known. Field studies suggest that >50% of all non-ambulatory pigs at the plant are fatigued and, thus, it is anticipated that ~0.3% of all pigs transported will develop the syndrome. Predisposing factors for this multi-factorial syndrome were characterized as pig, environment/facility, people, transport, and plant. Key gaps in the literature included but were not limited to the effects of genetics, health status, increased leanness/muscling, age/slaughter weight, production system, trailer design, transport time, and plant line speed.

Key Words: Pig, Transport Losses, Fatigue

W11 Welfare of finisher pigs during transportation to slaughter. M. Ellis*[1], M. Ritter[1], L. Anil[2], D. Butler[3], S. Curtis[1], C. Dewey[4], B. Driessen[5], J. Hill[6], J. Salak-Johnson[1], J. McGlone[7], C. Stull[8], and A. Johnson[9], [1]*University of Illinois*, *Urbana*, [2]*University of Minnesota*, *St. Paul*, [3]*Murphy Brown Farms, LLC*, *NC*, [4]*University of Guelph*, *Ontario*, [5]*Zootechnical Centre*, *Belgium*, [6]*Premium Standard Farms*, *MO*, [7]*Texas Tech University*, *Lubbock*, [8]*University of California*, *Davis*, [9]*National Pork Board*, *IA*.

An area of topical interest to the swine industry is the welfare of finisher pigs during transportation. The National Pork Board sponsored a transportation workshop which involved scientists, and government and industry representatives from North America and Europe to review the scientific literature, identify gaps in current knowledge, and identify future research needs. The review covered on-farm and transportation factors up to the point of unloading at the plant, and considered impacts on animal function and behavior as well as losses during transport. Inappropriate practices during transportation result in a significant cost to the industry in terms of pig losses, poor meat quality and overall swine welfare. At the farm, major factors impacting behavioral and physiological responses of the pig during transport include genetics, slaughter weight, environmental conditions (temperature and humidity), health status, marketing strategy, time off feed, pre-transport experiences, facility design, and nature of handling during loading. On the truck, major factors include truck design (e.g., pot-bellied vs. straight deck), location on truck, floor-space allowance, mixing of pigs from different groups, environmental conditions, and use of bedding. In addition, timing of events during transportation (loading, journey, and waiting times) and driving conditions (speed, rates of acceleration/deceleration, inclines, curves, and stops) are important factors. There has been limited research under typical North American conditions relating to pig welfare during transport, so considerable gaps exist in the knowledge base, particularly in relation to influences of pre-transportation factors on the pig's functional and behavioral responses to transportation.

Key Words: Pig, Transport, Welfare

W12 Relationships between transport conditions and the incidence of dead and non-ambulatory finishing pigs at the slaughter plant. M. J. Ritter*[1], M. Ellis[1], J. Brinkmann[2], K. K. Keffaber[3], and B. F. Wolter[2], [1]*University of Illinois*, *Urbana*, [2]*The Maschhoffs*, *Carlyle, IL*, [3]*ELANCO Animal Health*, *Greenfield, IN*.

Data on 74 loads of finishing pigs (mean BW = 129.0 ± 0.63 kg) from two finishing sites was collected over 4 seasons to evaluate the relationships between transport conditions and transport losses (dead and non-ambulatory pigs). Standard commercial procedures were used for pig handling and transportation. Pigs were loaded onto straight deck trailers, were mixed with unfamiliar pigs and were stocked at ~0.45 m^2/pig. Average load weight, load number within day, event times (loading, wait at farm, transport, wait at plant, unloading, and total time) and temperature and relative humidity in the trailer were recorded. Relationships between transport conditions and losses were evaluated using pearson correlations from the PROC CORR procedure of SAS. The incidence of non-ambulatory pigs at the farm and the plant were 0.26 and 0.85%, respectively, and 0.23% were dead on arrival at the plant. For 65 of the 74 loads, non-ambulatory pigs at the plant were classified as injured (0.24%) or non-injured (0.55%). Non-ambulatory pigs at the farm were positively correlated with relative humidity during loading and load number within day (r = 0.46 and 0.25, respectively; $P < 0.05$). The incidence of plant non-ambulatory, non-injured pigs was positively related to waiting time at the farm, unloading time, and total time (r = 0.24, 0.41, and 0.27; $P \leq 0.05$). The percentage of dead pigs at the plant was positively correlated to transport time, unloading time, and total time (r = 0.29, 0.52, and 0.40; respectively; $P \leq 0.01$). The incidence of total plant losses was correlated with waiting time at the plant, unloading time, and total time (r = 0.24, 0.51, and 0.36; $P < 0.05$). The percent of total plant non-ambulatory pigs was only related to unloading time (r = 0.32; P = 0.01), while none of the factors were related to plant non-ambulatory, injured pigs. Temperature in the trailer and average load weight were not related to losses. These data suggest that transport times and conditions may impact transport losses and this warrants further investigation.

Key Words: Pigs, Transport Losses, Transport Conditions

W13 The effect of sire line, floor space allowance in the barn, and gender on handling characteristics and stress responses in finishing pigs. M. J. Ritter*[1], M. Ellis[1], C. R. Bertelsen[1], J. Brinkmann[2], B. A. Peterson[1], J. M. Schlipf[1], and B. F. Wolter[2], [1]*University of Illinois*, *Urbana*, [2]*The Maschhoffs*, *Carlyle, IL*.

A total of 419 market weight pigs (Mean BW = 122.1 ± 1.86) were used in a completely randomized design with a 3 × 3 × 2 factorial arrangement of treatments to determine the effects of sire line, floor space allowance in the barn, and gender on handling characteristics and stress responses in finishing pigs during loading. The treatments were: 1) sire line (A=Pietrain ancestry, B=Hampshire, and C=Duroc), 2) floor space allowance (0.61, 0.68, and 0.74 m^2/pig), and 3) gender (barrows and gilts). Pigs were moved from the pen to the truck in groups of 4-7 by two handlers. Handling interventions, time required to move, and a subjective handling score were recorded for each group. Rectal temperature and blood acid-base status were determined on 1 pig per group before and after handling. Before handling, gilts had lower ($P < 0.01$) rectal temperature than barrows (39.26 vs. 39.57 ± 0.09°C, respectively). Also, there was a sire line by floor space interaction for before handling lactate ($P < 0.01$; Line A = 2.17, 4.03, and 5.32; Line B = 3.27, 2.21, and 2.90; and Line C = 2.20, 5.13, and 3.91 ± 0.83 mmol/L, respectively for 0.61, 0.68 and 0.74 m^2/pig). In general, sire line, floor space, and gender had little effect on handling interventions or scores. Immediately post-handling, gilts had higher ($P < 0.05$) blood pH than barrows (7.39 and 7.33 ± 0.04, respectively), pigs from line B had lower ($P < 0.05$) rectal temperature than pigs from line C (39.13 and 39.44 ± 0.29°C, respectively), and pigs from line A had higher ($P < 0.05$) lactate than pigs from lines B and C (8.15, 5.67, and 5.97 ± 1.39 mmol/L, respectively for A, B, and C). Significant sire line by floor space by gender interactions existed ($P \leq 0.05$) for post-handling HCO3 and base excess. In summary, sire line differences existed for rectal temperature and lactate after handling. These data suggest that genetic lines may respond differently to handling.

Key Words: Pigs, Genetics, Handling

W14 Heart rate associated with routine handling in finishing pigs and sows. C. Lewis[1,2], L. Hulbert*[1,2], and J. McGlone[1,2], [1]*Pork Industry Institute*, *Lubbock, TX*, [2]*Texas Tech University*, *Lubbock*.

Routine husbandry requires that pigs be handled. Recommendations for use of certain handling devices should be based on the pigs reaction to these devices and methods. Exp. 1 examined the common pig handling devices for their effects on pig heart rate during a naive handling experience. The first device was an orange standard pig handling board. The second device was a cape consisting of red cloth that is folded into three sections, which can be formed in a u shape. The third device was a large red cloth flag extended on a pole. The fourth device was a standard blue paddle and a pole. The fifth device was an electric prod. The sixth moving method was the use of the board and the electric prod. The handling course involved 5 turns and movement through a narrow space. The narrow space was examined in a control setting and with a fan blowing room-temperature air towards the pigs face. Pigs were fit with Polar 610 IR heart rate monitors a few minutes before testing. Pigs were moved in groups of three with gentle force. Overall, there were no individual effects from any of the handling devices on heart rates of the pigs. However, pig heart rate was higher ($P < 0.05$) during testing than before testing (172 ± 3.5 and 138 ± 3.6). Movement through the course with the flag took longer ($P < 0.05$) compared with all other handling devices. Snaring is widely regarded as a stressful experience for the sow and regarded by some as inhumane. In Exp. 2, 12 gestating sows were fit with the Polar 610 IR heart rate monitors, allowed to rest, then snared for one minute, released and allowed to rest again. Interestingly, there were no statistical differences in the heart rate of the sows before, during, and after snaring. HR for before, during or after snaring, respectively, were 95.6, 93.2, 102.2 bpm ($P > 0.10$). Though vocalizations were observed among snared sows, they were not accompanied by an elevated heart rate. These results support the notion that pig vocalization is a defensive response not associated with elevation in heart rate and that moving with any of the common handling devices used in a gentle manner produces equivalent heart rates.

Key Words: Swine Handling, Heart Rate, Swine Stress

W15 Gender, age, and hormonal status affect recovery time from general anesthesia in pigs. D. Wray-Cahen*[1], W. Pritchard[1], A. Ashby[1], E. Russek-Cohen[1], J. Vossoughi[2], and J. Karanian[1], [1]*Food and Drug Administration*, *Laurel, MD*, [2]*Biomed Research Foundation*, *Olney, MD*.

Pain awareness during surgery is more prevalent in women than men and may be associated with the more rapid waking from general anesthesia observed in women. The gender, age, and hormonal status of an animal may affect how they respond to anesthesia and the speed at which they awaken from general anesthesia. To determine the effect of gender, hormonal status and age on anesthesia recovery time, we observed seven groups of pigs recovering from general anesthesia for interventional cardiovascular procedures: intact boars (M, n=21), barrows (MX, n=9), intact gilts (F, n=21), ovariectomized (OVX) gilts (FX, n=14), OVX gilts receiving estrogen (ERT, n=10), young gilts (YG, n=12), and young barrows (YB, n=7). Older pigs were all sexually mature and >90kg (X±SEM; 112±1kg). Young immature pigs were <32kg (25±4kg). After induction, a surgical level of general anesthesia (stage 3, plane 2) was maintained by isoflurane inhalation. Pigs received isoflurane for 188±5 min. Minutes post-anesthesia for responses to stimuli and for motor control parameters to be elicited were recorded. Younger pigs (YG, YB) awoke from anesthesia much quicker than older pigs (P<0.001), getting on their sternum, sitting, and standing >4-times faster. Older gilts (F, FX, ERT) recovered more rapidly than M. Castration, but not OVX, reduced the overall response times. F responded to stimuli (nose pinching, leg pulling) >2.3-times sooner than M (P<0.001). M were slower than other older pigs to get on their sternum (171±17 v 96±7 min; P<0.001), sit (187±16 v 116±7 min; P<0.002), and stand (202±17 v 129±8 min; P<0.02), respectively. These data demonstrate that young pigs awaken from gas anesthesia much more quickly than older pigs and that females (and MX) awake more quickly than M. These results may also have implications for anesthesia rates necessary to maintain a surgical plane of anesthesia. Gender, age, and hormonal status should be taken into account when administering anesthesia to pigs.

Key Words: Gender, Anesthesia, Age

Animal Health III

W16 Gnathostomosis ocurrence in wilds vertebrates in the south of Sinaloa State, Mexico. E. Torres*[1], S. Sánchez[1], C. De la Cruz[2], J. J. Portillo[3], and A. Lafón[4], [1]*EB-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [2]*FCQ-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [3]*FMVZ-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [4]*FZ-Universidad Autónoma de Chihuahua*, *Chihuahua, Chihuahua, Mexico*.

The present study was conducted on the hydrological basins of El Rosario and Escuinapa municipalities, located on the south of Sinaloa State, Mexico. The targets were to identify the hostesses that participate on the biological cycle of Gnathostoma spp and establish the probability of occurrence in the hostesses and habitats. A sample of 4469 vertebrates was obtained of a total of 27 species. Of these 15 were for fish, considered secondary hostesses; 1 of reptiles, 9 of birds, who participate as paratenic or accidental hostesses and finally 2 of mammals, considered to be definitive. Third stage larvae recovery and identification was made by the translumination technique with samples of muscular tissue, been positive 6 species of fish, 1 of reptiles, and 4 of birds, which come from 4 types of habitat. Diagnosis of adult parasites was by stomach and esophagus direct observation finding only one positive mammal species which was Didelphis virginiana (Virginia opossum). Results were analyzed by logistical regression, the species with more probability of occurrence (P< 0.05) of Gnathostoma were to Dormitator latifrons (Pacific fat sleeper) 0.38, Cichlasoma beani (Green guapote) 0.23 y Oreochromis spp (Tilapia) 0.079. Seasonal and permanent ponds presented a bigger proportion of species of infected vertebrates (0.28 and 0.20). According with the obtained results it is concluded that D. latifrons, C. beani and Oreochromis spp were the most important species, so suggested no consumption of raw or not enough cooked meat seasonal them. Lef hand, permanent ponds present a higher probability of favoring the presence of Gnathostoma, because of the number of secondary hostesses, from were the larvae come to concentrator and disperser hostesses, and the human being; closing the cycle on the definitive hostesses. Is it sugested to continue with the surveys over the hostesses and habitats, also avoiding the consumption of the registered species with high probability of occurrence, given the importance of this parasitosis in Sinaloa State and Mexico.

Key Words: Gnathostomosis, Zoonosis, Habitat

W17 Evaluation of garlic *(allium sativum l.)* anthelmintic properties to control internal parasite populations in adult female Boer goats. R. A. Franco and M. Worku*, *North Carolina A&T State University*, *Greensboro*.

In keeping with organic standards, producers are using natural materials to treat parasites. Diminished health, growth rate and feed conversion have been observed in sheep. There is a need for controlled experiments to support the effectiveness of these materials. Garlic *(allium sativum L.)* is actively antibacterial and may be effective. In order to evaluate a commercial, organically approved garlic product (Gempler′s) as a dewormer and to establish dosing rates for goats, twenty female Boer goats weighing ~40 kg were assigned to four groups (0, ½ tsp, 1 tsp, and 2 tsp), of five animals each. A comparison of fecal egg counts (FEC) (for roundworms and coccidia eggs), packed cell volume (PCV), FAMACHA scores, and body weight (BW) in GI parasite infected goats vs untreated animals were evaluated. A general linear model (GLM) analysis was run on all variables using SAS. The results of FEC (roundworms and coccidian eggs), FAMACHA scores, PCV and BW are represented in Table 1. In the correlation analysis, FEC for roundworms had a positive correlation with FAMACHA scores (r = 0.323, P≤0.0015) and a negative correlation with PCV (r = - 0.338, P≤0.0009), but none with any other parameters. FEC for coccidia eggs negative correlation with PCV (r = - 0.207, P≤0.0475). There was no other correlation observed for FEC for this variable. High FEC for roundworm and coccidia eggs were observed when low PCV values were recorded. PCV had a negative correlation with FAMACHA scores indicating anemia (r = - 0.332, P≤0.0009). The organically approved garlic extract did not reduce FEC or alleviate anemia at the concentrations tested.

Table 1. Data Averages for Treatment Groups and Variables Studied.

Treatment group	FEC roundworms EGP^{ns}	FEC coccidian EPG^{ns}	FAMACHA score *	PCV % ^{ns}	BW Kg. *
Control	2195.6	293.4	2.4 ^{ac}	21.8	43.6 ^{a}
Group 2	3870.2	291.2	2.8 ^{b}	20.2	39.5 ^{a}
Group 3	1921.0	462.8	2.1 ^{c}	22.3	51.9 ^{b}
Group 4	1930.8	482.8	2.4 ^{ab}	20.5	46.7 ^{ab}

^{ns} = non significant; * = significant at 5% level of probability.

Key Words: Garlic, Parasites, Goats

W18 Evaluation of FAMACHA®, PCV, BW and FEC as diagnostic approaches to evaluate the efficacy of Cydectin®(moxidectin) in controlling natural infections of *H. contortus* in adult female South African Boer, Spanish and Boer/Spanish cross goats. O. Alexander, M. Worku*, G. C. Bernard, and R. A. Franco, *North Carolina A&T State University*, *Greensboro*.

Haemonchus contortus is a gastrointestinal parasite that causes weight loss, anemia and possible death in livestock. The FAMACHA® card is a system in

use by goat and sheep producers to check for the degree of anemia by scoring the color of the ocular membrane, based on a scale from 1 to 5, with 1 exhibiting good health and no need for anthelmintic treatment. The goal of this study was to evaluate the utility of packed cell volume (PCV), bodyweight (BW), fecal egg count (FEC) and the FAMACHA®, card to evaluate the efficacy of Cydectin® as an anthelmintic treatment against *H. contortus* in goats. Twenty adult female South African Boer, Spanish and Boer/Spanish cross goats weighing ~40 kg were selectively assigned to treatment groups according to their parasite burden. Cydectin® was administered to the goats via oral drench at 0.02mg/kg. On days 0, 14, 30, 45 and 60 fecal and blood samples were taken from the goats that were also weighed and scored using FAMACHA®. FECs were conducted using a modified version of the McMaster's method. A negative, simple linear correlation with a statistical significance of (P≤ 0.001) was observed between PCV and FEC, and a negative correlation between FAMACHA® and PCV and between BW and FEC existed, but there were no relationships between other treatments. When administered at the recommended dose, Cydectin®(moxidectin) proved to have a 72% anthelmintic efficacy. The FAMACHA ® was useful in evaluating efficacy and can supplement PCV, BW and FEC in the determination of *H. contortus* burden in goats.

Key Words: FAMACHA, Moxidectin, Goats

W19 Temporal changes in rectal temperature and serum prolactin of weaned brahman-influenced heifers previously grazing endophyte-infected tall fescue pasture. G. Aiken*[1] and M. Looper[2], [1]*USDA-ARS, Forage-Animal Production Research Unit*, *Lexington, KY*, [2]*Dale Bumpers Small Farms Research Center*, *Booneville, AR*.

Suckling calves maintained on endophyte-infected tall fescue (*Festuca arundinacea* Schreb)can potentially suffer from fescue toxicosis. Twenty heifers (1/4 to 3/8 *Bos indicus*) were utilized to monitor rectal temperature and serum prolactin concentrations for 8 d post-weaning (Feb. to Oct.) from endophyte-infected tall fescue pastures. Heifers were removed from cows at approximately 0800 h on 19 October at a mean age of 226 ± 37 d and mean 205-d weaning weight of 220 ± 42 kg. During the post-graze weaning period, heifers grazed common bermudagrass [*Cynodon dactylon* (L.) Pers.] and were supplemented 2.3 kg/d per heifer of a commercial weaning ration that contained an antibiotic. Rectal temperatures were recorded, and serum was collected to quantity concentrations of prolactin at approximately 1000 h on the day of weaning (d 0) and on d 1, 2, 3, 6, and 8 post-weaning. Daily ambient temperature during the monitoring period averaged 19.7 ± 2.3°C. Rectal temperatures were never critically high (> 40.9°C), but were influenced (P < 0.001) by day. Rectal temperatures were higher on days 0, 1, 4, and 6 (mean = 40.4 ± 0.4°C). Rectal temperatures declined below 39.5°C on day 2, when ambient temperature decreased, and on d 8 to 39.4 ± 0.5°C. Concentrations of prolactin averaged 3.2 ± 3.7 µg/ml on d 0 and increased (P < 0.001) to 22.0 ± 13.5 µg/ml by d 6. Increases in prolactin over the 8 d post-weaning period indicated there could be a concurrent rapid reduction in circulating ergot alkaloids.

Key Words: Fescue Toxicosis, Weaning, Prolactin

W20 Is male reproduction affected by fescue toxicosis? P. A. Eichen*, T. J. Evans, B. C. Wray, L. E. Wax, L. T. King, E. M. Walters, J. K. Critser, G. E. Rottinghaus, and D. E. Spiers, *University of Missouri*, *Columbia*.

Fescue toxicosis is known to have a major impact on female reproductive function, but little is known about its effects on male reproduction. A preliminary study was performed to investigate the effects of heat stress (HS; 31°C), combined with endophyte toxins and associated decreased feed intake on male reproductive function. Young adult male rats (n=48; 65-70 d) were implanted with temperature transmitters to monitor core body temperature. Rats were fed a diet containing endophyte-free (E-) tall fescue seed and maintained at thermoneutrality (TN; 21°C) for five days before treatment to record baseline feed intake and growth rates. Rats were assigned to one of three treatments at either TN or HS: E- diet; endophyte-infected tall fescue seed diet (E+), formulated to deliver ~150.5 µg ergovaline/kg BW/d; or E- diet pair-fed to E+ intake (pair-fed E+). Body weight and feed intake were recorded daily. After 14 days of treatment, rats were euthanized and organ and semen samples collected. Sperm was examined for total and progressive motility and morphology by computer assisted sperm analysis (CASA). Rats fed E+ at TN had an initial decrease in feed intake ($P<.05$), but quickly returned to near pretreatment level. Rats fed E+ during HS had decreased feed intake ($P<.05$) with no recovery. Growth rate was reduced in all treatment groups ($P<.001$) relative to E-, with E+ and pair-fed E+ during HS most having the greatest reduction. The hyperthermia typically associated with E+ during HS was seen, as was the hypothermia found in E+ at TN. Testes weight relative to BW was increased in all treatment groups ($P<.004$) compared to E-, with the largest increase in E+ and pair-fed E+ during HS. All testes appeared morphologically normal with ongoing spermatogenesis. Total sperm motility decreased with HS ($P< 0.05$). Reduced feed intake (i.e., E+ and pair-fed E+ during HS) tended to decrease total sperm motility ($P< 0.10$). Future studies will examine the impact of fescue toxicosis and heat stress on other biomarkers of male fertility in animals of various ages.

Key Words: Fescue toxicosis, Heat stress, Male reproduction

W21 Does Reduced Caloric Intake Contribute to Symptoms Associate With Fescue Toxicosis? L. E. Wax*, P. A. Eichen, G. E. Rottinghaus, and D. E. Spiers, *University of Missouri*, *Columbia*.

Many problems associated with fescue toxicosis may be linked to reduced caloric intake. A study was performed using pair-fed groups to identify this condition. Male rats (n=22; avg. BW160g) were implanted with telemetric temperature transmitters to record core temperature (Tcore). Rats were randomly assigned to treatments containing either endophyte-free (E-) or endophyte-infected tall fescue seed (E+), along with pair-fed groups, {E- pair fed (E- PF), E+ pair fed (E+ PF)} containing only E- seed. Feed intake and body weights were recorded daily. Animals were maintained at thermoneutral conditions (TN; 21°C) for seven days, followed by 14 day heat stress (HS; 31°C) and a seven day recovery at TN. Blood samples were collected at end of study for serum analysis. E+ rats had an immediate ~8g (50%) decrease in feed intake (FI) upon introduction of E+ diet at TN followed by a partial recovery prior to HS. Feed intake was reduced in all groups during HS. However, E+ rats had the largest reduction, with partial recovery by the end of HS. All groups increased FI when returned to TN, but E+ rats never returned to E- level. Growth rate reflected changes in feed intake with no difference between pair-fed and corresponding treatment groups. Exposure to HS resulted in 0.7°C increase Tcore of E+ rats above that of E+PF rats ($P<0.001$). Reduced FI of E+PF rats likely decreased metabolic rate (MR) during HS to reduce Tcore below E+ level to agree with known benefits of dietary restriction during HS. During TN recovery, Tcore of E+PF rats rebounded along with FI. Lower blood glucose level in this group ($P<0.001$) suggests an increase in metabolism. The E+PF rats exhibited a greater compensatory response during recovery than any other group ($P<0.001$). Results show that although intake of rats fed an endophyte-infected diet are similar to their pair-fed counterparts under thermoneutral and heat stress conditions, the utilization of the food and corresponding thermoregulatory ability are very different.

Key Words: Fescue toxicosis, Heat stress, Feed restriction

W22 Growth performance of postweaning piglets fed diets containing flaxseed. S. Durand*[1,2], A. Guigère[2], M. Lessard[2], and J.-F. Bernier[1], [1]*Universite Laval*, *Québec, Quebec, Canada*, [2]*Agriculture and Agri-Food Canada, Dairy and Swine Research and Developpement Centre*, *Sherbrooke, Quebec, Canada*.

The objectives of this trial were to evaluate the effect of feeding flaxseed on growth performance and frequency of diarrhea in piglets during 4 weeks after weaning. Forty-eight Duroc-Yorkshire-Landrace piglets were weaned at 21±7 d of age and assigned to one of 3 isocaloric and isonitrogenous dietary treatments: control (T0), 3 % flaxseed (T3) and 6 % flaxseed (T6). Piglets were given *ad libitum* access to their respective diets for 28 d. Phase I diet was fed from d 1 to 7 and phase II diet was fed from d 7 to 28. These two diets were formulated to meet or exceed the NRC nutrient requirements. In spite of a simi-

lar initial weight (p≥0.2), final weight of piglets fed 6 % flaxseed (34.1 ± 1.4 kg) was significantly lower (p≤0.05) than those fed T0 (37.5 ± 1.4 kg) or T3 (37.0 ± 1.1 kg). Feed conversion was increased during this period (p≤0.01) for T6 (1.58 ± 0.04) as compared to T0 (1.43 ± 0.03) and T3 (1.46 ± 0.04). The feed conversion ration was rather stable after 5 days. Diarrhea frequency was higher (p≤0.01) in piglets fed T6 (15.2 %) as compared to T0 (7.1 %) and T3 (8.9 %). Diarrhea was observed mainly the day following feed restriction for weight measurement. In conclusion, diets with 6 % added flaxseed appear to have negative effect to piglet growth at 49 ± 7d of age.

Acknowledgements: La Federation des Producteurs de Porcs du Quebec and La Coop-Federee

Key Words: Flaxssed, Growth performance, Piglet

W23 Characterization of Bacterial Populations in the Gut of Piglets Treated with Probiotics by Using PCR Analysis. N. Gagnon*[1], E. Degagné[3], G. Talbot[1], M. Dupuis[1], P. Ward[2], D. Roy[2], T. A. Tompkins[3], and M. Lessard[1], [1]*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada*, *Lennoxville, Quebec, Canada*, [2]*Food Research and Development Centre, Agriculture and Agri-Food Canada*, *St. Hyacinthe, Quebec, Canada*, [3]*Institut Rosell-Lallemand Inc*, *Montreal, Quebec, Canada*.

In piglets treated with *Pediococcus acidilactici* (PA) and/or *Saccharomyces cerevisiae boulardii* (SC), PCR amplification assays were developed to characterize gut microflora and to detect PA in the gut, mesenteric lymph nodes (MLN) and liver. Thirty litters were allocated at birth to the following treatments: 1) Control without (C) or 2) with antibiotic (tiamulin) (C+A) added into feed, 3) PA, 4) SC and 5) PA+SC. During lactation, probiotic treatments (10^9 CFU) were given orally three times a week to piglets. After weaning (d 21), probiotics were added into the diet (10^9 CFU/kg). Three piglets per litter were slaughtered at 18 and 24 days of age, respectively (weaning period), or after *E. coli* challenge at 56 days of age. Bacterial DNA from samples was extracted and purified. A set of universal bacterial primers targeting the 16S and 23S rRNA genes was used to amplify the ribosomal intergenic spacer region (RISA) for characterization of gut flora at weaning period. Dendograms, principal components analysis (PCA) and diversity indices were used to compare RISA profiles of piglets. Diversity indices indicated that microbial diversity in the gut was increased ($P < 0.10$) in piglets allocated to C and SC groups compared to those of PA and C+A groups. Comparisons of RISA profiles using dendograms and PCA indicated that variation between fecal samples could not be explained by treatment or time effects. To detect PA in colon feces, MLN and liver of PA-supplemented piglets on days 18, 24 and 56, a specific PCR assay using a set of primers targeting its 16S rRNA gene was set up. The detection limit of this PCR assay was 10^3 CFU/g. The results showed a strong signal for fecal samples from PA-supplemented piglets before weaning while it was weak or negative for those obtained after weaning or after challenge. Detection of PA in MLN and liver was performed after incubation in MRS broth for 18 h. After weaning, no PA was detected in both tissues whereas after challenge 13% and 4% of MLN and liver samples were respectively positive. The PCR amplification assays helped to better understand the influence of probiotics on bacterial population in the gut of piglets.

W24 Probiotics and yeast modulate acute phase response in feedlot steers. A. Jafari*[2,1], V. Emmanuel[1], K. Beauchemin[3], J. Leedle[4], and B. Ametaj[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Isfahan University of Technology*, *Isfahan, Iran*, [3]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [4]*Chr. Hansen, Inc.*, *Milwakee, WI.*

Feeding feedlot steers high proportions of starch is associated with major changes in rumen microflora and metabolism as well as with high occurrence of metabolic diseases such as acidosis and laminitis. Recent research indicates that supplementing cattle with probiotics or yeast improves their health status and performance; however their mechanism of action is not yet understood. The objective of this research was to investigate whether supplementation of Enterococcus faecium and Saccharomyces cerevisiae (yeast) modulates mediators of acute phase response in feedlot steers. Eight steers received either the control treatment or E. faecium EF212 and yeast in a crossover design with two squares, four steers within each square and two periods. The length of each period was 3 wk, with a 10-d adaptation and an 11-d measurement period. The squares (groups) within the experiment were run concurrently. Body weights of steers in group 1 and 2 were 484+/- 58 kg and 530 +/- 33 kg, respectively at the start of the experiment. The experimental diet contained 87% steam-rolled barley, 8% whole crop barley silage and 5% supplement (DM) basis. The bacteria and yeast were blended with calcium carbonate to supply 6×10^6 cfu of bacteria per gram (6×10^6 cfu/d) and 6×10^6 cfu of yeast per gram (6×10^6 cfu/d) when top-dressed into the diet once daily at the time of feeding (10g/d/steer). Steers fed control diet received only carrier (10g/d/steer). Blood samples were drawn from the jugular vein on d 17 and 21 of each period and serum amyloid A (SAA) and haptoglobin (Hp) were measured by ELISA. Results indicated that oral supplementation of E. faecium EF212 and yeast increased plasma concentrations of SAA (325 vs 385 μg/mL)) and Hp (242 vs 431 μg/mL). Plasma concentrations of SAA and Hp did not change in time (d 17 vs d 21). In conclusion, oral supplementation of E. faecium and yeast increased concentration of two crucial acute phase proteins (SAA and Hp) in feedlot steers fed high proportions of grain. Further research is warranted to investigate the mechanism by which feeding of probiotics and yeast modifies immune response in feedlot steers.

Key Words: Probiotics, Yeast, Acute Phase Response

W25 Effects of bacterial direct-fed microbials on meditors of acute phase response in feedlot steers. D. Emmanuel*[1], A. Jafari[2,1], K. Beauchemin[3], J. Leedle[4], and B. Ametaj[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Isfahan University of Technology*, *Isfahan, Iran*, [3]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [4]*Chr. Hansen, Inc.*, *Milwakee, WI.*

The objective of this research was to investigate the effects of oral supplementation of Enterococcus faecium on mediators of acute phase response in feedlot steers. Eight steers received either the control treatment or E. faecium EF212 in a crossover design with two squares, four steers within each square and two periods. The length of each period was 3 wk, with a 10-d adaptation and an 11-d measurement period. The squares (groups) within the experiment were run concurrently. Body weights of steers in group 1 and 2 were 484+/- 58 kg and 530 +/- 33 kg, respectively, at the start of the experiment. The experimental diet contained 87% steam-rolled barley, 8% whole crop barley silage and 5% supplement (DM) basis. The bacteria supplemented were blended with calcium carbonate to supply 6×10^6 cfu of bacteria per gram (6×10^6 cfu/d) when top-dressed into the diet once daily at the time of feeding (10g/d/steer). Steers fed control diet received only carrier (10g/d/steer). Blood samples were drawn from the jugular vein on d 17 and 21 of each period and serum amyloid A (SAA) and haptoglobin (Hp) were measured by ELISA. Feedlot steers supplemented with E. faecium EF212 had lower concentrations of SAA (351 vs 409 μg/mL) and Hp (223 vs 272 μg/mL) in plasma compared to controls; however the difference was not significant. Oral supplementation of E. faecium also had no effect on plasma SAA and Hp in time (d 17 vs d 21). Both plasma concentrations of SAA and Hp correlated positively ($r=0.728$ $P<0.001$, $r=0.58$ $P< 0.01$, respectively) with blood pH; however, no significant correlations were found between plasma SAA and Hp and plasma glucose or lactate. Taken together these results indicate that oral supplementation of E. faecium had no effect on mediators of acute phase response in feedlot steers.

Key Words: Probiotics, Acute Phase Response, Feedlot Steers

W26 Relationship of prepartum plasma nonesterified fatty acids (NEFA) to periparturient production, health and reproduction of Jersey cows. G. Higginbotham*[1], J. Merriam[2], E. Nogueira[3], and J. Santos[3], [1]*University of California Cooperative Extension*, *Fresno*, [2]*Ahlem Farms*, *Hilmar, CA*, [3]*University of California*, *Tulare*.

Three Jersey dairy herds in California were visited weekly during a 16-wk period and a blood sample and body condition score (BCS) were taken from 830 cows within 21 d of projected calving (actual days prepartum were 1 to 23).

Plasma was analyzed for concentrations of NEFA. Production, reproduction and health data were evaluated in the first 120 d in lactation. Concentrations (uEq/L) of NEFA were divided into quartiles (Q1=31.1 to 94.3; Q2=94.4 to 125.4; Q3=125.7 to 182.3; and Q4=183.4 to 2685.1) and data were analyzed with the effects of NEFA quartile, day prepartum when blood was collected, dairy, parity, and BCS. Data are presented in the following sequence according to NEFA quartile: Q1, Q2, Q3 and Q4. NEFA concentrations increased as calving approached (P<0.01), but they were not influenced (P>0.15) by parity or BCS. Yields (kg/d) of milk (28.1 vs 28.3 vs 27.5 vs 27.4; P=0.21) were not affected by NEFA, but of 3.5% fat-corrected milk (32.4, 32.5, 31.3, and 30.9; P<0.02), milk fat (1.250 vs 1.250 vs 1.196 vs 1.174; P<0.01), and milk true protein (0.979 vs 0.984 vs 0.956 vs 0.944; P=0.08) reduced as NEFA concentrations increased. Reduction in yields of fat and fat-corrected milk were caused by lesser milk fat % (4.52 vs 4.46 vs 4.40 vs 4.30%; P<0.01). Increasing plasma NEFA was not associated with conception rate at first (35.7 vs 38.4 vs 35.2 vs 34.6%; P=0.92) or second AI (25.3 vs 23.4 vs 28.0 vs 28.1%; P=0.83), with the proportion pregnant at 120 d postpartum (65.6 vs 65.8 vs 66.1 vs 61.6%; P=0.89), and with days open for all cows (89.0 vs 89.1 vs 89.5 vs 90.4 d; P=0.98). Incidence of mastitis (15.2%) and d postpartum at the first clinical mastitis case (27.9 d) did not differ (P>0.15) according to NEFA. The proportion of cows leaving the herd (11.2%) and the interval from calving to leaving the herd (109.4 d) were not associated (P>0.15) with NEFA. Increasing plasma NEFA concentrations prepartum reduced milk fat content, which affected yields of fat and fat-corrected milk, but they were not associated with reproduction and health.

Acknowledgements: Partially funded by the American Jersey Cattle Association.

Key Words: NEFA, Reproduction, Jersey

Beef Species

W27 Calves energy retention and efficiency to weaning in Nellore, British x Nellore and Continental x Nellore crossbred calves. L. Calegare[1], M. M. Alencar[2], G. M. Cruz[2], and D. P. D. Lanna*[1], [1]*Animal Growth and Nutrition Lab*, *ESALQ/USP, Piracicaba, SP, Brazil*, [2]*Embrapa*, *Sao Carlos, SP, Brazil*.

Calf energetic efficiency is the ratio of the empty body energy (EBE) at weaning and metabolizable energy intake (MEI - concentrate plus milk). The objective of this study was to determine EBW composition and energy retained to weaning. Forty cow/calf pairs were randomized in blocks by calving date. Nellore cows were bred to Nellore bulls and crossbred cows (Canchim x Nellore, Angus x Nellore, and Simmental x Nellore) were bred to Canchim (5/8Charolais: 3/8Zebu) bulls. Cows and respective calves; NL, 3/4C, 1/4A, and 1/4S were individually fed a pelleted diet (16% CP, 2.24 Mcal ME, DM basis) from 15 d postpartum to weaning at 180d. The NL calves consumed less ME (P>0.01) than 1/4S, 796±66 vs. 1061±61. The 1/4A and 3/4C calves were intermediate: 938±57, 955±56 Mcal, respectively. Calves were slaughtered at weaning, and body composition estimated by 9-10-11th rib section chemical composition. The energy retained was a difference between EBE at weaning and at birth. EBW of NL calves was lower (P<0.05) at birth and weaning than crossbreds: 29.7±1.9, 149±11 vs. 38.4±1.9, 183±9 (3/4C); 36.4±1.9, 196±9 (1/4A); and 42.5±1.9, 203±10 kg (1/4S). At weaning 1/4A calves had lower water (P<0.05) and higher EBW fat contents (P<0.05; 61.6±0.8, 14.0±0.8, respectively) than 3/4C (64.6±0.8, 10.9±0.8), and 1/4S (64.3±0.8, 11.3±0.9). NL calves had higher EBW water (64.3±0.9%) than 1/4A and intermediate fat content (12.2±0.9%). NL calves deposited 46% and 31% less EBE (P<0.05) than 1/4A and 1/4S: 291.2±33.4 vs. 424.4±29.4 and 381.7±31.2, respectively. The 3/4C calves had intermediate EBE, 341.2±28.5 Mcal. The 1/4A calves were more efficient (P<0.05) than NL, 3/4C, 1/4S: 0.455 vs. 0.372, 0.355, and 0.363±0.03, respectively. British crossbreds were more efficient because of higher growth rate (dilution of maintenance) and higher fat deposition (higher k_g). Nellore deposited 31% less EBE, but was as efficient as 1/4S probably because of lower maintenance requirements.

Acknowledgements: Fapesp, CNPq, Embrapa, USP

Key Words: Body Composition, Genotypes, Weaning Weight

W28 The relationship between infrared thermography and residual feed intake in cows. A. L. Schaefer*[1], J. Basarab[2], S. Scott[3], J. Colyn[1], D. McCartney[1], J. McKinnon[4], E. Okine[5], and A. K. W. Tong[1], [1]*Agriculture and Agri-Food Canada*, *Lacombe, Alberta, Canada*, [2]*Alberta Agriculture Food and Rural Development*, *Lacombe, Alberta, Canada*, [3]*Agriculture and Agri-Food Canada*, *Brandon, Manitoba, Canada*, [4]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*, [5]*University of Alberta*, *Edmonton, Alberta, Canada*.

The present study examined the relationship between infrared thermographic images collected non invasively and residual feed intake (RFI) in cows. RFI is the difference between actual and expected feed intake based on size and growth over a fixed time. Dorsal thermal scans were collected on 37 mature, crossbred beef cows (mean BW = 750 kg) on three dates approximately one month apart using an Inframetrics 740 or 760 camera. Duplicate thermal scans were used for analysis. A maximum dorsal temperature was used in the thermal calculations. Residual feed intake was monitored on all animals for an 84 day period using an electronic ID and a Growsafe® feed monitoring system. Cows were classed into three categories, namely, those expressing RFI < 1 (more efficient), those with RFI > 1 (less efficient) and those animals with intermediate RFI. Based on least squares analysis with two tailed, unpaired t-tests, cows with RFI < 1 (mean RFI -2.81 kg as fed per day ± 2.06 SD, n=12) displayed significantly lower average dorsal maximum temperatures than cows with RFI values >1 (mean RFI 3.87 kg as fedper day ± 2.86, n=11) (17.9 C ± 1.3 for RFI < 1 vs 19.7 C ± 1.43 for RFI >1 respectively, P< 0.01). Using representative feeding costs for cows, these differences inRFI would equate to greater than $100 per animal per year. The data suggest that the use of infrared thermal scans may display utility in the assessment and ability to fort feed efficiency in cattle.

Key Words: Cattle, Feed Efficiency, Infrared

W29 Correlations between residual feed intake and carcass traits in finishing steers administered different anthelmintic treatments. P. A. Lancaster, B. R. Schilling*, G. E. Carstens, E. G. Brown, T. M. Craig, and D. K. Lunt, *Texas A&M University*, *College Station*.

Unlike feed:gain ratio (F:G), residual feed intake (RFI) is a measure of feed efficiency that is independent of growth traits. Several studies have reported that RFI is correlated with carcass composition. The objective of this study was to determine if carcass traits will improve the accuracy of predicting DMI used to calculate RFI. Red Angus steers (n = 119; BW 296 ± 34 kg) were assigned to one of three anthelmintic treatments and individually fed a high-grain diet (ME = 2.73 Mcal/kg) for 138 d using Calan feeders. Traits measured were DMI, 28-d BW, as well as 12th rib fat thickness (BF), KPH, marbling score (MS), and REA at harvest. Step-wise regression was used to examine effects of carcass traits in predicting DMI beyond the base model (DMI = β1*ADG + β2*mid-test metabolic BW; MBW). Anthelmintic treatment did not affect (P > 0.25) DMI, ADG, MBW, F:G, or carcass traits, and had negligible effect when included in the base model as a class variable. Inclusion of KPH and BF into an adjusted model (R^2 = 0.66; RMSE = 0.81) resulted in a small improvement over the base model (R^2 = 0.59; RMSE = 0.88). RFI calculated from base and adjusted models were correlated (P < 0.001) with DMI (r = 0.64 and 0.58) and F:G (r = 0.46 and 0.43), but not ADG or MBW. Base model RFI was correlated (P < 0.05) with BF (r = 0.27), KPH (r = 0.32), and MS (r = 0.20), but not REA, whereas, adjusted model RFI was not correlated with carcass traits. Both models revealed that steers with low RFI (< 0.5 SD below the mean) consumed 18-19% less DMI, but had similar ADG and MBW compared to steers with high RFI (> 0.5 SD above the mean). From base model, steers with low RFI had less

(P < 0.01) BF (1.29 vs 1.56 ± 0.06 cm), KPH (3.12 vs 3.58 ± 0.10%) and MS (3.90 vs 4.19 ± 0.07) compared to high RFI steers. Carcass traits did not differ between adjusted model low vs high RFI steers. Although Spearman's rank correlation for base and adjusted model RFI was 0.87, results suggest that inclusion of carcass composition traits in models to estimate RFI may be warranted.

Key Words: Net Feed Efficiency, Regression Models

W30 Evaluation of SafeGuard® (fenbendazole) oral drench in addition to Ivomec® (ivermectin) pour-on vs. Dectomax® (doramectin) injectable alone on parasite load, performance and carcass merit of finishing heifers. C. D. Reinhardt*, J. P. Hutcheson, and W. T. Nichols, *Intervet, Inc.*, *Millsboro, DE*.

Seven hundred fifty-six crossbred yearling heifers were treated with either 1) Safe-Guard (fenbendazole) drench plus Ivomec (ivermectin) Pour-on (SG+IVO) or 2) Dectomax (doramectin) Injectable alone (DMXINJ). Heifers receiving SG+IVO shed 97% fewer (P=.003) worm eggs per sample 35 days after treatment than heifers treated with DMXINJ. With a reduced parasite burden, SG+IVO treated heifers consumed 1.2 lb more feed daily, were 29 and 25 lb heavier at harvest (live and carcass adjusted basis), had .14 and .10 lb higher ADG (live and carcass adjusted basis) and had 16 lb heavier carcasses than DMXINJ treated heifers (P<.10). There were no differences in feed efficiency, yield grade, or carcass quality. Heifers treated with SG+IVO did have a lower percentage of dark cutters (P<.10) than DMXINJ heifers (.5 vs. 2.1%). The combination of Safe-Guard and Ivomec Pour-on increases feed intake, daily gains, and carcass weight in feedlot heifers compared to using Dectomax injectable alone.

Key Words: Fenbendazole, Feedlot, Dewormer

W31 Effects of Revalor®-G in grazing heifer growth performance and subsequent breeding performance. W. T. Nichols*[1], K. Hill[2], J. P. Hutcheson[1], and C. D. Reinhardt[1], [1]*Intervet, Inc.*, *Millsboro, DE, USA*, [2]*Hill Veterinary Svcs.*, *Kaysville, UT, USA*.

One-hundred fifty Angus and Angus cross-bred heifers approximately 12 months of age were used to evaluate the effects of Revalor®-G on grazing heifer growth performance and subsequent breeding parameters. Heifers were assigned to either an implant treatment (R) group (n=75) consisting of Revalor-G (40 mg Trenbolone Acetate and 8 mg Estradiol 17β) or negative control (C) group (n=75) on day 0 by assigning every other heifer through the chute to one of the two treatments. Treatment R heifers received the Revalor-G implant subcutaneously in the right ear according to label directions on day 0. All heifers were individually tagged at processing and individual weights were taken following the implanting and tagging process on d 0. Four two year old Angus bulls were introduced to the herd on d 36. Bulls were subsequently removed 60 days later. Heifers were individually weighed after standing overnight in a dry pen on d 96 to ascertain final weights. All heifers were pregnancy checked by palpation on d 135 and d 148. The initial weights between treatments were significantly (P<.001) different, while the final weights were similar (P>.63). These differences resulted in the R treatment significantly (P<.001) improving ADG and total gain in comparison to the C treatment. There were no differences found between treatments in percent pregnancy (74% and 72% respectively for C and R). However, there was a significant (P<.001) difference in days to conception which favored C. These data indicate that grazing heifer ADG was improved 12% and total gain improved 11% by implanting with Revalor-G. In addition this trial demonstrated that implanting heifers with Revalor-G did not negatively affect conception rate of breeding heifers. However, the use of Revalor-G might increase days to conception in comparison to non-implanted heifers.

Heifer Grazing Performance and Breeding Parameters

Item	Revalor®-G	Control	P-value	SEM
Initial wt, kg	296	302	<.001	0.57
Final wt, kg	358	357	.63	2.04
Gain, kg	62	56	<.001	0.40
ADG, kg	0.65	0.57	<.001	0.018
No. Pregnant[1]	54	56	1.00	
days to Conception	30	24	<.001	0.58

[1]Chi-Square Analysis

Key Words: Anabolic Implants, Grazing, Heifers

W32 Evaluating rapid methods for determination of total conjugated linoleic acid in beef fat. M. E. R. Dugan*[1], D. C. Rolland[1], and J. K. G. Kramer[2], [1]*Agriculture and Agri-Food Canada*, *Lacombe, Alberta, Canada*, [2]*Agriculture and Agri-Food Canada*, *Guelph, Ontario, Canada*.

The level of conjugated linoleic acid (CLA) in beef may be of ecomomic value due to its potential health benefits. Levels of CLA in beef can be quite variable between animals even when feeding the same diet, as CLA and CLA precursors are products of the sometimes inconsistent process of bacterial biohydrogenation. Thorough analysis of CLA isomers involves a combination of techniques including GC with a 100 m column combined with silver ion HPLC, and thus is ill suited for rapid sorting of carcasses or tissues of potential economic value. Three simple methods for the measurement of CLA in beef fat using CLA's characteristic absorbance at 233 nm were, therefore, investigated and compared with results obtained by GC. Twenty four beef fat samples ranging continuously in CLA concentration from 0.32 to 1.92% were used for this study. Regressing CLA concentrations determined by GC with those obtained by (1) direct extraction with ethanol (2) after saponification and (3) after direct methylation of beef fat with sodium methoxide (0.5M) followed by measurment of absorbance at 233 nm in ethanol resulted in R^(2)^s of 0.96, 0.93 and 0.98 respectively and significant slopes for all equations (P < 0.01). As a consequence, when comparing differences between predicted and actual results, saponification results tended to be more variable than results obtained after direct methylation (P = 0.10). Direct extraction by ethanol followed by measuring absorbance at 233 nm may thus be the simplest and most viable method for the rapid sorting of beef carcasses with differing CLA contents. It would now, however, be interesting to test the robustness of this methodology during a larger scale industry survey.

Key Words: CLA, Beef, Method

W33 Effect of method and timing of castration on growth performance and morbidity of newly arrived stocker cattle. M. D. Ratcliff*, E. B. Kegley, S. L. Krumpelman, and J. A. Hornsby, *University of Arkansas Division of Agriculture*, *Fayetteville*.

Method and timing of castration could be one of many factors that impact the performance and health of newly arrived stocker cattle. Two hundred seventy two crossbred male calves (185 bulls, 87 steers; 210 ± 14.7 kg) were purchased and shipped to the Stocker Unit in Savoy, AR in three groups. Upon arrival, calves were weighed, identified, and allowed access to hay and water for 24 h. Bull and steer calves were randomly assigned to pens, and within pens, assigned to one of five treatment groups consisting of: calves that arrived as steers; calves that arrived as bulls and were castrated surgically on d 0 or 14; calves that arrived as bulls and were castrated utilizing a bander on d 0 or 14. The next day, calves were processed and designated bull calves were castrated. On d 14, the remaining bull calves were castrated. Calves were housed in 0.45 ha grass lots and were offered ad libitum hay and a daily grain supplement (1.8 kg as fed basis). Calves were observed for 43, 50, and 52 d for each group received, respectively. For bulls, there was a method × castration day interaction ($P < 0.01$) for ADG. Bulls surgically castrated on d 0 had the greatest ADG (0.66 kg)

with bulls surgically castrated on d 14 gaining the least (0.50 kg). Steers had a tendency ($P = 0.06$) to have higher total ADG when compared to calves that arrived as bulls. Neither method nor timing of castration affected the number of bulls treated for respiratory disease, the number of antibiotic treatments required/calf, or medication costs/calf ($P \geq 0.54$). However, calves that arrived as steers had a lower percentage of calves that received the first and second round of antibiotic treatments, number of antibiotic treatments required/calf, and medication costs when compared to bulls ($P < 0.04$). This study indicated that method and timing of castration would impact overall growth performance of newly arrived stocker-cattle; however, if calves are castrated prior to arrival, ADG and morbidity could be enhanced.

Key Words: Castration, Stocker Calves, Cattle

W34 Weight and carcass characteristics of nelore, guzerat-nelore and brahman-nelore steers. E. Ribeiro*[1], J. Hernandez[2], E. Zanella[3], M. Shimokomaki[1], S. Prudencio-Ferreira[1], E. Youssef[1], H. Ribeiro[1], and J. Reeves[2], [1]*Universidade Estadual de Londrina*, *Londrina, PR, Brazil*, [2]*Washington State University*, *Pullman*, [3]*Universidade de Passo Fundo*, *Passo Fundo, RS, Brazil*.

This experiment was carried out to evaluate the performance of steers of three genetic groups: 1) Nelore x Nelore (NN), 2) Guzerat x Nelore (GN) and 3) Brahman x Nelore (BN). Forty-one animals, 24 mo of age at the initiation of the study, were grazed on Brachiaria grass, in the state of Mato Grosso, Brazil. All animals came from the same herd and were raised under the same conditions. They were slaughtered at 3 years of age. At the beginning of the experiment and at slaughter, Brahman-crossed animals were heavier than the animals from the other two groups. Means for body weight for the groups NN, GN and BN, were respectively, 324, 320 and 343 kg ($P<0.06$) at the beginning of the experiment, and 474, 470 and 499 kg ($P<0.02$) at slaughter. However, average daily gains were similar among the groups (0.388, 0.386 and 0.409 kg/d, respectively). Brahman (BN) group produced heavier ($P<0.05$) hot carcasses (253 kg) than the Guzerat (GN) group (238 kg), but they were not different than the straightbred Nelore (NN) group (242 kg). Percentages of carcass muscle (58.7, 56.5 and 57.3 %), fat (23.1, 25.4 and 25.1 %) and bones (17.9, 17.8 and 17.4 %) were similar among the groups (NN, GN and BN, respectively). Other carcass traits (dressing percentage, ribeye area, fat thickness and marbling) and meat tenderness, measured by a trained panel (5.5, 6.2 and 6.0) or by a texturometer (135, 111 and 134, Newton's force) were, also, similar among the three genetic groups (NN. GN and BN, respectively). Crossing other zebu breeds (Brahman or Guzerat) with Nelore did not improve qualitative characteristics of carcasses and meat; however, crossing with Brahman resulted in heavier animals with heavier carcasses.

Key Words: *Bos indicus*, Crossbreeding, Zebu

Companion Animals: Nutritional and Health Considerations for Companion Animals I

W35 Metabolic & histopathological effects of the somatotropin/insulin-like growth factor axis on bone healing in a canine unstable gap fracture healing model. F. Buonomo*[1] and D. Millis[2], [1]*Monsanto Company, Animal Science Division*, *St. Louis, MO*, [2]*University of Tennesee*, *Knoxville*.

The involvement of the somatotropin/IGF-I axis on bone fracture healing was investigated using an unstable gap fracture model in dogs. Beagle dogs (24) were randomly assigned to groups receiving canine somatotropin (cST) at 0, 2, 4 or 6 mg/d for 42d. A 3mm radial ostectomy was then performed on all dogs. Weekly blood samples were obtained preoperatively, and for 12wks post-surgery for cST, IGF-I and osteocalcin (OST) determinations. Radiographs were obtained biweekly to assess the progression of fracture healing. Biweekly ^{99}mTechnetium-MDP injections and scans were performed to determine metabolic activity at ostectomy sites. Scans were evaluated for pattern of activity and count densities at the ostectomy sites as compared to those of the ipsilateral humerus. Radiographic bone area (BA), bone mineral content (BMC) and bone density (BD) were determined by DEXA at the ostectomy site, proximal and distal to the ostectomy, and the total bone at 12wks post-operative. Bones were then subjected to 3 point bending biomechanical testing, and ultimate load at failure (ULF) and stiffness were determined. Comparisons between trt groups were made using either Student's T test or repeated measures ANOVA as appropriate.

Serum cST, IGF-I and OST increased during healing in cST-treated dogs, but remained unchanged in control dogs ($P<.01$). CST-treated dogs had more advanced signs of radiographic healing than control dogs; the former nearly reaching clinical union by wk 12, while the latter developed oligotrophic nonunions. All dogs had increased ^{99}mTc uptake at ostectomy sites over time; that being greater in cST-treated vs. control dogs. BA, BMC and BD of ostectomized radii were greater at all measured sites in the cST-treated dogs. Indices of biomechanical strength indicated that ULF and stiffness of the ostectomized radii were greater at all measured sites in the cST-treated dogs. These results demonstrate that somatotropin-induced increases in serum growth factor levels, such as IGF-I and OST, are associated with improved parameters indicative of advanced bone fracture healing.

Key Words: Somatotropin, IGF-I, Canine

W36 Antioxidants to protect petfood diets enriched in essential fatty acids from autoxidation. T. Tanner* and L. Deffenbaugh, *Kemin Industries, Inc.*, *Des Moines, IA*.

Fat in a petfood diet provides a majority of the gross energy as well as essential dietary fatty acids. Fat is highly susceptible to degradation, especially in a dry petfood diet where exposure to pro-oxidants accelerates autoxidation. Ingestion of oxidized lipids has a negative effect on growth, antioxidants status and some immune functions of dogs (Turek, et al. 2003). The choice of the type and levels of fats is largely determined by nutritional targets for the ratio of ω-3 and ω-6 fatty acids and specific essential fatty acids such eicosapentaenoic acid and docosahexaenoic acid. Animal fats are more stable and less costly than vegetable and marine oils, but do not always provide ideal levels of unsaturated and essential fatty acids. The challenge of stabilizing dry diets, often preferred over wet diets for convenience and cost, is magnified when unsaturated fats and oils are used, greatly increasing the risks of consuming oxidized fats. An experimental petfood diet was used to identify the best antioxidant for a highly unsaturated diet. The diet was composed of corn, poultry meal, rice, soybean meal, vitamins and minerals plus 5% salmon oil applied topically to the extruded core. No liquid animal fat was used. In ambient storage, this diet treated with either ethoxyquin and tocopherols alone experienced severe oxidation within one month. Blends of tocopherols and rosemary extract protected this diet through 3 months ambient storage, maintaining Peroxide Value at <2 meq / kg. Further, accelerated storage suggested that the tocopherol / rosemary extract blends will maintain stability of this highly susceptible diet for >6 months. The addition of ascorbyl palmitate to blends of tocopherols and rosemary extract further improves efficacy in marine oils and diets containing marine oils. The use of tocopherol / rosemary extract blends in such difficult to stabilize diets is finally approaching the target 12 month shelf life target for dry pet foods, which will likely be achievable with further optimization.

Key Words: Essential Fatty Acids, Antioxidants, Autoxidation

W37 Cloning and in vitro characterization of dog PepT1 and development of a polarized cell model to study PepT1 trafficking and regulation. B. Zanghi*[1], N. Etienne[1], A. Matthews[1], E. Miles[1], G. Davenport[2], and J. Matthews[1], [1]*University of Kentucky*, *Lexington*, [2]*The IAMS Company*, *Lewisburg, OH*.

Peptide Transporter 1 (PepT1) mediates the H^+-dependent absorption of di- and tripeptides in intestinal and renal epithelial cells. To identify the protein respon-

sible for putative dog PepT1 (dPepT1) activity reported earlier by us (FASEB J. 2001, 15: A829), we generated a full-length cDNA predicted to encode a 708 amino acid-protein from MDCK cells using 5′- and 3′-RACE and RT-PCR methodologies. Dog PepT1 shares 81, 83, and 83% amino acid identity with human, sheep, and pig PepT1, respectively. To characterize the functional activity of dPepT1, non-polarized Opossum Kidney (OK) cells were transiently transfected with pcDNA3.1-dPepT1 or pEGFP-N1-dPepT1 (GFP-PepT1) plasmids and glycylsarcosine (GlySar, 1 mM) uptake measured 48 h after transfection. With both dPepT1 and GFP-dPepT1, H^+-dependent [^{3}H]GlySar uptake (pmol•mg^{-1} protein·30 min^{-1}) by transfected OK cells was optimal at pH 5.5 (3.1 times greater ($P < .0001$) vs pH 7.5) and saturable (Km = 0.57 ± 0.25 mM). IC_{50} studies demonstrated that dPepT1 possesses a range of substrate affinities (TrpLeu: 38 µM, carnosine: 1200 µM, cefadroxil: 600 µM). GlySar uptake was similar with dPepT1 and dPepT1-GFP. Western blot analysis demonstrated immunoreactivity of anti-pig PepT1 antibody for dPepT1 (92 kDa) in OK cell homogenates. To develop a cell culture model to study membrane-specific substrate- or hormone-dependent regulation of dPepT1, polarized OK cells were transfected with dPepT1 and GlySar uptake (pmol·well^{-1}·90 sec^{-1}) measured. Apical GlySar uptake was 8 times greater ($P < .01$) than basolateral. This report uniquely describes the molecular and functional characterization of dog PepT1, and demonstrates that a useful cell model to study membrane trafficking and membrane-specific regulation of PepT1 has been established.

Key Words: Canine, Peptide Transport, GFP-PepT1

W38 Feeding of chicken or soy protein-based diet differentially affects in vivo PepT1 uptake capacity in dogs. B. Zanghi*[1], G. Sipe[1], G. Davenport[2], and J. Matthews[1], [1]*University of Kentucky*, *Lexington*, [2]*The IAMS Company*, *Lewisburg, OH*.

Intestinal Peptide Transporter 1 (PepT1) expression can be upregulated by increasing amounts of dietary casein and certain dipeptides. Previously, we demonstrated that orally bolused [^{3}H]cefadroxil (CEF, 40 µCi, 40 nmol) was a good substrate to detect changes in PepT1 uptake capacity in adult, female, mongrel dogs (JAS, 2004, 82(1): A375). The objective of these experiments were to evaluate the effect of feeding isonitrogenous diets that contained chicken (C) or soy (S) protein sources on PepT1 functional capacity and total tract digestibility. CEF was bolused 4 (Exp. 1) or 14 h (Exp. 2) after feeding and ^{3}H appearance, metabolism, and disappearance in blood, urine, and feces was measured. Exp 1 compared the effect of 18-d feeding of C, S, and S supplemented with carnosine or glycylsarcosine diets on these CEF parameters using a 4 x 4 Latin Square design (n = 4; BW = 21.3 ± 2.5 kg), whereas Exp 2 evaluated 39-d feeding of C versus S diets with a crossover design (n = 3). For Exp 1 and 2, the C diet had a greater ($P < 0.05$) apparent total tract DM, OM, CP (92 vs 86%), DE, and NDF digestibility versus any S diet. In Exp 1, plasma content (pmol) of CEF from 3.5 or 5.5 h through 12 h after dosing (renal retention capacity) was 19 or 24% greater ($P < 0.06$) with the C diet than the S diet. In Exp 2, plasma content of CEF was 200 or 89% greater from 0 through 1.5 h or 2.5 h, respectively, after dosing (intestinal uptake capacity) with the S diet than C diet. No treatment effects were observed for CEF metabolism or ^{3}H disappearance from plasma or urine in either experiment. Within a dietary treatment and across experiments, intestinal and renal CEF absorption capacity increases in the postprandial state of dogs fed a C diet, whereas CEF absorption capacity is about the same in the postprandial and fasting state of dogs fed a S diet. These data indicate that C and S diets differentially affect in vivo PepT1 functional capacity.

Key Words: Canine, Intestine, Cefadroxil

Dairy Foods: Dairy Microbiology and Dairy Processing

W39 Quality characteristics and consumer acceptance of yogurt fortified with date fiber. I. Hashim*, A. Khaul, and H. Afifi, *UAE University*, *Al Ain, United Arab Emirates*.

Milk and dairy products do not contain fiber while the by-product produced during date syrup production is a good source of dietary fiber. The objective of this study was to investigate the effects of date fiber (DF) fortification on yogurt quality and sensory properties. Quality characteristics, sensory properties and consumer acceptance of yogurt fortified with DF were evaluated. Yogurt samples were prepared from whole milk using a commercial yogurt formula (2.5% milk solid nonfat, 0.6% stabilizer and commercial yogurt culture). Control yogurt and yogurts containing 1.5, 3, and 4.5% DF as well as 1.5% wheat bran (WF) were prepared. Acidity (1.04) and pH (4.47) of yogurt were influenced by DF fortification (1.08 and 4.61-4.65). Yogurts fortified with DF had firmer texture (hardness 55-57) and darker color [lower L* (75.4-84.8) and higher a* (2.7-4.9)] than control (L = 95.5 and a* = -.8) or WF (L=89.3 and a* = 0.8) yogurts. Hedonic ratings by 32 consumers indicated that yogurt appearance (8.3) and color (8.5) were significantly affected by the addition of DF (6.2-6.5). Yogurt containing up to 3% DF had similar hedonic ratings for sourness, sweetness, firmness and overall acceptance as the control yogurt. Increasing DF to 4.5% decreased sensory ratings and acceptability of yogurt significantly.

Fortifying yogurt with 3% DF produced acceptable yogurt with beneficial health effects.

Acknowledgements: This study was funded by the Research Council at United Arab Emirates University.

Key Words: Yogurt, Date Fiber, Quality and Consumer Acceptance

W40 Effect of milk heat treatment on the growth and viability of *Bifidobacterium animalis* Bb12 during fermentation and storage of yogurt. L. Fachin and W. Viotto*, *State University of Campinas - UNICAMP, Faculty of Food Engineering, Department of Food Technology*, *Campinas, SP, Brazil*.

Production of yogurt with *Bifidobacterium* spp. has being attracting much attention in the last years due to health benefits of these microorganisms. However, it is claimed that a minimum level of these bacteria (usually 10^6 cfu/g of the product) should remain viable at the moment of consumption. Many studies have pointed to the low viable counts of these microorganisms during shelflife. Lactulose is a known prebiotic that is produced by severe heat treatments of the milk. The objective of this work was to evaluate the effect of the heat treatment of 142°C/15 s comparing to the control one, 90°C for 5 minutes, on the growth of *Bifidobacterium animalis* BB 12 during yogurt fermentation and its viability during storage, monitoring textural changes, sineresis and yogurt post-acidification. Heat treatment of 142°C/15 s had no effect on the growth of *Bifidobacterium animalis* Bb12 during yogurt fermentation and on its viability during storage. Yogurt post-acifdification also did not change but heat treatment impaired texture, decreasing hardness, gummines and adhesiveness of the product. Whey separation, however, was slightly improved compared to the control.

Key Words: Heat Treatment, Probiotic, Yogurt

W41 Effect of *Propionibacterium freudenreichii* PS-1 on the growth and viability of *Bifidobacterium animalis* Bb12 during fermentation and storage of yogurt. L. Fachin and W. Viotto*, *State University of Campinas - UNICAMP, Faculty of Food Engineering, Department of Food Technology*, *Campinas, SP, Brazil*.

Bifidobacterium spp. is increasingly being incorporated into dairy foods, especially yogurt, due to their health benefits. However, many studies have shown

low viability of these microorganisms during shelflife. Consequently, much attention is being paid to increase growing and survival of these microorganisms in dairy foods. In the last decade, some studies have pointed to the ability of *Propionibacterium* spp. in producing some bifidus growth promoter metabolites. The objective of this work was to study the effect of *Propionibacterium freudenreichii* PS-1 on the growth of *Bifidobacterium animalis* Bb 12 during yogurt fermentation and its viability during storage, monitoring textural changes, sineresis and yogurt post-acidification. *P. freudenreichii* PS-1 decreased fermentation time of yogurt by 1.2 hours while slightly increased *Bifidobacterium* growing during fermentation. Viability of *B. animalis* Bb 12 decreased 0.3 log cycles in yogurt with *P. freudenreichii* PS-1 and 0.8 cycles in control yogurt during 4 weeks of storage at 7°C. Yogurt texture was drastically changed by addition of propionibacteria with a great increase in gumminess and adhesiveness of the product. Yogurt with *P. freudenreichii* PS-1 also showed a lesser tendency to post-acidification than the control one and it also decreased whey separation by half of its value after storage.

Key Words: *Bifidobacterium*, *Propionibacterium*, Yogurt

W42 Development of symbiotic goat's milk yogurt beverage. S. Li*, S. Gokavi, and M. Guo, *University of Vermont*, *Burlington*.

Goat's milk and its products are gaining popularity in the USA and other developed countries and they are considered as specialty foods. The objectives of the study were to develop symbiotic beverages; and to evaluate the viability of probiotics during storage. Four prototypes were developed: Plain (A), Vanilla (pH 4.1) (B), Strawberry (pH 3.8) (C) and Vanilla (pH 3.8) (D). Yogurt base was made using the starter culture Yofast-20 (mixture of *S. thermophilus*, *L. delbrueckii* ssp. *bulgaricus*, *L. acidophilus*, *Bifidobacterium* ssp. and *L. casei*) from Chr. Hansen. To the yogurt base sugar, inulin, pectin, water, strawberry flavor, strawberry concentrate, beet extract, citric acid and probiotic supplement (ABC -1 containing *L. acidophilus*, *Bifidobacterium*, spp. and *L. casei*) were added as per the prototypes and then homogenised. The beverages were stored under refrigerated conditions and analysed for changes in pH, titratable acidity (TA) and viscosity. The probiotics were also enumerated every week to determine their viability during storage. Total solids of the beverages ranged from 17.2-17.8, protein 2.5-2.6, fat 2.9, ash 0.6-0.7 and carbohydrates 11.1-11.9%. The beverages had calcium ranging from 148.0-165.3, phosphorous 145.7-167.7, potassium 246.7-351.3 and sodium 64.0-78.9 mg/kg, respectively. The values of pH, TA and viscosity were 4.10±0.03, 4.09±0.06, 3.83±0.06 and 3.83±0.06, 0.71±0.03, 0.71±0.02, 0.84±0.02 and 0.84±0.02%, 31.5±2.67, 31.1±4.43, 39.9±6.81 and 31.1±3.04 mPas for A, B, C and D, respectively. The initial population of *L. acidophilus*, *Bifidobacterium* spp. and *L. casei* were $3.17\pm2.2\times10^7$, $2.5\pm1.7\times10^7$, $3.7\pm1.8\times10^7$ and $1.8\pm1.1\times10^7$; $9.0\pm9.2\times10^7$, $8.58\pm2.2\times10^8$, $8.94\pm1.32\times10^8$ and $5.39\pm3.4\times10^8$; $2\pm1\times10^6$, $2\pm1\times10^6$, $4\pm3\times10^6$ and $2\pm1\times10^6$ cfu/ml for A, B, C and D, respectively. *Lactobacillus acidophilus* was viable only for two weeks, however, *Bifidobacterium* spp. and *L. casei* remained viable for 3 weeks and their viability will be studied for about 8-10 weeks. The results indicate that goat's milk may be a good vehicle for developing symbiotic beverages.

Acknowledgements: Authors would like to thank Oak Knoll dairy for providing goat's milk for the studies.

Key Words: Goat's Milk, Symbiotic, Beverage

W43 Fat free plain yogurt manufactured with inulins of various chain lengths and *Lactobacillus acidophilus* or *Lactobacillus casei*. K. Aryana*, S. Begum, and P. McGrew, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Health benefits of inulin are several, namely; it is a dietary fiber, improves activity of beneficial bacteria and increases calcium absorption. Dairy products such as fat free plain yogurt do not have fiber. Objective was to determine the impact of short, medium and long chain inulins on the physico-chemical, sensory and microbiological characteristics of fat free plain yogurt manufactured with *Lactobacillus acidophilus* or *Lactobacillus casei*. *Lactobacillus acidophilus* or *Lactobacillus casei* was incorporated in the yogurt mix immediately after inoculation with *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. Short, medium and long chain lengths inulins were incorporated at the rate of 1.5% w/w yogurt mix. Total solids in the control was kept constant with non fat dry milk. Viscosity, pH, syneresis, instrumental color (L^*,a^*,b^*), sensory flavor, body texture, appearance and color of the yogurts were studied at days 1, 11 and 22 after product manufacture. Readings were recorded in triplicate per replication. Two replications were conducted. Data were analyzed by ANOVA using the Proc GLM of SAS. Significant differences were determined at α=0.05.

In the yogurts made with *Lactobacillus casei* inulins of different chain lengths did not impact product viscosity, appearance, and b^* values. Yogurts with inulins had significantly (p<0.05) higher *L. casei* counts compared to control.

Freshly made (day 1) yogurts with either *L. casei* or *L. acidophilus* had significantly (p<0.05) higher flavor scores, lower body and texture scores, lower L^* (lightness) values compared to yogurts stored for days 11 and 22.

In the yogurts made with *Lactobacillus acidophilus* inulins of different chain lengths did not impact product viscosity, syneresis, pH, a^* and b^* values. Yogurts with long and short chain length inulins had body and texture scores comparable to the control. The interaction effect of chain length and storage time was significant (p<0.05) for *L. acidophilus* counts.

Chain length of inulins did not impact most of the characteristics of probiotic yogurts.

Key Words: Symbiotic, Fermented, Milk

W44 Fat free lemon and strawberry flavored yogurts fortified with folic acid. C. Boeneke* and K. Aryana, *Louisiana State University Agricultural Center*, *Baton Rouge*.

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. The objective of this study was to examine the effect of different concentrations and stages of addition of folic acid on the physico-chemical and sensory characteristics of flavored yogurts over a storage period. Fat free yogurts were 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 and incorporation of lemon and strawberry flavoring. 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 Duncans Multiple Range Difference Test. Lemon and strawberry pH values were lower than plain yogurt. Level of folic acid did not impact flavor scores. Mean flavor scores for lemon and strawberry yogurts were higher than plain yogurts. Body and texture values of lemon and strawberry yogurts appeared to decrease over the five week storage period. Addition of flavor to folic acid fortified yogurts helped improve flavor scores.

Key Words: Folic Acid, Fortified

W45 Physical and sensory attributes of stirred yogurts: impact of the physical properties of initial gel and breakdown process. W. J. Lee* and J. A. Lucey, *University of Wisconsin*, *Madison*.

In stirred yogurts, the structure of the initial (intact) gel network and stirring method used for the disruption process, are crucial factors determining the sensory and textural properties. Objectives of this research were to study the relationships between physical and sensory properties of the initial yogurt gels and stirred yogurts made from these gels. Yogurt gels were prepared from milk heated at 75 or 85°C for 30 min and incubated at 32, 38, or 44°C. Stirred yogurts were made by shearing these gels at 5 s^{-1} for 1 min. Low amplitude oscillatory rheology and shear rate sweeps were performed to determine the dynamic moduli and apparent viscosity (AV), respectively. Quantitative descriptive analysis was

used to determine the sensory attributes of stirred yogurts. Increasing milk heating temperature and decreasing incubation temperature resulted in gels with higher storage modulus, AV values at structural breakdown point, and yield stress and with lower maximum in loss tangent and permeability values. In the very low shear rate region (i.e. 0.01 to 0.1 s^{-1}), the AV initially increased with increasing shear rate due to the resistance posed by the intact network; this behavior could not be modeled with commonly used models for stirred yogurt. In stirred yogurts, the use of higher heating and lower incubation temperatures resulted in increased AV, oral viscosity, and the sensory mouth coating attribute as well as a decreased particle size. A positive relation was observed between storage modulus of initial gels and oral viscosity (r = 0.77) while permeability was negatively correlated with oral viscosity (r = -0.84) and AV at low (10 s^{-1}) shear rate (r = -0.73) of stirred yogurt. Maximum in loss tangent during the initial gelation phase was negatively correlated with oral viscosity (r = -0.85), mouth coating attribute (r = -0.88), and AV at low (10 s^{-1}) shear rate (r = -0.78). In conclusion, the physical properties of initial yogurt gels had a significant influence on the physical and sensory properties of stirred yogurts.

Key Words: Yogurt, Rheology

W46 Sensory description of plain yogurt made from milk of different origins. M. Almena*, K. McEvoy, B. Yon, and A. Howard, *University of Vermont*, *Burlington*.

The goal of this study was to evaluate the sensory characteristics and consumer acceptability of different varieties of plain yogurt made from cow, sheep, goat, water buffalo (WB) and soy milk, respectively. A trained sensory panel evaluated the samples in terms of appearance, texture and flavor characteristics using descriptive analysis. Commercial samples from each yogurt were evaluated by a convenience sample of 109 consumers enlisted at a supermarket that specializes in natural and gourmet foods. Consumers were asked to select the most and least favorite sample, and to rate the texture and flavor of the 5 samples using a 9-pt hedonic scale. The questionnaire also included demographic and eating habits information. Data were statistically analyzed by ANOVA and Chi-square tests using SPSS. Cow milk yogurt was characterized as having a smooth appearance, creamy texture with high acetaldehyde notes and low acidity. The WB yogurt had a distinctive white-porcelain color, very thick and firm texture, with low sweetness and acidic flavor, in contrast to the soy yogurt which had brown color, chalky texture and high sweetness. Sheep milk yogurt had granular appearance, curdy texture and strong sour flavor. Goat milk yogurt also had strong flavor but smooth and creamy texture. Strong significant differences ($P \leq .001$) were identified between the texture scores among consumer data. Goat yogurt had the highest texture score and WB yogurt had the lowest. No significant differences between genders were found in terms of flavor or preferences. However, consumer eating habits, especially the type of yogurt regularly consumed (plain or flavored), strongly determined the acceptability of the product. Individuals who regularly consumed plain yogurt significantly preferred the WB and goat milk yogurts ($P \leq .01$), and identified the soy yogurt as least favorite. However, consumers who eat flavored yogurt preferred the soy milk product, probably due to the higher sweetness level (soy yogurt included sugar, though labeled as "plain").

Key Words: Yogurt Sensory Evaluation, Milk Type

W47 Incorporation and survival of immobilized probiotic bacteria in arroz con leche, a Mexican dairy dessert. H. Hernandez-Sanchez*, E. Alvarez, and M. Labastida, *Instituto Politecnico Nacional*, *Mexico, DF, Mexico*.

Lactobacillus casei has been shown to be a probiotic bacteria with therapeutic and immunomodulatory properties and able to colonize the intestine when ingested in dairy products. Immobilization has been used in probiotic cultures to increase their survival during their transit through the gastrointestinal system. If the size of the beads of immobilized microorganisms is big, the consumers may not like it. Foods with particles in suspension could be good options to incorporate the immobilized probiotics and this is the case of Arroz con Leche, a popular dairy dessert in Latin America which includes rice, milk, sugar and cinnamon in its preparation. *L. casei* was grown in MRS broth and the cells harvested by centrifugation and suspended in a sterile solution of sodium alginate which was allowed to drip slowly into a vessel containing $CaCl_2$ solution to obtain 2 mm beads with a concentration of 5 X 10^6 cfu/g. Free and immobilized *L. casei* cells were incubated in 0.01 N HCl at 150 rpm and 37°C for 1 h to simulate the transit through the stomach. Survivals of 2 and 40% were measured for the free and immobilized cells respectively. The size of the beads decreased in 30% after the incubation. The sensory evaluation results indicated a good acceptance of the dessert with the incorporated immobilized *L. casei* cells. It can be concluded that a good functional dairy product could be obtained by this method and that immobilization actually improved the survival of the microorganisms.

Acknowledgements: The authors appreciate the financial aid of COFAA and CGPI-IPN.

Key Words: Probiotics, Immobilization, Arroz con Leche

W48 Assessment of potential probiotic properties of *Latobacilli* strains isolated from traditionally home-made Koumiss in Inner Mongolia of China. H. Zhang*[1], T. Sun[1], J. Xu[1], L. Wang[1], Y. Yun[1], B. Menghe[1], R. Wu[1], J. Wang[1], and M. R. Guo[2], [1]*Inner Mongolia Agricultural University*, *Huhhot, Inner Mongolia, China*, [2]*University of Vermont*, *Burlington*.

Fifty strains of *Lactobacilli* isolated from 16 samples of traditionally home made koumiss in Inner Mongolia of China were assessed for their potential probiotic properties. *L.Casei ZL3-6* and *L.acidophilus* ZL12-1 were screened out for their resistance and tolerance to the *in vitro* gastrointestinal digestion. *L. Casei*ZL3-6 showed higher ability of resistance to bile salt compared with *L. acidophilus* ZL12-1. They can still grow in the media containing 1.6% and 0.3% of bile salt for *L.casei* ZL3-6 and *L. acidophilus* ZL12-1, respectively. Both of *L. casei* ZL3-6 and *L. acidophilus* ZL12-1 can hydrolyze bile salt to liberate free bile acid in the growth media. There is no significant difference in activity between the two strains during the period of incubation at 37C for 24 h. The two strains showed a strong ability of removing cholesterol from the growth media 49.61% by *L. casei* ZL3-6 and 32.39% by *L. acidophilus* ZL12-1, respectively. The results indicate that the two isolated strains may be the potential candidates for developing probiotics.

Key Words: Koumiss, Probiotic, *Lactobacilli*

W49 High protein buttermilk powder; manufacture and properties. V. V. Mistry* and J. R. Dornellas, *South Dakota State University*, *Brookings*.

A process was developed to manufacture a sweet buttermilk ingredient powder. The process involved the concentration of sweet buttermilk by ultrafiltration to approximately 5X concentration, followed by double diafiltration to 5X with water. The initial protein content of buttermilk was 2.9% and the final 15.9% (21% total solids). Powders were manufactured from buttermilk that was ultrafiltered as well as from diafiltered buttermilk. The concentrates were spray-dried in a single-stage, gas-fired spray dryer with a rotary atomizer at an inlet air temperature of 200°C and outlet air temperature of 85 to 95°C. The powders from ultrafiltered buttermilk had a protein content of approximately 61.5%, 4.9% moisture and 13.3% lactose. The diafiltered powder had a protein content of approximately 73% and a moisture content of 5.3% and 1% lactose. Powders were packaged and stored under four storage conditions; room temperature and refrigerated storage under vacuum packaging, and room and refrigerated temperature storage under atmospheric conditions. Powders were tested for solubility index, oxidation, and gelation. Storage studies over six months revealed no off-flavor development during storage under refrigerated or room temperatures or under vacuum or atmospheric conditions. Powders produced with diafiltration and having over 72% protein had a typical protein flavor. Solubility index of ultrafiltered powders (4.6 mL) was significantly lower than those of diafiltered powders (22.7 mL). Heat induced gels were prepared from the powders by reconstituting powder to 15% protein in water using and adjusting pH to 6.0. The liquids were then heated to 80°C for one hour and cooled under running tap water for 2 hours. Gels were stored at 7°C overnight before measuring firmness using a penetrometer. Firmness of the ultrafiltered powders was 276.4 mm and that of the diafiltered powders was 345 mm. This process offers

opportunities for the production of high protein powders from sweet buttermilk for food applications.

Key Words: Buttermilk, Protein, Drying

W50 Effects of packaging material, storage temperature, and fat content on the changes of the chemical composition of Ultrapasteurized milk bottled in amber polyethylene Terephthalate (PET) containers. J. Bailard*, W. Harper, M. Pascall, and V. Alvarez, *The Ohio State University*, *Columbus*.

Shelf life of high temperature short time (HTST) milk is 14-21 days. Ultrapasteurization (UP) milk is heated to temperatures higher than HTST, increasing shelf life. Packaging and heat affect shelf life. Polyethylene terephthalate (PET) bottles are better barriers to moisture and oxygen compared to polyethylene. Amber colored PET reduces light oxidization, decreasing flavor changes and spoilage. Extending the shelf life of milk increases its competitiveness in the beverage industry. The objective is to determine the effect of storage temperature and fat levels on shelf life of UP milk in amber PET bottles. Skim and whole milk were ultrapasteurized and aseptically packaged in amber PET bottles and stored at 24°C and 7°C. Milk stored at 24°C was sampled every 3 days for 30 days, and milk stored at 7°C was sampled every 6 days for 90 days. Dissolved oxygen, headspace oxygen, and standard plate count were analyzed. Milk samples were analyzed with an electronic nose based on negative chemical ionization with gas chromatography used to verify results. Milk stored at 24°C has a shorter shelf life than refrigerated milk. The headspace of skim and whole milk stored under refrigeration and at 24°C decreased over a 90 day and 30 day period, respectively. The dissolved oxygen for the 24°C decreased over time for whole and skim milk compared to the refrigerated milk which increased over time. SPC showed no growth for 90 day refrigerated milk and for 24°C stored milk. Using electronic nose, volatiles in skim milk and whole milk were able to be separated. Electronic nose data was consistent with shelf life results with volatiles being comparable at different time points, indicating the milk was acceptable until 90 days.

Key Words: Polyethylene Terephtalate (PET), Ultra-Pasteurization, Shelf Life

W51 Effects of evening primrose oil addition on quality of cholesterol-removed butter and lowering blood cholesterol. T. H. Jung, J. J. Kim, S. H. Yu, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was designed to carry out effects of evening primrose oil (EPO, containing 80% gamma-linolenic acid) on quality of cholesterol-removed butter during 8 week storage and lowering blood cholesterol in rats. Three different treatments were control (no β-CD, no EPO), β-CD-treated butter (10% β-CD, no EPO) and EPO-added and β-CD-treated butter (10% β-CD, 2% EPO). The rate of cholesterol removal reached 92.7%. TBA value was higher in EPO-added and cholesterol-removed group than others throughout storage periods. Most of rheological values in EPO-added and cholesterol-removed butter increased with storage period, and were similar to those in control. Especially, scores of hardness and cohesiveness were higher in β-CD-treated butter. In sensory analysis, most of properties except texture and color were affected adversely in EPO addition at every storage period. In animal study, total blood cholesterol was significantly lower in β-CD-treated group, and EPO-added and β-CD-treated group as 201.8 and 190.5 mg/dL, respectively, compared with that in control as 230.0mg/dL after 6 week feeding. The present results indicated that although EPO addition resulted in high TBA value and impaired sensory quality, total blood cholesterol and triglyceride were lowered in rats.

Key Words: Evening Primrose Oil, Blood Cholesterol, β-Cyclodextrin

W52 Sensory evaluation of regular, whey and cultured butters. S. Jinjarak*, A. Olabi, R. Gonzalez, W. Lires, and R. Jimenez-Flores, *California Polytechnic State University*, *San Luis Obispo*.

The objective of this work was to characterize the sensory qualities of whey, cultured and regular unsalted butters produced at the Dairy Product Technology Center (DPTC; n=3) or obtained from commercial sources (n=6). Descriptive analysis was performed to determine the significant differences between samples and interactions between variables. A panel of nine judges rated samples on a triplicate basis. Training took nine one-hour sessions and was followed by regular evaluation sessions. The samples were rated on a 15-cm line scale and data obtained was analyzed using SAS® statistical software. Significant differences between the three types of butters were obtained on yellow, acidic odor ($p<0.001$), cheese odor, cardboard odor, acidic and grassy flavors ($p<0.01$), porous, hard, shiny, mouth coating and nutty flavor ($p<0.05$). Cultured butter was significantly shinier than whey butter and had a higher score than regular butter. Whey butter was more yellow than cultured butter, which in turn was more yellow than the regular butter. The whey butter was more porous, and had higher scores on nutty flavor and cardboard odor than regular and cultured butters. Regular butter was significantly harder than cultured butter but not whey butter. Cultured butter had more mouth coating, acidic odor and flavor and grassy flavor than regular and whey butters. The commercial samples were more porous, crumbly, and had more artificial butter odor, rancid odor and flavor and cardboard odor. Results from Principal Component Analysis indicated that DPTC Whey butter and DPTC Regular butter were similar and were characterized by a sweet taste. Whey butter characteristics compared very favorable with commercial cultured butter and was very similar to regular butter.

Key Words: Butter, Sensory Analysis, Cultured Butter

W53 Characterization of slow acid-producing *Streptococcus thermophilus* strains. R. J. McCarthy*, O. Anggraeni, W. J. Harper, and P. D. Courtney, *The Ohio State University*, *Columbus*.

The simultaneous manufacture of quality Swiss cheese and kosher-certified whey is a challenge. Over-acidification of the curd at the lower cook temperatures required for kosher whey can result in low-grade cheese. Slow acid-producing *Streptococcus thermophilus* strains may slow curd acidification at the kosher cook temperature. The objective was to compare growth, acid production, and gene expression of *S. thermophilus* for potential use in a kosher process. Thirteen slow acid producing *S. thermophilus* cultures were obtained from culture manufacturers. One fast acid producing culture was included for comparison. Each strain was inoculated into UHT milk, pre-warmed to 48.3°C or 51.7°C. UHT milk and a standard inoculation rate standardized conditions for all strains. Colony forming units and pH were monitored over time. Strains were genetically typed by pulsed field gel electrophoresis of genomic DNA treated with *Sma*I or *Apa*I. Genetic profiles were compared using statistical software. The ATPase and urease genes were amplified from one *S. thermophilus* strain by PCR and used as probes in Southern hybridizations. Northern blots determined intensity of gene expression in log and stationary phases. Ten of the 13 strains reduced the pH slower than the control, fast acid producing strain. Growth rates or final cell densities correlated with acid production. The final pHs ranged from 4.93 to 5.59. Strains S754 and S847 reduced the pH to only 5.59 and 5.4, respectively, suggesting acid sensitivity in these strains. No clustering of slow acid production or acid sensitivity was observed in the comparison of DNA restriction profiles. Six strains were selected for further genetic analysis. Southern blots confirmed the presence of ATPase and urease genes. Northern blots indicated a difference in gene expression among the six strains and a correlation between expression level and acid production. Results may assist in selection of *S. thermophilus* strains for slow acid production at low cook temperatures, potentially allowing quality cheese and kosher whey production.

Key Words: *Streptococcus*, Swiss Cheese, Kosher Whey

W54 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Composition and proteolysis. S. Awad*, A. Hassan, and F. Halaweish, *South Dakota State University*, *Brookings*.

In a previous study, EPS-producing cultures produced reduced fat Cheddar cheese with physical properties similar to those of its full fat counterpart. This reduced fat cheese developed bitterness after 3 months of ripening. The objective of this work was to monitor proteolysis during ripening of reduced fat Cheddar cheeses made with different EPS-producing and nonproducing cultures. Results showed that the actual yield, moisture, moisture in the nonfat substance (MNFS) and residual coagulant activity were significantly higher in cheese made with a ropy strain of *Lactococcus lactis* ssp. *cremoris* (JFR1) than in all other reduced fat cheeses. Proteolysis, as determined by polyacrylamide gel electrophoresis and

the level of water soluble nitrogen, was also higher in cheese made with JFR1 than in all other reduced fat cheeses. However, cheese made with JFR1 contained the least amount of free amino acids among all cheeses. RP-HPLC analysis showed a significant increase of hydrophobic peptides (causing bitterness) during storage of cheese made with JFR1. The results showed that bitterness in reduced fat Cheddar made with EPS-producing cultures resulted from the high moisture level and chymosin activity. This study recommends using debittering cultures in conjugation with EPS-producing strains in making reduced fat Cheddar.

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Bitterness

W55 *Propionibacterium freudenreichii* growth is differentially affected by the serum of Swiss cheese slurries prepared with different *Lactobacillus helveticus* strains. P. Limpisathian*, W. J. Harper, and P. D. Courtney, *The Ohio State University*, *Columbus*.

Swiss cheese makers report that some combinations of *L. helveticus* and *P. freudenreichii* cultures result in poor eye and flavor formation, whereas other combinations perform well. The objective was to develop a rapid method to predict successful strain pairings. Cheese curds were prepared aseptically from UHT milk using *S. thermophilus* alone (control) or *S. thermophilus* plus one of four *L. helveticus* strains. Curds were homogenized into a slurry with 60% moisture and 1% salt in moisture. The slurries were centrifuged, and the resulting serum was filtered. Each sterile slurry serum was added to chemically defined medium (CDM) lacking amino acids. One of five *P. freudenreichii* strains was inoculated into CDM containing each slurry serum, and growth was monitored spectrophotometrically. Maximum growth rate and lag phase were calculated using the Richards model. Peptide profiles of slurry sera were observed using HPLC. *Propionibacterium freudenreichii* growth was not observed in CDM lacking slurry serum. CDM supplemented with slurry sera, including the control serum prepared without *L. helveticus*, supported the growth of four of the five *P. freudenreichii* strains to different extents. *Propionibacterium freudenreichii* P764M1 did not grow with any slurry serum. *Lactobacillus helveticus* L350 slurry serum stimulated growth of four *P. freudenreichii* strains beyond that observed with the control serum. In contrast, *L. helveticus* L346 slurry serum inhibited growth of these four strains in comparison to the control serum. L887 slurry serum slightly stimulated *P. freudenreichii* P873 growth, but delayed ATCC9614 growth. L856 slurry serum also slightly delayed ATCC9614 growth compared with the control serum. Slurry sera from different *L. helveticus* strains differed in their peptide profiles, which may contribute to the observed differences in *P. freudenreichii* growth. The slurry serum model has potential for screening *P. freudenreichii* and *L. helveticus* pairings for Swiss cheese manufacturing.

Key Words: *Propionibacterium freudenreichii*, *Lactobacillus helveticus*, Swiss Cheese

W56 Processing factors that affect the quality of pilot plant scale Swiss type cheese. C. J. Kuo*, N. Koca, T. Ji, V. B. Alvarez, and W. J. Harper, *The Ohio State University*, *Columbus*.

Industry reports frequent problems with overset eyes when using the Kosher requirement of cooking to less than 49 deg. C. Work with Swiss cheese made under pilot plant conditions showed that overset eyes occurred in most cheese being cooked at 48 deg. C and not in cheese cooked at 53 deg. C, a standard make procedure. Twenty-six blocks of Swiss type cheese were made at the university pilot plant over 6 processing days as an attempt to find the most important processing factors that affect the cheese quality. Combination of different ratios of starter organisms, method of placing curds into molds, and method of pressing were selected as the variables for the trials. After 21 days in the warm room (22°C), the products were compared based mainly on the quality of eye formation. Changes in starter culture ratio and in curd placing method did not improve the eye quality significantly. At the same curd pH at dipping (6.4), increase weight to more than two folds during pressing made marked improvement on eye quality. Higher pressure (not vacuum) also resulted in higher acetic and propionic acid contents. The data suggested that overset is primarily related to the greater number of nucleation sites due to a difference in curd textural properties. Preliminary treatment with vacuum in between first and second pressing appeared to reduce overset and make for a denser structure. Optimization of the vacuum treatment in respect to time and degree of vacuum requires additional work. The vacuum treatment is not practical commercially, but can provide an understanding of the mechanism of overset eyes common in Kosher cook Swiss cheese.

Key Words: Swiss Type Cheese, Pilot Plant, Processing

Food Safety: Control of Hazards

W57 Effects of in-feed anti-salmonella egg yolk antibodies on shedding and antibiotic resistance of bacteria in swine. S. Rattanatabtimtong*, A. Mathew, S. Chattin, E. Jarboe, and R. Clift, *University of Tennessee*, *Knoxville*.

Two experiments were conducted to determine effects of anti-salmonella egg yolk antibodies (ASEYA) on shedding of *Salmonella enterica* Typhimurium and antibiotic resistance of *E. coli*. In Experiment 1, 132 weaned pigs in 2 replicate trials were randomly assigned to 6 dietary treatments including a control without additives or similar diets containing apramycin followed by carbadox, or oxytetracycline, or ASEYA, or dried egg yolk lacking ASEYA, or spray dried plasma protein. Following initiation of treatments, pigs were challenged with a *S.* Typhimurium. Fecal samples were collected prior to treatments, just prior to challenge, and on various days until pigs reached market weight, for isolation of salmonella and *E. coli* to determine shedding and antibiotic resistance patterns. In Experiment 2, 64 market-age pigs in 2 replicate trials were randomly assigned to 4 treatments, including a control diet without additives, or diets containing ASEYA, or dried egg yolk without ASEYA, or IM injections of ceftiofur. Treatments were continued for 2 days, after which pigs were challenged with *S.* Typhimurium then mixed and transported to a holding facility to simulate shipping to market. Fecal samples were obtained prior to initiation of treatments, just prior to challenge and transport, immediately following transport, and at 24 and 48 hours following transport, for recovery of salmonella. In Experiment 1, the percentage of pigs shedding salmonella was decreased ($P<.05$) for antibiotic treatments compared to other diets; however, resistance was higher ($P<.05$) in *E. coli* from pigs fed antibiotics. In Experiment two, although a treatment effect was observed immediately after transport ($P<.001$), neither ASEYA nor ceftiofur were effective in reducing salmonella shedding. These studies indicate that in-feed addition of anti-salmonella egg yolk antibodies may not be effective in controlling shedding of salmonella in swine.

Key Words: Salmonella, Egg Yolk Antibodies, Swine

W58 Effect of grain processing on performance and fecal shedding of E. coli O157 in finishing feedlot heifers. B. E. Depenbusch*, E. R. Loe, M. C. Corrigan, T. G. Nagaraja, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

Ninety-two crossbred yearling heifers (initial BW = 347 kg) were fed diets containing dry-rolled corn (DRC) or steam flaked corn (SFC) to assess the impact of grain processing on prevalence of E. coli O157. Steam flaking typically results in more extensive ruminal digestion, and thus less substrate flow to the hindgut, potentially altering populations of flora in the hindgut. During the prescreening phase, heifers (n=92) were fed a common DRC finishing diet. Heifers were screened for presence of E. coli O157 using a fecal grab sample (FECAL) and by swabbing the rectoanal mucosa (RAMS). Animals that tested

positive by either sampling technique (TOTAL; n=30) were randomly assigned to individual pens and fed diets consisting primarily of DRC or SFC. Animals assigned to the SFC diet were transitioned from the DRC diet over a 9-d period. Animals were again sampled using both techniques on days 14, 21, 28, 36, 43, and 50. Average daily gains during the study were 1.75 and 1.43 kg/day for cattle fed SFC and DRC, respectively ($P < 0.01$). No differences in DMI were detected ($P < 0.85$) between SFC and DRC (8.44 and 8.52 kg/day, respectively), but gain efficiency was improved ($P < 0.01$) with SFC compared to DRC (0.207 and 0.168 kg/day, respectively). E. coli prevalence for TOTAL remained above 50% for the first 14 days, and then declined over time (53, 33, 0, 27, 6, and 13% for DRC and 67, 27, 40, 40, 20, 6% for SFC on days 14, 21, 28, 36, 43 and 50, respectively). No treatment × day interactions were detected for TOTAL, RAMS, or FECAL ($P > 0.70$, $P > 0.60$, and $P > 0.30$, respectively). Feeding SFC improved performance of heifers compared to DRC, but did not impact E. coli O157 prevalence rates. This study does demonstrate that it is feasible to utilize pre-screening as a method for identifying cattle that are positive for E. coli O157, and to subsequently use these animals to investigate the impact of preharvest intervention strategies on E. coli O157 prevalence rates.

Key Words: E. coli O157, Steam-Faked Corn, Dry-Rolled Corn

W59 Effect of monensin and tylosin on shedding of *Escherichia coli* O157:H7 by feedlot cattle. T. A. McAllister*[1], S. J. Bach[2], and T. R. Callaway[3], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Agriculture and Agri-Food Canada Research Centre*, *Summerland, BC, Canada*, [3]*USDA-ARS*, *College Station, TX*.

In North America, monensin and tylosin are routinely included in diets for feedyard cattle. These antibiotics have activity against Gram-positive bacteria, and it has been theorized that their effects on the intestinal environment may promote proliferation of Gram-negative bacteria such as *Escherichia coli*. The effects of these additives on fecal shedding of *E. coli* O157:H7 were studied in a feedyard environment using 32 finishing steers randomly assigned to four treatments. A diet containing 85% barley grain, 10% barley silage, and 5% supplement was amended with 33 ppm monensin (M); 11 ppm tylosin (T); both additives (M+T); or no additives (control, C). All steers were orally inoculated with 10^{10} cfu of a mixture of four strains of nalidixic acid-resistant *E. coli* O157:H7. Fecal (rectal grab), oral (mouth swab) and environmental (water, water-bowl interface, feed, and pen floor fecal pat) samples were collected weekly for 12 wk to track the inoculant strains. Prevalence of *E. coli* O157:H7-positive fecal samples did not differ ($P = 0.26$) among treatments, nor did the rate ($P = 0.81$) or duration ($P = 0.85$) of fecal shedding of the organism. Fecal samples were positive for *E. coli* O157:H7 more frequently ($P < 0.001$) than were oral swabs. More ($P = 0.02$) *E. coli* O157:H7-positive oral swabs were recovered from group T than from the controls. *Escherichia coli* O157:H7 was not detected in any water samples (0/47). It was present in 1 of 47 water bowl swabs, 7 of 48 feed samples (C, 2/12; M, 2/12; T, 2/12; M+T, 1/12), and 36 of 48 fecal pats (C, 6/12; M, 10/12; T, 10/12; M+T, 10/12). Feed and water were not significantly contaminated even when cattle were dosed orally with 10^{10} cfu of *E. coli* O157:H7. There was no evidence that dietary inclusion of monensin or tylosin, alone or in combination, increased fecal shedding of *E. coli* O157:H7.

Key Words: *E. coli* O157:H7, Fecal Pat, Oral Swab

W60 Clinical trial testing the effect of vaccination and direct-fed microbials on prevalence of *E. coli* O157:H7 in commercial beef feedlots. R. Peterson*, D. Smith, R. Moxley, T. Klopfenstein, G. Erickson, and S. Hinkley, *University of Nebraska*, *Lincoln, NE*.

A clinical trial was conducted to field test the effect of vaccination against EHEC type III secreted proteins or feeding a direct-fed microbial product (DFM) on the prevalence of *E. coli* O157:H7 (EC) in commercially fed cattle. Feedlots were classified as either feeding or not feeding a DFM (Lactobacillus acidophilus and Propionibacterium freudenreichii). Within feedlots, pens of vaccinated (VAC) and nonvaccinated (NOVAC) cattle were matched by time of testing. Two doses of vaccine were given, one at initial processing and another at reimplant. Each pen of cattle enrolled in the study was sampled for EC starting at least one week after the second dose of vaccine was given, and continued every three weeks for four test period samplings. EC test samples were ropes hung from the neckrail of the feedbunks overnight where cattle could easily lick, chew, or rub on them. Culture of EC from at least one rope classified the pen as EC-positive. The outcome variable was the probability for pens to test EC-positive. Data was analyzed using the GENMOD procedure of SAS accounting for clustering by matched pair and repeated measures. We studied 148 pens of cattle (n=21,691 head of cattle) in 19 commercial feedlots; 49 paired pens in feedlots feeding DFM and 25 pairs in feedlots not feeding DFM. VAC pens of cattle were less likely to test ROPES-positive than their matched NOVAC pens of cattle (OR=0.63, P=0.009). However, there was no difference (P=0.14) in the probability for pens to test EC-positive in feedlots feeding DFM compared with feedlots not feeding DFM. Additionally, month (P<0.001), region (P<0.001), and pen condition (P=0.03) helped to explain the probability for pens of cattle to test positive for EC. These data suggest that vaccination may be a promising pre-harvest intervention for the control of EC in commercially fed cattle.

Key Words: Direct-Fed Microbial Product, *Escherichia coli* O157:H7, Vaccination

W61 Inhibition effects of phage displayed peptides against *E. coli* O157:H7. C. J. Fu*, F. J. Schmidt, and M. S. Kerley, *University of Missouri*, *Columbia*.

Eight phage clones, identified from 80 phage clones selected against pathogenic E. coli O157:H7 by phage display technology, were tested for their inhibiting or killing effects in 96-well microplate incubations. The PEG/NaCl purified phages (10^{12}) and the bacteria (10^{3}) were inoculated in tryptic soy broth (TSB) in each well. The growth of the bacteria was determined by reading OD at 630 nm from 0-h to 24-h (0, 4, 6, 8, 12, and 24 h) at 37°C. The OD was corrected by the blanks which were inoculated with only the phage clones. The results indicated that the OD decreased by 40-60% from 8-h to 24-h when phage clones were incubated with bacteria compared to bacteria incubated without clones or compared to the incubation of library phages with the bacteria. The CFU was determined from the 24-h incubation well. The results were in agreement with the OD changing. The bacterial morphology was observed by confocal microscope at 2000x. The results indicated that bacterial morphology was changed from rod to round. We concluded from these experiments that the selected phage clones might inhibit the bacteria by binding their cell surface proteins or receptors and interrupt growth and differentiation. Further information is needed to elucidate the possible receptors.

Key Words: E. coli O157:H7, Phage Clones, Phage Display

W62 Effect of spraying acetic acid and refrigeration on microbial load in beef cattle carcass. F. G. Rios*, E. Ley, R. Verdugo, and G. Contreras, *FMVZ-Universidad Autónoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

With the objective of determinate the effect of spraying acetic acid and refrigeration on microbial load in beef cattle carcass, an experiment was conducted. Forty beef carcass were used in a randomized experiment design, twenty carcass were processed as regular management system; the other twenty carcass were sprayed with 20 mL of acetic acid 2% (vol/vol), solution before entering in the cold room. All carcass were stored at 4°C. After five minutes in cold room, using hisopes, the samples were take from surface leg, flank, and shoulder of each carcass. After 22 h, the same surfaces in carcasses were sampled. The samples were incubated (35°; 24 h). To relationship environmental condition with carcass surface microbial content, 40 plates were exposed five minutes in cold room, after were closed and incubated (35°C; 24 h). After incubation were read searching for growth of Salmonella spp., Escherichia coli, mesophylus aerobes, and coliforms. Results were recorded as CFU, data were transformed to log of CFU+1 and analyses of variance were performed and data are show as log CFU/cm2. Effect of refrigeration was analyzed by T-Test, and relationship between data carcass and data cold room, were analyzed by correlation test. Salmonella spp. and E. coli were not found in carcass and environment. Acid acetic diminished (P<0.01) account of meshophylus in leg (2.39 vs. 1.26 CFU/cm2), flank (2.51 vs. 1.26 CFU/cm2), and shoulder (2.88 vs. 1.36 CFU/cm2), and diminished (P<0.01) coliforms load (2.64 vs. 2.08 CFU/cm2) in shoulder; not effect was observed (P<0.05) in leg and flank. Was observed tendency (P=0.07) to reduced account of meshophylus (2.60 vs. 2.41 CFU/cm2) and diminished (P<0.01) coliforms load (2.48 vs. 1.68 log CFU/cm2) by

refrigeration effect. Not was found correlation (P>0.10), between microbial load of beef cattle carcass and cold room. Its concluded, that spraying acetic acid 2% solution and refrigeration, reduce microbial contamination of beef carcass surface and inhibit presence of E. coli and Salmonella.

Acknowledgements: SIMAC-CONACyT and Abbatoir Municipal Culiacan

Key Words: Beef Carcass, Microbial Contamination, Acid Acetic

W63 Relationship between kind, repose time and ruminal content consistence on bovine regurgitation at slaughter. F. G. Rios*, M. F. Moreno, J. J. Portillo, and G. Contreras, *FMVZ-Universidad Autónoma de Sinaloa, Culiacan, Sinaloa, Mexico*.

The objective of this experiment was determine the relationship between kind, repose time at ruminal content in head of bovine slaughtered. The bovine monitored, Brahman breed, were 5,188 animals, with 2611 calves, 1755 bull calves, 564 veals and 258 heifers. The repose time were classified in three categories: 1) animals with repose time less at three hours; 2) animals with repose time major three hours and less at twelve hours, and 3) animals with major repose time at twelve hours. After of insensibilitation procedure was registered the presence of ruminal content in throat and mouth in head of beef and carcass was identified to evaluated the consistence of ruminal content as: 1) watery, 2) semi-watery, and 3) dense. Data were disposed in frequency tables and analyzed by X2 Test. In the male group (calves and bull calves), the regurgitation (8.65 %) was less (P=0.10), that female slaughtered (11.5 %) (veal and heifers). Not was observed relationship (P=0.58) between repose time and kinds, in regurgitation. Whit repose time major than twelve hours increased (P<0.01) the presence of ruminal contente in head, when ruminal content was watery (75.1 %) and semi-watery (19 %).

It is concluded that at major repose time increases the regurgitation when content ruminal consistence is watery and semi-watery, and is higher the proportion in females that regurgitates than males.

Acknowledgements: TIF # 111 Ganadera Integral Vizur Slaugtherhouse

Key Words: Ruminal Content, Bovine Head, Repose Time

W64 Lead levels in three commercial brands of pasteurized milk from northern Mexico. J. A. Sosa-Garcia[1], M. Garcia-Carrillo[1], M. C. Hernandez-Serrano[2], and R. Rodriguez-Martinez*[1], [1]*Universidad Autonoma Agraria Antonio Narro - Unidad Laguna, Torreon, Coahuila, Mexico*, [2]*Universidad Autonoma de Coahuila, Torreon, Coahuila, Mexico*.

Lead, one of the most important heavy metal contaminants, is mainly derived from industrial processes. When lead is in high levels in animal tissues, it may cause health problems with serious social and economical consequences. Both for animals and humans, foods is one of the most common channels for lead poisoning, and in humans, milk is very likeable to cause such poisoning due to its metabolic pathway. Therefore, lead levels were measured in three different commercial brands of pasteurized milk, identified as A, B, and C, which were collected in three cities (Torreon, Coahuila; Gomez Palacio and Lerdo, Durango) from Region Lagunera in Mexico (LN 25º 00' LO 103º 14' and 1320 msnm). In order to collect 30 ml from each liter, one liter from each brand was obtained from stores located in each one of the cardinal points from each one of the cities. Samples were carried out at 4ºC to the Biochemistry Laboratory from University Autonomous of Coahuila, where they were stored at -18ºC until 48 h later, when they were analyzed by atomic absorption spectrophotometry (AAS) to determine their lead levels. The results were compared against the levels established in the Norma Oficial Mexicana (NOM) and the World Health Organization (WHO), and they were contrasted with another two international organizations (Brazilian and Romanian Norms). Two of the 36 samples from a commercial brand (B) showed upper levels (0.115 y 0.104 mg/kg) to those allowed for NOM and WHO norms (0.1 mg/kg). On the other hand, 6 samples (17%) were higher than the allowed for the Romanian regulation and 21 samples (58%) exceed the Brazilian norm. This results show that even though in a general way, the lead levels in pasteurized milk for human consumption in Region Lagunera, are below allowed limits (NOM and WHO norms), they are very close to the limits; beside that, in some cases they are higher, and this fact could be a serious health public problem since lead is a metal which accumulates in animal tissues in a chronic way. Consequently, it is necessary to continue with researches that allow us characterize the role milk and other foods of animal origin has in the epidemiology of this metal.

Key Words: Lead, Milk, Pasteurization

W65 Application of automatic flow cytometry as a conventional method for determination of total bacterial count in Brazil. L. D. Cassoli[1], A. C. O. Rodrigues*[1], A. Coldebella[2], L. C. Roma, Jr.[1], and P. F. Machado[1], [1]*University of Sao Paulo (USP), Piracicaba, SP, Brazil*, [2]*EMBRAPA Suinos e Aves, Concordia, SC, Brazil*.

Brazilian dairy industry has experienced great changes in milk quality during the last years. The approval of the National Plan of Milk Quality Improvement that will be introduced in July 2005 brings new evaluation parameters and regulatory limits for the Brazilian milk. Total bacterial count (TBC) was included as one of the new evaluation parameters for the entire produced milk. A well-known automatic equipment (Bactocount-Bentley Instruments) which determines TBC by flow cytometry was adopted for monitoring. However, the regulatory limit for TBC was established in colony forming units (cfu) and the Bactocount gives bacteria number by counting individual bacteria cells which can be 2 to 3 times higher than a TBC result in cfu. In this case there is the necessity to develop a transformation equation from individual bacterial count (IBC) to cfu according to Brazilian levels of TBC. The objective of this study was to create an equation to associate IBC with cfu and, consequently, express TBC results as cfu. Bulk tank milk samples (n = 219) from 57 dairy farms located in Sao Paulo and Minas Gerais state were collected from June to December 2004. Milk samples were split and used to run standard plate counts and Bactocount readings. Milk analyses were performed in duplicate. Average TBC was 630,000 cfu/ml. The equation was defined as $LOG_{10}(cfu) = 0.722 \times LOG_{10}(IBC) + 1.474$ with coefficient of correlation of 0.81 and accuracy of estimate s(y,x) = 0.312. Correlation was uniform for the whole TBC range. The coefficients indicated a great correlation between methods. The equation has been used to transform IBC results in cfu and additional research has been done to evaluate seasonal influence in the correlation between IBC and cfu.

Key Words: Flow Cytometry, Bacterial Count, Milk Quality

W66 Milk quality and new regulations in Brazil. A. C. O. Rodrigues*, L. D. Cassoli, and P. F. Machado, *Clinica do Leite, ESALQ, USP, Piracicaba, SP, Brazil*.

Milk production continues to grow in Brazil enhancing the national dairy industry. However, Brazilian milk quality needs to be improved to achieve international standards. Since 1997, the Brazilian Department of Agriculture has discussed milk quality issues which resulted in the creation of the National Plan of Milk Quality Improvement. This plan determines new rules for production, shipment, quality and grade of milk which will be effective on July 2005. One of the most important rules for milk quality is that all produced milk will have to be cooled in the farm and be shipped in bulk to dairy plants. Changes will be implemented progressively and will have different deadlines according to the milk production region of Brazil. Sao Paulo state is part of the most productive region of Brazil and, after July 2005, will need to supply milk produced under the new milk quality standards. The objective of this study was to determine raw milk quality in Sao Paulo state and to verify the amount of produced milk that could follow the new regulations. Each month during the year of 2004, bulk milk samples of Sao Paulo dairies (4004 per month) were sent to an official laboratory (Clinica do Leite) and analyzed for milk composition, somatic cell count (SCC) and total bacterial count (TBC). Average milk composition was 3.48% (SD = 0.45) of fat, 3.18% (0.20) of protein and 12.12% (0.57) of total solids. Fourteen percent of the produced milk could not be sold according to the new minimum limit for fat content of 3.00%. Both SCC and TBC showed a high average of 469,000 cells/ml (median = 343,000) and 443,000 cfu/ml (238,000), respectively. There was no relationship between SCC and TBC. Brazilian regulatory limit of raw milk for SCC and TBC was initially defined as 1,000,000 units; 8% and 15% of the produced milk would exceed the limit for SCC and TBC, respectively. Fat, protein, SCC and TBC had seasonal patterns.

The study showed that Brazilian dairies need improvement to attend the new milk quality standards. Research, extension and experience of other countries that have already passed through this process are important to guide the Brazilian dairy industry.

Key Words: Milk Quality, Regulation

W67 HACCP and GMP paper free management. B. M. de O. Ramos[1], R. Ramos[2], V. C. Oliveira[2], and L.H. da S. Miglioranza*[1], [1]*Universidade Estadual de Londrina*, *Londrina, Paraná, Brazil*, [2]*VRSys*, *Londrina, Paraná, Brazil*.

Our work presents a software for HACCP/GMP management in the milk industry. The aim was the development of a diagnostic instrument to assess the performance of those food quality tools, based on the paper free management concept. It is easy to deal with the software, not requiring advanced computer knowledge. The GMP management is quite difficult because there is subjective element in the evaluation. Rules and scores attributed involves different environment, proposal and goals. They must be adapted to any situation before and inside the industry, respecting the particular characteristics presented by any critical points in the milk production. Moreover, the conventional HACPP management generates great amounts of paper archives, records and reports, becoming a non practical and suitable work. In the proposed software, the subjective variables are transformed in objective variables that can be measured, plotted and graphically registered. The system identifies the objective variables and develop procedures appropriated to monitor them as basis for any evaluation of strategy implementation in the milk quality control. The program uses mechanisms of scoring, divided in three levels: low risk (0 - 3), medium risk (4 - 6) and high risk (7 - 10). The input data and all the added information are managed by the MySQL database. The system permits also a visual description and generates a computational formula for a resultant graphic. The report and the statistical data are modeled according to the manufacturer needs. There is also an automatic backup tool, and is available the update for the internet. As a final result, a higher assurance of milk quality can be obtained, by the comparisons of graphic results in time intervals.

Key Words: Objective Variables, Quality Control, Performance of Quality

Forages and Pastures: Feeding and Management

W68 A quick test for estimating added water or feeding adjustments for corn silage and haylage. R. Norell*[1], J. Packham[2], and S. Parkinson[3], [1]*University of Idaho*, *Idaho Falls*, [2]*University of Idaho*, *Paris*, [3]*University of Idaho*, *Preston*.

A critical quality control point in TMR management is to monitor dry matter content of ensiled forages. TMR feeders need to adjust feed loading amounts when forage dry matter declines. The objectives of this study were to: 1) develop regression equations for predicting added water and feeding adjustments using silage density measurements and 2) evaluate repeatability of density determinations. Samples from 6 haylages (mean DM = 43%) and 6 corn silages (mean DM = 32%) were collected from commercial dairies. Samples were split into five sub-samples and water was added (wt/wt) in the following water to silage ratios: 0/100; 10/90; 20/80; 30/70, and 40/60. Density was determined by weighing a shallow, flat container (volume =1.18 l), filling with silage, weighing in grams, and converting to density (g/l). Dry matter contents were obtained from Utah State University feed testing laboratory. Percent added water can be modeled with a quadratic equation using sample density minus initial density as the independent variable ($P<0.0001$, $R^2=0.92$). Feeding adjustment can also be modeled with a quadratic equation using sample density minus initial density as the independent variable ($P<0.0001$, $R^2=0.86$). Feeding adjustment (Y variable) was initial dry matter divided by test sample dry matter. Slopes and intercept did not differ ($P>0.4$) between haylage and corn silage for either model. Repeatability was assessed with 5 technicians measuring silage density 10 times each for 3 corn silages and 3 haylages. CV was below 6% in all 30 test combinations. Variation within forage differed between technicians ($P<0.05$) in 4 out of 6 forages. Two technicians consistently averaged higher densities. Density determinations at the farm level should be conducted by the same person or each tester should establish their respective initial density measurement. Accuracy would be improved by weighing 3 or more samples and calculating mean density. Measuring silage density is a quick, easy test for estimating added water or estimating required feeding adjustments for corn silage and haylage at the farm level.

Key Words: Dry Matter, Corn Silage, Haylage

W69 Nutritive value and proper level of mixed feeding of *Atriplex cancsens* and *Panicum antidotale* in Balouchi sheep. V. Kashki* and H. Tavakoli, *Agriculture and Natural Resources Research Center of Khorasan*, *Mashhad, Khorasan, Iran*.

Atriplex cancsens is one plant species that is widely used for range reclamation but it does not satisfy total animal requirements; therefore, in this experiment it was used as a complement with *Panicum antidutale*. *Panicum* was replaced by *Atriplex* at levels of 0, 25, 50, 75 and 100 percent of dry matter. Apparent digestibility of feeds (In vivo), digestible dry matter (DDM) digestible organic matter (DOM) digestible crude protein (DCP) digestible cell wall content (DNDF) and digestible gross energy (DE) were determined by using 20 male Balouchi lambs. Animals were randomly assigned to 5 groups and studied in a complete randomized design with 5 treatments. Data were analyzed using the GLM procedure of SAS. Chemical characteristics of species were measured with AOAC methods. Crude protein, cell wall content and gross energy for *Atriplex* were 13.72 %, 32.75 %, 16.43 %, 3720 (kcal/kg), for Panicum they were 12.2 %, 62.03 %, 29.17 % and 3845(kcal/kg) respectively. Results showed that there were significant differences in digestibility of dry matter (DM), organic matter (OM), crude protein (CP), cell wall content (NDF) and Energy between treatments ($P<0.05$). Treatment with 75% *Atriplex* and 25% *Panicum* had greatest in DDM and DOM. Dry matter intake, water daily intake, urine daily excretion, rumen N-NH3 and rumen liquid pH were significant between treatments ($P<0.05$). There was no significant difference between blood glucose and sheep live weight changes. Mixed consumption of *Atriplex* and *Panicum* in the ratio of 50:50 increased dry matter intake relative to other treatments in sheep.

Table 1. Apparent nutrient digestibility of plants in sheep

A.ca/P.an	Treatment	DDM (%)	DOM (%)	DCP (%)	DNDF (%)	DE (%)
0:100	1	34.39^{d}	40.25^{c}	63.70^{b}	43.76^{bc}	29.73^{b}
25:75	2	45.46^{c}	46.59^{b}	70.76^{b}	43.33^{bc}	39.59^{b}
50:50	3	52.54^{b}	50.61^{ab}	84.97^{a}	48.25^{b}	46.92^{b}
75:25	4	57.99^{a}	54.47^{a}	86.63^{a}	57.21^{a}	53.97^{a}
100:0	5	56.43^{a}	49.10^{a}	91.79^{a}	40.39^{a}	52.49^{a}
SE		1.139	1.487	2.884	2.265	1.279
P		0.0001	0.0001	0.0001	0.0011	0.0001

Means in columns within a category with unlike superscripts differ significantly ($p<0.05$).

Key Words: Atriplex Cancsens, Panicume Antidotale, Balouchi Sheep

W70 Glyphosate spraying on forage accumulation and quality of a range of the Flooding Pampa (Argentina). M. J. Arzadun* and S. A. Mestelan, *Facultad Agronomia UNCPBA*, *Azul, Pcia. Buenos Aires, Argentina*.

Spraying glyphosate at the end of summer is a practice used to improve winter forage of some rangelands of Argentina to enhance the production of *Lolium multiflorum L.* developing from a natural seed bank. Nevertheless, the effect of this practice on forage accumulation and quality has not been evaluated. A 2-yr experiment evaluated the effects of glyphosate application (G) vs intense defoliation (D), applied at late summer in a randomized complete block design, with 4 replications, on a 250 m^2 area. Forage was evaluated on 3 clipping dates: June, October and December (produced in autumn, winter and spring, respectively). The components warm season grasses (WSG), cool season grasses (CSG), and legumes, were estimated by hand separation and samples of whole plots were analyzed for IVDMD and CP. Due to significant interactions between factors, results were analyzed for each clipping date. Accumulated DM in G was higher in autumn and winter, but lower in spring. CSG yields were higher in G for the 3 cuts in both years, but WSG decreased in winter and spring ($P < 0.05$). Legumes (mainly Lotus glaber L) were eliminated in G, but for D reached they 51% in December 2003. CP levels in G trend to be lower than in D probably due to the legume contribution and IVDMD was higher in G in June and October 2003. G improved quality during autumn and winter but was not effective to increase forage accumulation. The subsequent decrease in forage accumulation and quality, nevertheless, suggests a limited application of this practice.

Forage accumulation and quality in three periods after the treatments

		2002			2003		
		June	October	December	June	October	December
CP,							
% of DM	D	8.05	9.85	8.30	12.80	17.30	11.60
	P <	NS	0.033	NS	NS	0.096	0.080
	G	71.1	77.0	69.9	81.6	82.2	68.1
IVDMD,							
% of DM	D	64.0	73.5	68.8	79.2	79.3	71.9
	P <	0.092	0.082	NS	0.026	NS	NS
	G	71.1	77.0	69.9	81.6	82.2	68.1

Key Words: Rangeland, Glyphosate, Forage Production

W71 Afternoon harvest and greater ruminal degradability of supplemental protein interact to increase digestibility and voluntary intake of switchgrass (SG) hay fed to beef steers. G. Huntington*[1] and J. Burns[1,2], [1]*North Carolina State University*, *Raleigh*, [2]*USDA-ARS*, *Raleigh, NC*.

The objective was to interact AM (0600) vs PM (1800) harvest with ruminal degradability (HI or LO) of a protein supplement to change voluntary intake, apparent digestibility or N retention by steers fed SG (*Panicum virgatum L.* var. Alamo) hay. Black steers (255 ± 14kg BW) were blocked by BW, then randomly assigned (5 steers each) to AM /HI, PM /HI, AM /LO, or PM /LO. Steers were group-housed in covered, outdoor pens with individual feeding gates. After adaptation to the facility and 14 d standardization, ad libitum hay intake was measured for 21d (7-d adjustment and 14-d intake estimate) followed by a 5-d digestion trial in individual crates. Steers were fed 767 (LO) or 825 (HI) g/d supplement to provide 268 g CP/d. One steer in PM/HI was removed from the study. Concentrations are g/kg DM, and digestibilities are g/100g intake. Compared to AM, PM had greater DM concentrations of total nonstructural carbohydrate (TNC, 75 vs 60), and lower concentrations of NDF (760 vs 770), ADF (418 vs 427), and CP (55.6 vs. 58.6). Protein fractions A, B2, and B3 were similar for AM and PM, but HI contained more g/kg protein of A (694 vs 296) and less B2 fraction (174 vs 554) than LO. Harvest interacted with supplement to increase ($P < 0.07$) ad libitum digestible DM intake (kg/100kg BW) for steers fed PM/HI (1.14) than for steers fed PM/LO (1.02), but no difference for steers for AM/LO or AM/HI (1.07). Similarly, NDF ($P < 0.09$) and ADF ($P < 0.03$) digestibilities were greater for PM/HI (59.1, 59.7) than for PM/LO (57.5, 57.3), but greater for AM/LO (57.0, 57.5) than for AM/HI (55.5, 55.7). Digestibility of DM (59.4 vs 57.1), and N (65.1 vs 63.2) was greater ($P < 0.03$) for PM than AM. Digestibility of N was greater ($P < 0.02$) for HI (65.2) vs LO (63.1). Treatments did not affect hay intake (3.93 kg/d), N retained (15.8 g/d) or serum urea-N (5.25 mM). Increased TNC was not sufficient by itself to increase voluntary intake, but increased protein degradability interacted with PM harvest to increase ruminal fiber digestion and voluntary intake of beef steers.

Key Words: Switchgrass, Protein Supplement, Beef Steers

W72 Effects of eugenol, terpin-4-ol, α-terpineol, and methyl eugenol on consumption of alfalfa pellets by sheep. R. Estell*[1], E. Fredrickson[1], D. Anderson[1], and M. Remmenga[2], [1]*USDA ARS Jornada Experimental Range*, *Las Cruces, NM*, [2]*New Mexico State University*, *Las Cruces*.

Secondary compounds present in shrubs on rangelands in the western United States are often aversive to livestock. However, effects of many of these compounds on intake have not been individually tested. Four experiments were conducted to examine effects of individual terpenes on alfalfa pellet intake by lambs. Forty-five lambs (9 lambs/treatment) were individually fed alfalfa pellets sprayed with either eugenol, terpin-4-ol, α-terpineol, or methyl eugenol at one of five concentrations in an ethanol carrier. Treatments (0, 0.5, 1, 2, and 10X) were multiples of the concentration (X) of a specific terpene on the leaf surface of *Flourensia cernua*. Terpenes were applied to alfalfa pellets (0.64 kg $lamb^{-1}$ d^{-1}, DM basis), and consumption was measured during a 20-min interval for 5 d. Lambs were adapted to handling and individual pen feeding for 10 d and were maintained and fed alfalfa pellets in one group (except during 20-min tests) at a mean total daily intake of 3.9% of BW (DM basis). A day effect ($P < 0.0001$) was detected for intakes in all four experiments, but no day x treatment interactions were observed ($P > 0.05$). The day effect was generally due to lower intake of alfalfa pellets on day 1, except for the methyl eugenol experiment, in which lambs consumed more pellets on day 1. No treatment effects were observed ($P > 0.05$) for any of the four chemicals tested; thus, none of these chemicals were strongly related to intake of alfalfa pellets by lambs under the conditions of this study.

Key Words: Herbivory, Intake, Terpene

W73 Conserved whole-crop wheat and forage maize feeding value relative to grass silage and *adlibitum* concentrates for beef cattle. K. Walsh*[1,2], P. O'Kiely[1], and F. O'Mara[2], [1]*Teagasc, Grange Research Centre*, *Dunsany, Co. Meath, Ireland*, [2]*University College Dublin*, *Belfield, Dublin, Ireland*.

Seventy beef steers, mean initial BW 424 (s.d. 33.0) kg, were blocked for liveweight and breed and allocated to one of 5 dietary treatments in a randomized complete block design. Treatments were grass silage (GS), maize silage (MS), fermented whole-crop wheat (FWCW), whole-crop wheat alkalage (ALK) and *ad libitum* concentrates (ALC). The GS was produced from a permanent temperate sward. The ALK grain was cracked and ensiled with a urea plus urease based additive. Forages were individually offered *ad libitum* and were supplemented with 3kg concentrates/steer/day throughout the 160-day trial. The mean DM (g/kg) of GS, MS, FWCW and ALK was 161, 303, 391 and 705 respectively. Ad-libitum concentrate composition was 830g rolled barley, 100g soya-bean meal, 50g molasses and 20g minerals & vitamins /kg and the concentrate supplement was 650g rolled barley, 280g soya-bean meal, 50g molasses and 20g minerals & vitamins /kg. The model for analysis of variance accounted for diet and block. Total DM intake and carcass growth were lowest for GS ($p<0.001$). Relative to ALC, GS, FWCW and ALK had a poorer ($p<0.05$) FCE (Feed Conversion Efficiency), lower BW ($p<0.05$) and carcass weight gains and a lower dressing percentage ($P<0.05$). The FCE of MS was better than the ALK ($p<0.001$) or the FWCW ($p<0.05$). Forage maize and whole crop wheat silages supported superior levels of growth by cattle compared to grass silage (IVDMD 698g/kg). There was no animal productivity advantage with alkalage compared to fermented whole-crop wheat. High quality forage maize or whole crop wheat can give superior levels of animal production compared to grass silage.

	GS	MS	FWCW	ALK	ALC	s.e.m.
Forage DM intake (kg/d)	4.54[a]	6.75[b]	7.07[b]	7.56[c]	0.95[d]	0.166
Total DM intake (kg/d)	7.07[a]	9.27[c]	9.59[bc]	10.06[bd]	9.86[b]	0.194
Liveweight gain (g/d)	802[a]	1200[bc]	1149[c]	1132[c]	1302[b]	48.3
Carcass gain (g/d)	479[a]	776[bc]	723[cd]	686[d]	851[b]	30.9
Carcass weight (kg)	290[a]	335[bc]	329[c]	321[c]	348[b]	5.2
FCE[1]	15.2[a]	12.1[b]	13.5[c]	14.8[ac]	11.9[b]	0.5

[1] (Feed Conversion Efficiency - kg DM intake/kg carcass gain), Within row, means with the same superscripts are not significantly different (p>0.05)

Key Words: Cattle, Maize, Whole-Crop Wheat

W74 Cool-season grasses for dry cow forage. J. H. Cherney* and D. J. R. Cherney, *Cornell University*, *Ithaca, NY*.

Relatively low potassium (K) concentration in non-lactating dairy cow diets is critical to animal health. Species selection, fertilization and harvest management can have a major impact on forage K concentration. Our objective was to evaluate five grass species for forage nutritive value and yield under two-harvest management and differing availability of soil K. Three K fertilizer treatments were applied to reed canarygrass (*Phalaris arundinaceae* L.), timothy (*Phleum Pratense* L.), orchardgrass (*Dactylis glomerata* L.), smooth bromegrass (*Bromus inermis* L.), and tall fescue (*Festuca arundinacea* L.) for six years on a Williamson silt loam (coarse-silty, mixed, active, mesic Typic Fragiudepts) soil type in Ithaca, NY. All grass species persisted through the completion of the experiment, without visible K deficiency symptoms. Yield of DM was significantly ($P < 0.05$) higher (5.6% higher) under split application of K fertilizer than the 0 K fertilizer treatment. Annual K uptake was increased 17.2% with split application of K fertilizer, although apparent recovery of K averaged less than 20%. Forage quality was not greatly impacted by K fertilization, although the K concentration of forage increased by 12% due to K fertilization. Fertilization with K tended to reduce the forage concentration of P, Ca, Mg, Bo and Na. Application of K fertilizer to 0 K fertilizer plots at the conclusion of the experiment overcame any negative effects on DM yield due to prolonged absence of K fertilization. It was possible to achieve low forage K concentrations in cool-season grasses and maintain stand persistence, with lowest forage K concentrations in timothy.

K concentration of forage, g/kg Dry Matter

Grass species	Spring	Fall
Timothy	14.5d	9.11c
Orchardgrass	15.9bc	14.1a
Reed canarygrass	16.3b	10.7b
Smooth bromegrass	17.8a	11.7b
Tall fescue	15.1cd	13.2a
SED	0.54	0.55
K fertilizer rate (kg K/ha, annually)		
0	14.7c	10.9b
112	16.3b	12.4a
112 split-applied	16.8a	12.0a
SED	0.23	0.30

Means followed by different letters within a column differ. SED=standard error of the difference.

Key Words: Potassium, Dry-Cow, Perennial Grasses

W75 Effects of winter stocker growth rate and finishing diet on beef longissimus vitamin and mineral composition. R. N. Sonon, Jr.*[1], S. K. Duckett[1], J. Neel[2], S. Sellappan[1], J. Fontenot[3], and W. Clapham[2], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS*, *Beaver, WV*, [3]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Longissimus muscle (LM) of Angus-cross steers (n=68, year 1; n=63, year 2) was assayed to determine the effects of winter stocker growth rate (LOW, MED, or HIGH) and finishing diet (corn silage-concentrate, CONC or pasture, PAST) on the fat-soluble vitamins (retinol, â-carotene and á-tocopherol), water-soluble vitamins (thiamine and riboflavin), and mineral (Ca, Mg, K, Zn and Fe) content of this tissue. Retinol content of LM did not differ between years ($P = 0.132$), stocker growth rates ($P = 0.727$) and finishing diets ($P = 0.286$). However, β-carotene content of LM was higher ($P < 0.01$) in year 2 whereas, α-tocopherol content was greater ($P = 0.033$) in the LM from year 1. The LM of PAST had about 1.4 and 3.3 times greater ($P < 0.01$) β-carotene and α-tocopherol contents, respectively than that of CONC. A year by growth rate by finishing diet interaction occurred for LM thiamine content ($P = 0.060$). In year 1, thiamine content was greater ($P < 0.05$) for MED than LOW finished on CONC and greater ($P < 0.05$) for HIGH than MED or LOW among PAST steers with no observed differences between stocker growth rates in year 2. Regardless of year, thiamine content was about 105% greater ($P < 0.05$) for PAST than CONC. Riboflavin content of LM from PAST was 193% greater ($P < 0.01$) than that of CONC. Mineral composition of LM varied between years ($P < 0.05$) with year 1 showing higher content for Ca whereas, year 2 exhibiting greater contents for Mg, Zn, and Fe. PAST LM Ca content was greater ($P < 0.01$) compared with that of CONC (7.89 vs 5.72 mg/100 g tissue) with LM Mg content showing a similar trend ($P = 0.076$). On LM K content, PAST was greater ($P < 0.01$) than CONC when steers were grown at HIGH but no differences between diets were observed from those grown at LOW and MED. PAST appears to support greater storage of β-carotene, α-tocopherol, thiamine and riboflavin, and Ca and Mg in beef longissimus tissue.

Key Words: Stocker Growth Rate, Finishing Diet, Vitamins and Minerals

W76 Near infrared (NIRS) analysis of forages: challenges and opportunities in the application of the Dairy NRC 2001. P. Berzaghi*[1], N. P. Martin[2], and D. J. Undersander[3], [1]*University of Padova*, *Italy*, [2]*Dairy Forage Research Center USDA-ARS*, *Madison, WI*, [3]*University of Wisconsin*, *Madison*.

The Dairy NRC 2001 has created a demand for new analytical assays, some relatively simple others like NDF digestibility requires sources of ruminal fluid not available in the vast majority of commercial labs. The NIRS Consortium has been providing calibration equations for forage prediction used in several laboratories, with performances (standard error of cross validation and R^2) that averaged across forages 1.0%, 0.89 for Ash, 0.7%, 0.95 for CP, 0.2%, 0.86 for fat, 2.2%, 0.94 for NDF and 1.8%, 0.91 for ADF. Commercial laboratories using NIRS calibrations can return accurate predictions to farmers within one day. The need to determine in vitro digestible NDF (dNDF) after 48 hour of incubation, used in the summative equation of the Dairy NRC has been a challenge for labs using NIRS. The lack of standardized in vitro methods across commercial and research laboratories creates confusion. The development of calibrations for digestible NDF using a reference method coming from a single laboratory creates the opportunity to reduce differences in results coming from different labs. However, the development of such a calibration equation has been a challenge. The NIRS Consortium calibrations performance for dNDF has on average a 2.4 % standard error of cross validation and $R^2 = 0.84$. The performance of calibration on NDF digestibility (NDFD), however has been disappointing, standard error of cross validation around 5% and R^2 below 0.4. Analysing data from 70 samples of corn silage with quadruplicate runs per sample has shown that standard deviation among replicates for NDFD was more than double that of dNDF (2.04 vs 0.94 %), partially explaining the lower NIRS performances on NDFD. Despite the lower accuracy compared to reference methods and in particular with in vitro techniques, NIRS can provide timely responses which combined with frequent testing can help farmers and nutritionists manage continuous changes in forage quality.

Key Words: NIRS, NDF Digestibility, Forage Quality

W77 Effect of level oil supplementation and carcass cooling temperature on beef tenderness of pasture-finished steers. E. Pavan*[1,2] and S. Duckett[1], [1]*University of Georgia*, *Athens*, [2]*Instituto Nacional de Tecnología Agropecuaria*, *Balcarce, Bs. As., Argentina*.

Eighteen Angus steers grazing a tall fescue pasture were randomly assigned to three levels of corn oil supplementation (LO: 0, 0.075 and 0.15% BW) and slaughtered after 117 d of grazing. For the first 12 h postmortem, the left side of each carcass was hung in a 2.2°C cooler with forced air circulation (LOW); whereas the right side was hung in a 2.2°C cooler with no air circulation (HIGH). HIGH sides were moved into the -2.2°C after 12 h. LM temperature and pH were evaluated during the first 24 h in both sides. Steaks were removed from LM and aged for 1, 3, 7, 14 or 28 d to evaluate tenderness, sarcomere length, free calcium and troponin-T degradation. Data were analyzed as a split-plot design using LO as whole-plot and cooler temperature (CT) as sub-plot, and repeated measures used for time effects. Temperature of the LM was influenced ($P < 0.01$) by CT; however LO did not alter temperature decline even though differences in carcass s.c. fat levels were observed. Ultimate pH was reached faster in 0.075 and 0.15 than in 0 ($P = 0.10$). Free calcium concentration and troponin-T degradation increased ($P<0.01$) with postmortem aging, but did not differ ($P > 0.10$) by CT. Oil supplementation had no effect ($P > 0.10$) on free calcium concentration, but decreased ($P = 0.02$) troponin-T degradation ($P < 0.01$). The effect of aging on initial ($P < 0.01$) and overall ($P = 0.03$) sensory tenderness or on Warner-Bratzler shear force values (WBS; $P=0.09$) varied with LO. Aging 28 d instead of 7 d increased ($P < 0.05$) initial and overall sensory tenderness in 0 and 0.15, but not ($P > 0.05$) in 0.075. These results show that oil supplementation of pasture finished steers alters the rate of postmortem aging. Cooler temperature alters temperature decline in LM but did not influence tenderness or interact with LO supplementation.

Key Words: Beef, Forage, Tenderness

W78 Effect of feeding eastern gamagrass on growth of meat goats. A. Faucette*, J. Bartlett, and E. Rhoden, *Tuskegee University*, *Tuskegee, AL*.

Eastern gamagrass (*Tripsacum dactyloides* L.) is a warm-season forage grass which has high energy and moderate crude protein. Bermuda grass (*Cynodon dactylon* L.) is a common forage in the South and is used as a standard for measuring the quality of other grasses. Goat production is becoming an important source of income on small-scale farms in the southeast. Coupled with this fact, there is limited research on the performance of goats fed eastern gamagrass. Therefore, the objective of this study was to evaluate weight gain, feed intake and carcass weight of meat goats fed eastern gamagrass (EGG) and Bermuda grass (BG). The study utilized 24 Boer cross goats (4-5 months old), housed in individual pens and fed one of four dietary treatments: 80:20 (A); 70:30 (B); and 60:40 (C) (EGG: concentrate); and 60:40 (D) (BG: concentrate) for 12 weeks. Forages were 12.38% CP and 50.31% TDN (BG) and 12.63% CP and 52.66% TDN (EGG). Concentrate was Sweet Stuff™ containing 12% Cp and 36.5% TDN. Water and mineral blocks were provided. Goats were fed at 5% of their body weight. Feed intake and refusals were monitored daily and feed offered was adjusted on a weekly basis. Body weights were recorded weekly after an overnight fast. Animals were slaughtered at the end of 12 weeks and hot and cold carcass weights recorded. Average daily intake did not differ significantly among the diets with 1020.2 g, 1178.3 g, 1112.6 g, and 1196.1 g for diets A, B, C, and D, respectively. There were no significant differences in overall weight gain among the diets. Animals fed diet C had the highest average daily gain of 94.71 g/day while the animals on diet B had the lowest (64.97 g/day). Gain: feed was 0.068, 0.055, 0.085 and 0.056 for diets A, B, C, and D, respectively. There was no significant difference in either hot or cold carcass weights among animals fed the various diets. However, the percent shrinkage was minimal for the various diets ranging from 0.26% for diet D to 1.45% for diet C. Eastern gamagrass compares well with BG and shows significant potential as a high quality feed for goats.

Key Words: Eastern Gamagrass, Bermuda Grass, Goats

W79 Enhancing conjugated linoleic acids (CLA) and omega-3 fatty acids in milk from cows fed green chopped forage. T. R. Dhiman*[1], S. A. Hagos[1], J. L. Walters[1], and S. Tamminga[2], [1]*Utah State University*, *Logan*, [2]*Wageningen University*, *Wageningen, The Netherlands*.

The objective of this research was to enhance the proportions of healthful fatty acids (FA), such as conjugated linoleic acid (CLA), *trans*-11 $C_{18:1}$ (trans vaccenic acid; TVA) and omega-3 FA, in milk from cows fed fresh green chopped alfalfa forage. Twenty Holstein dairy cows were randomly assigned to four treatments. The experimental design was completely randomized with five replicates. Experimental duration was 60 d. First 40 d were considered as an adaptation to the diets, and measurements were made during the last 20 d of the experiment. Cows in four treatments were fed 98% fresh green chopped alfalfa forage with either 2% calcium-salts of palm oil FA (Megalac®; CTL), 0.7% menhaden fish oil plus 1.3% Megalac®® (FO), 1.3% linseed oil plus 0.7% Megalac® (LO), or 0.7% fish oil plus 1.3% linseed oil (FLO) on DM basis. Daily feed intake and milk yield were recorded. Milk samples were collected from two consecutive a.m. and p.m. milkings every 4 d during the measurement period and analyzed for composition and FA profile. Dietary FA contents were 4.9, 5.1, 5.2, and 5.3% in CTL, FO, LO and FLO treatments, respectively. Daily feed intakes were: 22.7, 23.9, 23.3, 23.8 kg/d and total FA intakes were: 1.18^{b}, 1.27^{a}, 1.28^{a}, 1.35^{a} kg/d ($P < 0.01$) in CTL, FO, LO and FLO treatments, respectively. Cows produced 19.9, 20.7, 20.6, and 23.6 kg/d of energy corrected milk in CTL, FO, LO and FOL treatments, respectively. Milk fat and protein contents did not differ among treatments. The proportions of CLA were: 1.28^{c}, 1.67^{b}, 1.44^{bc}, and 2.07^{a} % and TVA was: 3.05^{c}, 3.83^{b}, 3.55^{b} and 4.83^{a} % in milk FA of CTL, FO, LO and FOL treatments, respectively. Supplementation of linseed oil (LO) increased the proportions of total omega-3 FA in milk compared to CTL. The ratio between omega-3:6 FA was 0.59^{b}, 0.78^{a}, 0.86^{a} and 0.89^{a} in CTL, FO, LO and FLO treatments, respectively. The results from this study suggest that CLA and TVA contents of milk from cows fed fresh green chopped alfalfa forage can be enhanced up to 60% by feeding 475 g/d of linseed oil plus menhaden fish oil at a 65:35 ratio without any negative effects on feed intake, milk yield or milk composition.

Key Words: Milk, Fatty Acid, Forage

Goat Species: Nutrition Grazing, and Forages

W80 Grazing behavior and energy expenditure by sheep and goats co-grazing grass/forb pastures at three stocking rates. G. Animut*[1,2], A. L. Goetsch[1], G. E. Aiken[3], R. Puchala[1], G. Detweiler[1], C. R. Krehbiel[2], R. C. Merkel[1], T. Sahlu[1], L. J. Dawson[4], and Z. B. Johnson[5], [1]*Langston University*, *Langston, OK*, [2]*Oklahoma State University*, *Stillwater*, [3]*USDA ARS Dale Bumpers Small Farms Research Center*, *Booneville, AR*, [4]*Oklahoma State University*, *Stillwater*, [5]*University of Arkansas*, *Fayetteville*.

This study examined the effects of stocking rate (SR) on grazing behavior and energy expenditure (EE) by growing sheep and goat wethers co-grazing grass/forb pastures. Grazing was for 16-wk periods in 2002 and 2003. Pastures consisted of various grasses, primarily bermudagrass and johnsongrass, and forbs such as ragweed. Sheep (Katahdin) and goats (≥ 75% Boer) averaged 21 ± 0.7 and 21 ± 0.5 kg initial BW, respectively, and were 4 to 5 mo of age when grazing began. Stocking rates were four (SR4), six, (SR6), and eight (SR8) animals per 0.4-ha pasture, with equal numbers of sheep and goats. The nine pastures (three/treatment) were divided into four paddocks that were rotationally grazed in 2-wk periods. In wk 3, 8, and 13 of both years, EE was determined for one goat and one sheep in each pasture via heart rate. Grazing behavior using IGER Grazing Behavior monitoring system units was measured over 24-h peri-

ods on the same animals. The number of steps increased linearly ($P < 0.05$) with increasing SR (2,279, 2,707, and 2,788 for SR4, SR6, and SR8, respectively [SE = 96.4]), but was similar for the two species (2,633 and 2,550 for sheep and goats, respectively [SE = 69.9]). As SR increased time spent eating increased (7.4, 8.4, and 9.6 h) and time spent lying (11.0, 10.2, and 8.9 h), ruminating (7.9, 7.7, and 6.8 h), and idling (8.6, 8.0, and 7.6 h for SR4, SR6, and SR8, respectively) decreased ($P < 0.05$). Goats spent less time eating (1.1-h difference) and more time idling (0.7 h-difference) than did sheep ($P < 0.05$). Stocking rate, species, and year interacted ($P < 0.05$) in EE of wethers (year 1, sheep: 510, 569, and 572 kJ/kg $BW^{0.75}$; year 2, sheep: 572, 597, and 648 kJ/kg $BW^{0.75}$; year 1, goat: 524, 524, and 640 kJ/kg $BW^{0.75}$; year 2, goat: 499, 496, and 551 kJ/kg $BW^{0.75}$ for SR4, SR6, and SR8, respectively [SE = 17.0]). In summary, influences of SR on grazing time and EE can vary with grazing season. Under the forage conditions of this study, SR had similar effects on grazing behavior of sheep and goats when co-grazing. Effects of SR on EE may contribute to ADG response by small ruminants.

Key Words: Goats, Grazing, Sheep

W81 Goat preference of five tropical legumes. S. Pietrosemoli*, F. Arenas, D. Bermudez, O. Peley, and A. Casanova, *La Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*.

Forage palatability is an important factor in goat production, particularly when forages are expected to provide a major part of the daily nutrient intake. Preference by goats for *Indigofera hirsuta*, *Cannavalia spp*., *Tephrosia cinerea*, *Teramnus spp*. and *Clitoria ternatea* harvested at two stages of maturity, 42 and 74 d, was evaluated using four lactating French Alpine X Nubian goats (4 years old, 29.1 kg BW). The experimental forages were grown in an ecologically dry forest area of Zulia, Venezuela. In the preference study, before grazing, 200 g of each forage, freshly harvested, was simultaneously offered for 25 min to each individually-penned goat, after which fresh matter was removed and weighed. A completely randomized experimental design was used. The study was replicated three times for each maturity stage. *Indigofera hirsuta* (155.8 and 166.9 g DM at 42 and 74 d, respectively), *Clitoria ternatea* (161.4 and 159.5 g DM at 42 and 74 d, respectively) and *Canavalia spp*. (141,2 g DM at 42 d), showed the highest intake, albeit without statistical differences among them. Intake of these three legumes at these stages of maturity, were statistically different ($p \leq 0.01$) from intakes of *Tephrosia cinerea* and *Teramnus spp.* . Maturity stage affected *Canavalia spp.* ($p \leq 0.01$) and *Tephrosia cinerea* ($p \leq 0.05$) intake with lowest values at 74 d (93.4 g and 68.7 g DM, respectively). *Teramnus spp*. intake was not affected by maturity (98 and 106.2 g DM at 42 and 74 d, respectively). *Indigofera hirsuta* and *Clitoria ternatea* showed the highest intake at both stages of maturity, whereas the lowest intake was recorded for *Tephrosia cinerea* at 42 d (68.7 g DM). Results of this study indicated that some legume species were consumed by goats in greater quantities than others. Intake variations were also observed to be influenced by maturity stage, leading to quantifying various chemical and physical characteristics of these forage legumes to determine their relationship to palatability.

Key Words: Preference Study, Palatability of Forages, Tropical Legumes

W82 A comparison of herbicide, goats and mowing for control of woody vegetation species. S Hart*, J Joseph, A. Goetsch, and J Brokaw, *E Kika de la Garza American Institute for Goat Research*, *Langston, OK*.

The objective of this study was to compare herbicide, goats and mowing for control of woody vegetation species and impact on herbaceous species. The study site was a native tallgrass prairie which had been invaded by woody species (blackberry, buckbrush, winged elm and sumac). Two replicate 2.0 ha pastures were stocked with goats for two summers (15 and 10 hd/ha), in early June and were removed each fall. Replicate 0.4 ha plots were used for other treatments. Herbicide treatment consisted of 1.2 L of Grazon P+D and 1.2 L of Remedy in 200 L of water/ha applied during the growing season each year. Woody vegetation cover was measured by the line intercept method on five-30 M permanent transects/pasture and herbaceous species identified at 0.3 meter intervals on the transect. Herbicide treatment reduced percent ground cover of blackberry (17.7 vs 1.9 $P < 0.10$), flame leaf sumac (16.2 vs 0, $P < 0.10$), smooth sumac (1.2 vs 0, NS) rose (5.7 vs 2.0, NS) and sassafras (1.1 vs 0, NS) but winged elm, buckbrush and greenbriar were not controlled by herbicide. Goats reduced percent ground cover for blackberry, (18.5 vs 13.7. $P < 0.10$), sumac (21.1 vs 17.0, NS), rose (3.7 vs 2.2, NS), poison ivy (1.5 vs .7, NS), and dogwood (9.1 vs 4.2, NS), but buckbrush and persimmon cover increased despite being defoliated by goats (25.1 vs 33.3, NS; 2.9 vs 5.7, NS). Only ground cover of buckbrush and flame leaf sumac were decreased by mowing (1.4 vs 0, NS; 10.2 vs 4.2, NS). Grazing by goats reduced cheat, broomsedge bluestem, hogwort and sericea lespedeza as a percent of species. However, Scribners panic, velvet panic and black medic were increased as a percent of species. Mowing reduced percentage of common yarrow, and inland rush, but increased sedge, bermudagrass, Scribners panic, velvet panic and beaked panic grass. Herbicide reduced percentage of common yarrow, hogwort, and yellow oxalis but increased cheat, Scribners panic, beaked panic and tall fescue. In this two year study, herbicide was very effective at reducing woody species and goats were more effective than mowing but their effectiveness was limited by the short duration of the study.

Key Words: Goat, Brush, Herbicide

W83 Postweaning performance by crossbred Boer kids consuming pelletized alfalfa subsequent to grazing at different stocking rates. A. Asmare[1,2], A. K. Patra*[1], R. Puchala[1], G. Detweiler[1], T. A. Gipson[1], T. Sahlu[1], and A. L. Goetsch[1], [1]*Langston University*, *Langston, OK*, [2]*Alemaya University, Dire Dawa*, *Dire Dawa, Ethiopia*.

Thirty-two crossbred Boer kids were used to determine effects of different preweaning grazing treatments, influencing ADG, on subsequent postweaning performance while consuming dehydrated alfalfa pellets. Pastures used in the 76-d grazing period (0.4 ha) consisted of grasses such as bermudagrass and johnsongrass and various forbs, particularly ragweed. Stocking rates were 4, 6, and 8 does, each with two kids, per pasture (L, M, and H, respectively). In addition, a fourth treatment (C) entailed 8 does per pasture but with kid access to another 0.4-ha pasture containing mimosa trees. One-half of the does were Boer x Spanish and others were Spanish, with all having kids from Boer bucks. There were two groups per treatment, and four paddocks within each pasture were sequentially grazed in 7- to 14-d periods. Kids were weaned after grazing, with the 84-d subsequent growth phase (four 21-d periods) starting 3 wk later. Four kids from each pasture were used (one from each of four does), distributed into four pens each equipped with an automated feeding system. Initial BW was 17 kg (SE = 3.0) and preweaning ADG while grazing was 76, 61, 37, and 81 g for L, M, H, and C, respectively (SE = 6.7). Postweaning ADG was similar among treatments (56, 42, 49, and 69 g for L, M, H, and C, respectively; SE = 13.8), greater ($P < 0.05$) for wethers than for doelings (71 vs 37 g), not affected by genotype, and not correlated with preweaning ADG ($r = 0.09$; $P < 0.63$). Energy expenditure (EE), estimated each period from heart rate and the ratio of EE to heart rate determined for each animal, was similar among treatments (520, 554, 545, and 551 kJ/kg $BW^{0.75}$ for L, M, H, and C, respectively; SE = 20.7) and correlated with ADG ($r = 0.40$; $P < 0.0001$). In conclusion, differences among preweaning grazing treatments in ADG were not compensated for in a postweaning confinement phase with a pelleted alfalfa diet.

Key Words: Goats, Performance, Grazing

W84 Growth and carcass traits of percentage and crossbred boer wether goat kids raised under different production systems. C. Shoemaker*[1], S. Solaiman[2], C. Kerth[1], W. Jones[1], and D. Bransby[1], [1]*Auburn University*, *Auburn, AL,*, [2]*Tuskegee University*, *Tuskegee, AL*.

The effect of production systems on growth and carcass traits of percentage (87.5%) or crossbred (50.0%) castrated Boer goat kids was determined. Twenty four percentage (BW 23.0 +/- 0.74 kg; 8/treatment) and twenty one crossbred (BW 19.0 +/- 0.79 kg; 7/treatment) kids were randomly assigned within breed to one of three production treatments: 1) concentrate grain diet (CONC) con-

taining 40% dairy pellets, 40% soybean hulls, and 20% Bermudagrass hay; 2) Bahiagrass pasture (BG) supplemented with 150 g/head/day dairy pellets; 3) Mimosa browse (MB) supplemented with 100 g/head/day of cracked corn. The growth period consisted of 14 wk. Animals were harvested when a final BW of 35.0 +/- 5.0 kg was obtained or when the forage season ended. Yield measurements were collected 48 h postmortem. There were no breed-type differences after adjusting for initial weight, harvest weight or days to harvest using analysis of covariance. Percentage and crossbred Boer goat kids receiving the BG treatment had lower ADG (46.0 g/day +/- 5.22 ; $P < 0.0001$) than goats receiving the MB treatment (81.0 g/day +/- 5.28 ; $P < 0.0001$) and required more days on feed to reach harvest end points. Goats receiving the CONC treatment exhibited the highest ADG (141 g/day +/- 5.37 ; $P < 0.0001$) and reached harvest end point two to four weeks faster than BG or MB treatments. Goats from the CONC treatment had heavier harvest, hot carcass, and cold carcass weights ($P < 0.05$) with higher dressing and shrinkage percentages ($P < 0.05$) than did carcasses of the BG or MB treatments. No differences were observed ($P > 0.10$) in kidney pelvic fat, back fat, adjusted fat thickness, bone weight, percent lean weight or carcass selection grade between treatment groups. Carcasses from the CONC and MB treatments had heavier lean carcass weight and larger longissimus muscle area (LMA) ($P < 0.05$) than carcasses of the BG treatment. These results indicated that feeding percentage or crossbred Boer goat kids the CONC diet increases ADG, produces a heavier carcass with more lean weight and larger LMA than goats receiving grain supplementation on BG or ML systems.

Key Words: Goat, Production Systems, Carcass traits

W85 Effect of initial body condition of Boer x Spanish yearling wethers and level of nutrient intake on change in mass of internal organs and tissues. A.T. Ngwa*[1], L.J. Dawson[2], R. Puchala[1], G. Detweiler[1], R.C. Merkel[1], I. Tovar-Luna[1], T. Sahlu[1], and A.L. Goetsch[1], [1]*Langston University*, *Langston, OK*, [2]*Oklahoma State University*, *Stillwater*.

Yearling Boer x Spanish wethers (54) were used to assess effects of initial body condition and level of feed intake on change in mass of internal organs and tissues. Before the experiment, 27 wethers were fed to achieve high body condition score (BCS; 1 to 5) and BW (IF) and 27 were fed for low BCS and BW (IT). During the experiment, IF wethers were fed low amounts of a pelletized diet and IT wethers received high amounts. Measures were determined before the experiment and after 12 and 24 wk. BCS was 3.8, 3.2, 2.6, 1.9, 2.8, and 3.5 (SE = 0.11) and live BW was 53.3, 46.2, 42.4, 36.6, 40.1, and 48.2 kg (SE = 2.03) for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively. Mass of noncarcass components was 24.7, 21.6, 20.2, 14.7, 17.7, and 22.3 kg (SE = 0.73) for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively. There were substantial declines in mass of many internal organs with advancing time for IF compared with relatively small change for IT. Examples include the reticulo-rumen (1,030, 589, 516, 865, 778, and 729 g; SE = 41.2), abomasum (229, 161, 128, 196, 187, and 191 g; SE = 10.0), small intestine (594, 269, 227, 546, 325, and 364 g; SE = 20.5), large intestine (397, 240, 240, 325, 325, and 264 g; SE = 17.2), liver (864, 454, 419, 556, 604, and 669 g; SE = 30.7), heart (252, 162, 165, 185, 156, and 169 g; SE = 8.9), and kidneys (138, 90, 89, 101, 105, and 103 g for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively; SE = 5.1). Conversely, change in visceral fat was much greater for IT vs IF (5.7, 3.9, 2.8, 0.6, 2.5, and 5.1 kg for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively; SE = 0.33). In conclusion, these results suggest that initial body condition can impact change in mass of energetically expensive internal organs with different planes of nutrition as well as of energy storage depots such as visceral fat, which may influence nutrient requirements and efficiency of energy use.

Key Words: Goats, Body Condition, Body Composition

W86 Change in energy expenditure by meat goats with varying levels of feed intake. A. Asmare[1,2], R. Puchala[1], R.C. Merkel*[1], T. Sahlu[1], and A.L. Goetsch[1], [1]*Langston University*, *Langston, OK*, [2]*Alemaya University*, *Dire Dawa, Ethiopia*.

Twelve yearling meat goat wethers (7/8 Boer) were used in a 16-wk experiment to determine effects of different levels of nutrient restriction and a maintenance level of intake after restriction on energy expenditure (EE; kJ/kg $BW0.^{75}$). Dehydrated alfalfa pellets were fed throughout the experiment. During the first 4 wk for adaptation, wethers were fed near maintenance. In wk 5 to 10, six wethers were fed at 60% of the maintenance level and in wk 11 to 16 were again fed near maintenance (60/100). The other six wethers were fed at 80 and 60% of maintenance in wk 5 to10 and 11 to 16, respectively (80/60). BW and EE were measured on the last day of most weeks, with EE determined from heart rate and the previously determined ratio of EE to heart rate for each wether. BW did not differ between treatments (40.7, 38.9, 38.6, 37.1, 36.5, 37.1, 37.3, 37.4, 37.9, and 39.4 kg for 60/100, and 39.2, 38.2, 38.3, 37.5, 35.9, 37.5, 36.9, 36.3, 36.7, and 37.9 kg for 80/60 in wk 5, 6, 7, 9, 10, 11, 12, 13, 15, and 16, respectively). EE, expressed relative to BW at the end of the adaptation period, was not different between treatments in wk 4 (362 and 342; SE = 23.1), 5 (361 and 385; SE = 15.9), 6 (320 and 308; SE = 15.2), or 7 (280 and 302; SE = 13.2), but was numerically lower for 60/100 than for 80/60 in wk 9 (261 and 283 (SE = 7.3); $P < 0.08$) and 10 (259 and 276 kJ/kg $BW0.^{75}$ (SE = 6.8) for 60/100 and 80/60, respectively; $P < 0.13$). After the change in plane of nutrition, EE was less ($P < 0.05$) for 60/100 than for 80/60 in wk 11 (258 and 289; SE = 7.2) and greater ($P < 0.05$) for 60/100 in wk 12 (328 and 266; SE = 13.5), 13 (328 and 256; SE = 13.7), and 15 (332 and 257 kJ/kg $BW^{0.75}$ (SE = 7.8) for 60/100 and 80/60, respectively). In summary, there appears a 1- to 2-wk delay or lag in change in EE by goats in response to a marked decrease in feed intake or increase after a severe restriction. Change in EE upon nutrient restriction may be complete within 4 wk, but that with increased intake up to maintenance after a severe restriction can occur more quickly.

Key Words: Energy, Feed Intake, Goets

W87 Effect of shrub, tree and cacti foliage supplementation on rumen fermentation parameters in goats. A. Juarez-Reyes*, G. Nevarez-Carrasco, R. Montoya-Escalante, and A. Cerrillo-Soto, *Universidad Juarez del Estado de Durango*, *Durango, Dgo. Mexico.*

Five rumen-cannulated Spanish criollo goats were used to estimate the effect of supplementing an oat straw-based diet with shrub, tree and cacti foliage commonly selected by grazing goats in the semiarid region of North Mexico on rumen VFA, Ammonia-N and pH. Treatments consisted of oat straw (47% of the diet), alfalfa hay (22%), ground corn (11%), soybean meal (7 %) and foliage from *Quercus grisea* (T1), *Q. eduardii* (T2), *Acacia shaffneri* (T3) and *Opuntia spp* (T4) at a level of 13%. A control treatment (T5) had no supplement. The diets were isonitrogenous (10.6% CP). Data were analyzed by ANOVA according to a 5 x 5 Latin Square experimental design using PROC GLM. Total VFA concentrations ranged from 92 mM/l in goats fed the control diet to 80 mM/l in goats supplemented with *Q. grisea* ($P < 0.05$). Supplementation affected the molar proportions of acetate ($P < 0.01$), propionate ($P < 0.05$) and butyrate ($P < 0.001$). Goats supplemented with *Q. eduardii* registered the higher proportions of acetate and butirate (67.7% and 12.7%, respectively), whereas animals supplemented with *Oputia spp* had the higher proportions of propionate (17.7%). Rumen NH_3-N concentrations were affected by supplementation ($P < 0.001$) (mean = 5.7 mg/dl). Goats fed *Q. eduardii* registered higher NH_3-N concentrations (6.8 mg/dl) whereas lower concentrations (4.7 mg/dl) were observed in animals supplemented with *Opuntia spp*. The pH level in rumen fluid ranged from 6.54 to 6.74 with a mean of 6.65 ($P < 0.001$). Data indicate that under these conditions, total VFA concentrations are within the range of a normal forage diet. Mean NH_3-N concentrations are adequate for microbial growth. The level of pH indicate that celullolytic activities were not negatively affected by shrub, tree and cacti foliage supplementation. The utilization of *Q. eduardii* and *Opuntia spp* species as supplements may help to alleviate energy deficiencies in grazing goats during the dry season.

Acknowledgements: Project financed by the International Foundation for Science (B/2985-1). Support from ANKOM TECHNOLOGY, INC. is fully appreciated.

Key Words: Supplements, North Mexico, Harsh Season

W88 Tea saponins affect rumen fermentation and growth performance in Growing Boer Goats. W.-L. Hu*[1], J.-X. Liu[1], Y.-Q. Guo[1], Y.-M. Wu[1], J.-A. Ye[1], X.-W. Ye[2], Y.-M. Wang[2], and H.-W. Ye[2], [1]*Zhejiang University*, *Hangzhou, P. R. China*, [2]*Hangzhou Zhengxing Animal Industries*, *Lin'an, Zhejiang, P.R. China*.

Two experiments were conducted to investigate the effects of tea saponins (TS) on rumen fermentation and growth performance in growing Boer Goats. In Experiment 1, the Reading Pressure Technique (RPT) system was used to investigate the effect of addition of TS (0, 0.2, 0.4 and 0.8 mg/ml) on the ruminal fermentation in vitro. The 24h gas production and methane emission were significantly decreased when the TS was included. Compared to the control, the TS had little effects on pH values and the amounts of total volatile fatty acids in the rumen fluids. However, the fermentation patterns were changed, reflective of higher proportions of propionate. Ammonia-N concentration and protozoa counts were significantly reduced, while microbial protein yield were increased by the TS addition, suggesting that the TS could modify the rumen fermentation and inhibit the release of methane. In Experiment 2, twenty-seven growing Boer goats were used to evaluate the effects of the TS addition on growth performance. The animals received the same basal diets, and added with the TS at levels of 0 (C), 3¼ˆT1¼‰ and 6 g (T2) per day. The experiment lasted for 60 days with the first 15 days for adaptation. Blood samples were obtained by jugular venipuncture before the morning feeding on the final day of the experiment. The dry matter intakes, average daily gain and feed conversion ration in group T1 were higher than in other two. Serum total protein, albumin, high density lipoprotein cholesterol, Ca and P and alkaline phosphatase levels were higher in group T1 than those in C and T2, whereas the blood urea nitrogen, creatinine and total cholesterol were lower in the TS-added groups. The concentrations of glucose, glutamic-oxaloacetic transaminase and glutamic-pyruvic transaminase were not affected by the TS. From the results obtained in this study, it is inferred that the TS could modify the rumen fermentation and that proper doses of TS may have some potentials in improving the animal growth performance, whereas at high doses, it may have adverse effects on animal production.

Key Words: Tea Saponin, Rumen Fermentation, Grow Performance

W89 Relationship between *in vitro* gas production and cell wall compounds in the diet selected by goats grazing a poor quality rangeland in North Mexico. A. Cerrillo-Soto*, G. Nevarez-Carrasco, R. Montoya-Escalante, and A. Juarez-Reyes, *Universidad Juarez del Estado de Durango*, *Durango, Dgo, Mexico*.

The study was performed to determine the *in vitro* gas production characteristics of the diet selected by goats grazing a poor quality rangeland. Four esophageally cannulated Spanish criollo goats (33 kg BW) were used to collect extrusa samples during Spring (Apr-Jun), Summer (Jul-Sep), Autumn (Oct-Dic) and Winter (Jan-Mar). Samples were collected for two days each month, morning and evening. Samples (200 mg DM) were incubated in glass syringes using ruminal fluid from three sheep fed alfalfa hay *ad libitum*. Gas volumes were recorded at 0,3,6,9,12,24,48,72 and 96h post-inoculation. Data were fitted to the equation $p = a+b\ (1-e^{-ct})$, where *p* represents gas volume at time *t*, *a* the intercept, *a* + *b* the potential gas production, and *c* the constant rate of gas production during incubation. Data were analyzed by ANOVA for a completely randomized design. Simple linear correlation coefficients between chemical composition and *in vitro* gas production parameters were computed by PROC REG (SAS). Higher $a+b$ values ($P < 0.05$) were recorded in Spring (during the new growth period of shrub species), whereas Autumn (at the beginning of the dormant forage season) registered lower values (47.6 and 34.8 mL/200 mg DM, respectively). Differences ($P < 0.05$) were recorded in the constant rate of gas production *c* . Higher values were obtained during the regular rainy season (summer = 0.069 h^{-1}) and lower values were recorded in winter (when vegetative species are dormant = 0.047 h^{-1}). Negative correlations were recorded between $a+b$ and NDF (r = -0.77), ADF (-0.82) and lignin (r = -0.59). On the contrary, positive correlations were obtained between the constant rate of gas production *c* and CP (r = 0.79). It is concluded that differences in the *c* parameter between seasons indicate variations in nutrient availability. Negative correlations between cell wall constituents and *in vitro* gas production parameters indicated that such compounds have a detrimental effect on gas production.

Acknowledgements: Project financed by FUNDACION PRODUCE DURANGO, A.C. Support from ANKOM TECHNOLOGY, INC. is fully appreciated.

Key Words: Grazing, Semiarid Region, North Mexico

W90 In situ ruminal digestion kinetics and volatile fatty acid production rate in goats fed premium quality dehydrated alfalfa hay supplemented with three levels of a concentrate mix. N. E. Brown*, J. Bing, and R. N. Corley, III, *Tuskegee University*, *Tuskegee, AL*.

Three non-lactating, mature, Nubian does fitted with permanent ruminal cannulas were used in a 3 x 3 Latin Square design to examine the kinetics of in situ DM disappearance and the rate of VFA production. The diets consisted of Premium Quality Dehydrated Alfalfa Hay (US Alfalfa) supplemented with 30% (high forage diet), 50% (medium forage diet) and 70% (low forage diet) Nutrena Sweet Stuff ®. Proximate analysis and measurements of NDF, ADF, were also determined. The high, medium and low forage diets, had DM (92.6, 92.6 and 92.6%), CP (20.8, 18.8, 16.7%), NDF (33.8, 37.0, 40.1%) and ADF values (26.4, 28.0, 30.0%) respectively. Ruminal digestion kinetics of the high, medium and low forage diets respectively, estimated 50, 50, 53% soluble, 24, 22, 18% was potentially degradable, 26, 29, 29%, was indigestible and the fractional rate of digestion was 10, 15 and 8%h-1. There were no differences (P>.05) in the soluble and indigestible fraction (P>.05) among diets. The low forage diet was less degradable (P<.05) than the high and medium forage diets which did not differ (P>.05). The medium forage diet had a faster fractional rate of disappearance (P<. 05) than the high or low forage diets which differed (P<.05) from each other.

Estimates of daily VFA production were 3.5 mol/day for the high forage diet, 4.5 mol/day for the medium forage and 7.8 moles/day for the low forage diet. Although not significant (P>.05) there was a numerical increase in daily VFA molar production as commercial grain mix increased in the diet. Estimates of molar proportions of the high, medium and low forage diets respectively were 64:22:10, 61:24:12 and 62:22:12 for acetate, propionate and butyrate. No differences (P>.05) were seen in the molar proportions among the diets.

Increasing the ratio of commercial grain mix to the dehydrated alfalfa diets in this study did not result in significant (P>.05) benefits, but did result in numerical increases in VFA production rates in goats.

Key Words: Goats, Zero VFA Production, Dehydrated Alfalfa

Growth and Development: Physiology of Growth and Development

W91 DNA regulatory activity and RNA expression of the sequence surrounding the callipyge mutation. A. Skipwith*[1], A. Perkins[1], T. Shay[2], S. Eng[2], D. Moody[1], N. Cockett[2], and C. Bidwell[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Utah State University*, *Logan*.

The callipyge mutation is a single base pair transition from A (normal) to G (callipyge) in an imprinted gene cluster on chromosome 18 in sheep. The mutation occurred in a highly conserved 12 bp motif in the intergenic region between DLK1 and GTL2. The mutation alters the expression of several genes within the 215 kb cluster when the mutation is inherited in *cis*. Therefore, it has been hypothesized that the mutation occurred in a long range control element. In addition, a transcript named CLPG1 has been detected from the region containing the callipyge mutation. The objective of this project was to analyze the genetic regulatory role and transcriptional activity of the sequence around the

callipyge mutation. Twenty-four Sau3AII fragments ranging from 12,115 bp upstream to 26,106 bp downstream of the callipyge mutation were screened for enhancer activity using a luciferase assay and transient transfection of C2C12 cells. Seventeen luciferase plasmids had significantly higher activity than a minimal promoter plasmid (pGL3P; $P < 0.05$) and 2 plasmids had significantly lower activity than pGL3P ($P < 0.05$). Two luciferase plasmids were constructed containing 1.2 kb of sequence flanking the mutation including the 12 bp motif with either the normal or callipyge allele. Both plasmids had significant enhancer activity ($P < 0.01$) indicating that the callipyge mutation does not alter that activity. The expression of CLPG1 RNA was analyzed by quantitative PCR (measured as log transcript abundance per 100 ng total RNA) in *semimembranosus* muscle samples for all four genotypes at three ages (2 wk prenatal, 2 wk and 8 wk postnatal). There was a significant effect of genotype at the prenatal ($P = 0.024$) and 2 wk ($P < 0.001$) ages, but no significant effect of genotype at 8 wk of age ($P = 0.1834$). At 2 weeks of age, animals with the three genotypes containing a callipyge allele ($+^{Mat}/CLPG^{Pat}$, $CLPG^{Mat}/+^{Pat}$ and $CLPG^{Mat}/CLPG^{Pat}$) had significantly higher transcript abundance ($P < 0.01$) than animals with the normal genotype (+/+). The expression pattern of CLPG1 makes it unlikely to be directly involved with muscle hypertrophy.

Key Words: Callipyge, CLPG1 Transcript, Enhancer Activity

W92 Effect of dietary conjugated linoleic acid on adiposity and the adipose-transcriptome. K. M. Hargrave*, D. Pomp, and J. L. Miner, *University of Nebraska*, *Lincoln*.

Dietary conjugated linoleic acid (CLA) causes body fat loss in mice. The objective of this study was to determine CLA-induced alterations in circulating metabolic hormone levels and to identify differentially expressed genes. Twenty littermate pairs of male mice (n=40, 12-wk-old) were fed diets containing 0 or 2% CLA isomers (one littermate per diet). Feed intake and body weight were measured every 8 d. Following 16 d, mice were killed and bled. Body fat and lean mass were determined by dual x-ray densitometry, and epididymal (EPI) and retroperitoneal (RP) fat pads were weighed and collected. Blood glucose was determined using a SureStep glucose monitor. Plasma leptin, insulin, interleukin (IL)-6, and tumor necrosis factor (TNF)-α were determined using a multiplex assay (Linco) run on a Luminex analyzer. Total RNA from RP fat from five of the littermate pairs (n=10) was analyzed for mRNA expression levels with the Affymetrix Mouse 430A 2.0 Array. Message levels that changed at least 40% in all five pairs of littermates were considered significantly different. CLA reduced ($P < 0.01$) feed intake on d 16 but did not affect body weight. Dietary CLA caused a reduction ($P < 0.001$) in body fat and in EPI and RP fat pad weights of 31, 69, and 76%, respectively. Lean mass tended ($P = 0.07$) to be greater in CLA-fed mice. Glucose and insulin levels were not affected by CLA. CLA increased IL-6 (18 vs 40 pg/ml) and decreased leptin ($P = 0.07$) and TNF-α ($P < 0.05$). Although CLA did not increase mRNA levels of any genes in all five littermate pairs, Cbp/p300-interacting transactivator was increased in four of the pairs and steroidogenic acute regulatory protein was increased in three. In contrast, CLA-feeding decreased mRNA abundance of many genes across all five littermate pairs, including leptin (98% reduction), peroxisome proliferator-activated receptor γ (93%), and diacylglycerol acyltransferase 2 (96%). These results demonstrate that CLA-feeding alters the profile and expression of many hormones and genes involved in pathways regulating obesity. Several of these are novel and may be involved in CLA's mechanism of action.

Key Words: Conjugated Linoleic Acid, Gene Expression, Mice

W93 Decreased expression of DLK1 in the livers of 8 wk old callipyge lambs. J. N. Fleming*[1], J. M. Smith[1], T. S. Hadfield[2], S. L. Eng[2], D. E. Moody[1], N. E. Cockett[2], and C. A. Bidwell[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Utah State University*, *Logan*.

The livers of callipyge sheep have been reported to be smaller than the livers of normal animals. We hypothesized that if the change in liver size was a direct effect of the callipyge mutation, the liver would exhibit differential expression of genes from the imprinted gene cluster that surrounds the mutation. In order to investigate this, liver samples were collected from 15 lambs (callipyge phenotype, $+^{Mat}/CLPG^{Pat}$, n = 4; maternal heterozygotes, $CLPG^{Mat}/+^{Pat}$, n= 4; homozygotes $CLPG^{Mat}/CLPG^{Pat}$, n= 3; and normal, $+^{Mat}/+^{Pat}$, n=4) at 8 weeks of age. The effect of inheritance of the callipyge mutation on gene expression in the liver was determined by quantitative PCR (measured as the log of transcript abundance per 100 ng total RNA). The genes that were quantified from the callipyge locus included DLK1, GTL2, PEG11AS, PEG11 and MEG8. G3PD was also quantified for sample standardization. There was no significant effect of genotype ($P > 0.05$) on G3PD, GTL2, MEG8, PEG11AS, or PEG11 transcript abundance. A significant effect of genotype was seen for DLK1 expression ($P = 0.01$) with the callipyge lambs having the lowest mean transcript abundance (3.155 ± 0.140), followed by maternal heterozygotes (3.646 ± 0.162), normals (3.705 ± 0.140), and homozygotes (3.995 ± 0.140). Orthogonal contrasts were used to analyze the genetic model which indicated additive ($p = 0.010$) and reciprocal heterozygote ($p = 0.043$) models to be significant. In addition, the polar overdominance contrast was also significant ($p = 0.003$) for DLK1 transcript abundance. The decrease in liver DLK1 expression found only in callipyge animals suggests a direct effect of the callipyge mutation on postnatal liver growth.

Key Words: Callipyge, Liver, DLK1

W94 *Salmonella enterica* serovars Typhimurium and Choleraesuis provoke divergent responses in serum IGF-I in young pigs. B. L. Davis*, J. N. Fraser, K. A. Skjolaas-Wilson, T. E. Burkey, S. S. Dritz, B. J. Johnson, and J. E. Minton, *Kansas State University*, *Manhattan*.

Salmonella enterica serovar Typhimurium (ST) and serovar Choleraesuis (SC) account for essentially all cases of salmonellosis in swine, and are among the most important bacterial pathogens in terms of negative economic effects. However, these pathogens produce very different clinical outcomes, with ST producing mainly self-limiting enteritis, whereas SC, a so-called swine host adapted pathogen, is more likely to result in more serious and occasionally fatal septicemia. In numerous prior studies, we have shown that ST transiently reduced feed intake and circulating IGF-I, but recovery was rapid. Here we sought to develop a model of chronic salmonella exposure, and compare the two serovars. Weaned pigs were housed two/pen with free access to feed and water during a 14 d experiment. On d 0, pigs were fed 10^8 CFU ST or SC in dough balls, and bacteria were re-fed twice weekly through the course of the experiment. Control pigs were fed dough without bacteria. Feeders were weighed daily to estimate feed intake, and serum was collected on d 0, 7, and 14 to quantify circulating IGF-I (sampled from one pig/pen; same animal on each collection day). Daily feed intakes were generally similar between control pigs and those given ST (trend for reduction on d 6 and 14; $P < 0.1$). However, compared to control pigs, feed intake was dramatically reduced on d 2, 3, 4, 6, 8, 9, 10, and 13 in pigs given SC ($P < 0.01$) and tended to be reduced on d 5 ($P = 0.08$) and d 11 ($P = 0.06$). Serum IGF-I was similar between pigs on all treatments on d 0. IGF-I remained similar between control pigs and pigs fed ST on d 7 and 14. But, IGF-I was reduced in pigs given SC on d 7 ($P < 0.01$ vs. control and ST) and d 14 ($P = 0.07$ vs. control; $P < 0.05$ vs. ST). Thus, clear differences exist between the serovars to disrupt normal feed intake and alter circulating IGF-I. These differences may reflect the swine host-adapted nature of SC compared to ST. Moreover, the results from the ST treatment (compared to controls) indicate that the mere presence of low levels of the enteric pathogen are not sufficient to erode feed intake and reduce circulating IGF-I.

Key Words: Pigs, Salmonella, IGF-I

W95 Newborn calves fed colostrum of cows treated with rbST. Study II: IGF-I and IGF type I receptor gene expression in the liver and small intestine. A. Bagaldo, P. Pauletti, E. Delgado, D. Lanna*, L. Coutinho, L. Kindlein, and R. Machado Neto, *Escola Superior de Agricultura Luiz de Queiroz - USP*, *Piracicaba, SP, Brazil*.

Serum IGF-I levels are highly correlated to liver IGF-I synthesis; IGF-l level is also known to regulate the amount of IGF-I receptor. However, it is still to be determined what would be the impact of higher levels of IGF-I in the colostrum on the dynamic of IGF-I, both locally and systemically. This work studied the effect of different levels of IGF-I present in the colostrum in IGF-I and IGF type I receptor gene expression in the liver and intestine of calves. Forty-two, preg-

nant Holstein cows were randomly assigned to two groups, receiving either growth hormone (rbST) or vitamin E, starting from 35 days prepartum, and every 14 days thereafter until parturition. Newborn calves were randomly slaughtered right after birth (0d) without colostrum ingestion, at two (2d) and seven days (7d) of life after colostrum ingestion, and samples were taken from liver and jejunum for quantification of mRNA of IGF-I and receptor type I. Data were statistically analyzed in a completely randomized design, 2X3 factorial arrangement. Expression of IGF-I was higher at birth in the liver of calves from rbST-treated cows (P<0.05), suggesting that rbST could have had an indirect effect in the fetus. At 7d, IGF-I mRNA was also higher in the livers of calves from rbST-treated cows. Colostrum from rbST group presented higher IGF-I concentration (+30%), which could have influenced the maturation of enterocytes and the absorption of nutrients by the calves, a condition that could explain the higher concentration found in the liver. The concentration of receptor type I mRNA decreased with calves age (P<0.05). Small intestine of calves showed a precondition for cellular response to the presence of IGF-I in colostrum at birth.

Key Words: Colostrum, IGF-I, mRNA

W96 Newborn calves fed colostrum of cows treated with rbST. Study I: Rna, dna and protein concentrations in the liver and small intestine. A. Bagaldo, P. Pauletti, E. Delgado, D. Lanna*, L. Kindlein, and R. Machado Neto, *Escola Superior de Agricultura Luiz de Queiroz - USP*, *Piracicaba - SP Brazil*.

Uncertainty regarding the effect of feeding IGF-I to calves refer to whether it could be absorbed or not, and which impact it would have over intestinal mucosa and/or animal metabolism as a whole, especially the liver. This work aims to study the effect of different levels of IGF-I found in colostrum of cows treated with rbST during dry period, in the development of the intestinal tract of newborn calves. Forty-two, pregnant Holstein cows were randomly assigned to two groups, receiving either growth hormone (rbST) or vitamin E, starting from 35 days prepartum, and every 14 days thereafter until parturition. Newborn calves were randomly slaughtered right after birth (0d) without colostrum ingestion, at two (2d) and seven days (7d) of life after colostrum ingestion, and samples were taken from liver and jejunum for quantification of DNA, RNA and total protein. Data were statistically analyzed in a completely randomized design, 2X3 factorial arrangement. Colostrum from rbST-treated group presented higher IGF-I concentration (+30%). In the liver samples, RNA and protein concentrations (mg g-1 tissue) were higher in 2d and protein/RNA ratio was higher in 7d (P<0.05). There was interaction between dam's group and calf age regarding the concentrations of DNA, protein, and protein/RNA and RNA/DNA ratios (P<0.05) for jejunum samples. Jejunum of calves fed colostrum from rbST-treated cows presented higher DNA concentration in 2d, which decreased to intermediate levels between 2d and 7d. This effect was also observed for protein/RNA ratio. DNA contents increased at 2d, but did not differ from 7d; protein/RNA ratio was also similar among ages of control group. Protein concentration in jejunum of rbST-treated group increased in 2d and decreased in 7d, while in calves from control group this increase was observed only in 7d. RNA/DNA ratio decreased with age (P<0.05) for these calves. Cells in jejunum of calves from rbST-treated cows presented a different phase of maturation.

Key Words: Calves, Colostrum, Intestine

W97 The role of muscle membrane phospholipids in the developmental decline in insulin sensitivity in the piglet. K. Bergeron*[1], J. F. Bernier[1], P. Julien[2], A. Myre[1], T. A. Davis[3], and M. C. Thivierge[1], [1]*Nutraceutical and Functional Food Institute/Département des sciences animales, FSAA, Université Laval*, *Qc, Canada*, [2]*Québec Lipid Research Ctr, Laval University Medical Ctr (CHUL)*, *Qc, Canada*, [3]*USDA/ARS Children's Nutr. Res. Ctr., Dept. Pediatr. Baylor Coll. Med.*, *Houston, TX*.

A decline in insulin sensitivity during postnatal development has been reported. Omega-3 long-chain polyunsaturated fatty acids **(n-3LCPUFA)** in muscle membrane phospholipids have been shown to increase insulin sensitivity in human pathologies, such as obesity and diabetes type II. The objective of the present investigation was thus to examine, in neonate piglets, the effects of enrichment of muscle membrane phospholipids with n-3LCPUFA on the decline in insulin sensitivity and protein anabolism. At 2 d of age, 24 piglets were weaned and randomly assigned to one of two semi-purified milk replacers: control or enriched with n-3LCPUFA. Milk replacers were formulated to meet piglet requirements and had a composition similar to sow′s milk (lactose 31.0 %, protein 29.9 %, and fat 38.3 %). They differed in their fatty acid composition (Control: 0.82 % n-3LCPUFA; Enriched: 10.99 % n-3LCPUFA). Hyperinsulinemic-euglycemic-euaminacidemic clamp procedure (100 ng insulin/kg$^{-0.66}$·min^{-1}) were performed at either 9 or 26 d of age to measure insulin sensitivity. Two d later, simultaneous infusions of L-[1-^{13} C]phenylalanine (22 μmol/kg·h) and $NaH^{14}CO_3$ (1.0 μCi/kg·h) were conducted during a 4-h period to assess protein metabolism. Insulin-stimulated amino acid disposal rate decreased by 29% between 9 and 26 d of age (P = 0.04), and the feeding of a milk replacer enriched in n-3LCPUFA did not prevent the developmental decline in this response (P > 0.05). Whole body flux of phenylalanine tended to decrease with age (P = 0.09) but was not affected by milk replacers. Oxidation of phenylalanine tended to be reduced (P = 0.06) in n-3LCPUFA fed piglets, inducing a slight increase in phenylalanine accretion into proteins (P = 0.06). These changes of the metabolic use of amino acids in the neonate fed diets enriched with n-3LCPUFA suggest that further investigation is needed to determine whether these fatty acids can be used as a novel means of enhancing growing in farm animals.

Acknowledgements: Supported by FQRNT and Nutraceutical and Functional Food Institute. A special thank to Omega protein and Grober Nutrition.

Key Words: Omega-3 Long-Chain Fatty Acids, Insulin Sensitivity, Piglets

W98 Insulin-like growth factor binding protein (IGFBP)-3 and IGFBP-5 mediate TGF beta- and myostatin-induced suppression of proliferation in porcine embryonic myogenic cell cultures. E. Kamanga-Sollo, M. White, M. Hathaway*, and W. Dayton, *University of Minnesota*, *St. Paul*.

TGF-beta superfamily members myostatin and TGF-beta1 have been shown to suppress both proliferation and differentiation of myogenic cells. Treatment of cultured porcine embryonic myogenic cells (PEMC) with either TGF- beta1 or myostatin increases levels of insulin-like growth factor binding protein (IGFBP)-3 and -5 mRNA and protein. Additionally, both IGFBP-3 and IGFBP-5 cause IGF-independent suppression of proliferation in PEMC cultures. Consequently, we have examined the role of these IGFBPs in the ability of TGF- beta1 and myostatin to suppress proliferation of cultured PEMC. Treatment of PEMC cultures with either myostatin or TGF- beta1 significantly ($p < 0.01$) increases levels of both IGFBP-5 and IGFBP-3 mRNA. We have previously shown that immunoneutralization of IGFBP-3 decreases the proliferation-suppressing activity of TGF- beta1 and myostatin. Similarly, immunoneutralization of IGFBP-5 also significantly ($P < 0.05$) decreases the proliferation suppressing activity of these molecules. Simultaneous immunoneutralization of both IGFBP-3 and IGFBP-5 in TGF- beta1 or myostatin treated PEMC cultures restores both IGF-I and Long-R3-IGF-I-stimulated proliferation rates to 90% of the levels observed in control cultures receiving no TGF- beta1 or myostatin treatment ($p < 0.05$). Even though immunoneutralization of IGFBP-3 and -5 increased proliferation rates in TGF- beta1 or myostatin-treated PEMC cultures, phosphosmad 2 levels in these cultures were not affected. Consequently, we believe that our data strongly indicate that IGFBP-3 and IGFBP-5 mediate TGF-beta1 and myostatin-induced suppression of PEMC proliferation via IGF-independent mechanisms that do not involve phosphosmad 2 signaling.

Acknowledgements: Research supported by USDA National Research Initiative Competitive Grant Number: 00-03271

Key Words: IGFBP-3, IGFBP-5, Myostatin

W99 Exogenous ghrelin elevates plasma growth hormone concentrations in steers allowed ad libitum intake. A. E. Wertz-Lutz*[1], J. A. Daniel[1], J. A. Clapper[1], D. C. Beitz[2], and A. Trenkle[2], [1]*South Dakota State University*, *Brookings*, [2]*Iowa State University*, *Ames*.

Six steers (416 ± 17.2 kg) were used in a crossover design to determine the effects of intravenous infusion of bovine ghrelin (BGHR) on plasma growth hormone (GH) concentrations. Steers were fed individually once daily (0800) and allowed to consume ad libitum until 2000 when feed was removed. Daily feed allotment was sufficient to result in ≥10% feed refusal. Serial blood samples were collected from steers fitted with an indwelling jugular catheter at 15-min intervals from 0600 through 1800. Harvested plasma was assayed for BGHR and GH. Saline (SAL) or BGHR was infused via jugular catheter at 1200 and 1400, which were times when steers usually did not eat feed. Exogenous BGHR was infused to achieve a plasma concentration of 1000 pg/mL. This dosage was chosen on the basis of previous research that indicated a peak BGHR concentration of 1000 pg/mL for fasting steers. Steers were allowed 5 d to adjust between treatment periods. Then, treatments were switched between steer groups, and the sampling period was repeated. Compared with that of SAL steers (75 and 64 ± 28.9 pg/mL, 1215 and 1415 sampling time, respectively), average plasma ghrelin concentration was elevated (P≤0.0001) at the first post-infusion sampling for BGHR-infused steers (414 and 520 ± 25.9 pg/mL, 1215 and 1415 sampling time, respectively) after both infusion times. The BGHR infusion resulted in elevated (P≤0.0001) plasma GH concentrations (16.8 and 12.7 ± 1.61 ng/mL, 1215 and 1415 sampling time, respectively) compared with SAL infusion (6.8 and 3.6 ± 1.80 ng/mL, 1215 and 1415 sampling time, respectively) for both infusion times. Both plasma BGHR and GH concentrations returned to baseline by 30 min post-BGHR infusion and were similar (P≥0.05) to those for SAL steers after both BGHR infusions. Intravenous administration of BGHR to achieve a concentration in plasma similar to that of a fasting steer was sufficient to result in elevated plasma GH concentrations.

Key Words: Ghrelin, Growth Hormone, Beef Cattle

W100 Effects of constitutive expression of porcine IGFBP-3 on proliferation and differentiation of L6 myogenic cells. G. Xi*, E. Kamanga-Sollo, M. Hathaway, M. White, and W. Dayton, *University of Minnesota*, *St. Paul*.

Insulin like growth factor binding protein (IGFBP)-3 has been shown to either inhibit or potentiate proliferation of cultured cells depending on cell type and culture conditions. L6 myogenic cells do not produce detectable levels of IGFBP-3, however, we have shown that exogenous recombinant porcine IGFBP-3 (rpIGFBP-3) suppresses proliferation and differentiation of L6 myogenic cells in an IGF-I-dependent manner and also suppresses their proliferation via an IGF-I- independent mechanism. In order to assess the effects of endogenously produced IGFBP-3, we have transfected L6 myogenic cells with a vector containing rpIGFBP-3 cDNA under the control of the human EF-1Î± promoter and with the empty vector. We have isolated stable cell populations that constitutively produce porcine IGFBP-3 (tL6 cells) and stable mock transfected cell populations containing the empty vector (mL6 cells). Constitutive expression of IGFBP-3 does not influence expression of other IGFBPs (IGFBP-4 and IGFBP-5) that are normally produced by L6 myogenic cells. Immunoneutralization of IGFBP-3 using an anti-rpIGFBP-3 antibody increases both IGF-I- and Long-R3-IGF-I-stimulated proliferation of transfected L6 cells (39% and 23%, respectively) ($p<0.01$) but has no effect on mL6 cells. These data indicate endogenous porcine IGFBP-3, like exogenous rpIGFBP-3, suppresses the proliferation of L6 myogenic cells via both IGF-I-dependent and independent pathways. Immunoneutralization of IGFBP-3 also increased IGF-I-stimulated differentiation (38%, $p<0.01$) and caused a slight increase in Long-R3-IGF-I stimulated differentiation of transfected L6 myogenic cells but had no effect on mL6 cells. Results indicate that exogenous and endogenous IGFBP-3 affect proliferation and differentiation of L6 myogenic cells in a similar way. In addition, tL6 and mL6 cells provide a good system to further investigate the mechanisms by which IGFBP-3 affects proliferation and differentiation of myogenic cells.

Acknowledgements: Research supported by USDA National Research Initiative Competitive Grant Number 00-03271

Key Words: IGFBP-3, Stable Tansfection, L6 Myogenic Cells

W101 Transgenic over-expression of IGF-I modulates the synthesis and secretion of pig milk IGFBP-2 and -5 in the early and post-lactation periods. M. H. Monaco*, M. B. Wheeler, and S. M. Donovan, *University of Illinois*, *Urbana*.

IGF regulates mammary growth and development and its bioactivity is mediated through IGF binding proteins (IGFBP). Mammary-specific transgenic over-expression of IGF-I under the direction of the bovine α-lactalbumin promoter in lactating sows resulted in a >50-fold higher milk IGF-I, 2-fold higher milk IGFBP-2 and -5 as measured by WLB in early lactation and 1.2-fold higher IGFBP-2 in postpartum secretions. Herein, free IGF-I was determined by IRMA and mammary IGFBP-2 and -5 mRNA were measured by quantitative RT-PCR to test the hypothesis that IGF-I up-regulates mammary IGFBP-2 and -5 transcription to counteract the over-expression of IGF-I. Transgenic gilts (TG; n=6) and non-transgenic gilts (CON; n=6) were mated and upon parturition, litter size was normalized to 10 piglets. Piglets were allowed to suckle until day 21 postpartum. On d110 of gestation (110g), d3 and 14 of lactation, and d4 post-weaning, mammary tissues were obtained from each sow by surgical biopsy, and milk was collected. Total and free IGF-I were higher ($p<0.001$) in TG than CON milk. Free IGF-I accounted for 11.7±1.5% of the total IGF in TG milk during lactation, but only 3±1.2% in CON ($p<0.001$). In the post-weaning secretion, free IGF-I was 4-fold higher ($p<0.01$) in TG than CON. IGFBP-2 and -5 mRNA were affected by a transgene*day interaction ($p<0.006$), but not by transgene alone ($p=0.2$). IGFBP-2 and -5 expression decreased 2-fold ($p<0.02$) and 3.5-fold ($p<0.006$) between d110g and d3 in CON, but not TG sows. During involution, IGFBP-2 mRNA increased 2.6-fold in CON and 8-fold in TG compared to d14 ($p<0.02$). Independent of transgene, IGFBP-5 mRNA increased >15-fold during involution versus d14 ($p<0.05$). In summary, transgenic over-expression of IGF-I prevents the early postpartum decline in mammary IGFBP-2 and -5 mRNA observed in CON sows. Despite the marked up-regulation of IGFBP synthesis and secretion, free IGF-I in milk was 3-fold higher in TG than CON. (Funded by the USDA CSREES under project NRI 00-35206)

Key Words: IGF-I, IGFBP, Mammary

W102 Small intestinal IGF-I binding protein (IGFBP)-2 and -5 and IGF receptors in piglets suckling IGF-I transgenic sows. J. L. Hartke*, M. H. Monaco, R. H. McCusker, M. B. Wheeler, and S. D. Donovan, *University of Illinois*, *Urbana*.

We produced transgenic swine (TG) that exhibit 60- to 100-fold over-expression of IGF-I in milk (600 ug/L) compared to non-transgenic sows (CON) sows (10 ug/L) and have shown that piglets suckling TG sows have greater ($P < 0.05$) small intestinal mucosal weight, protein and DNA content, and lactase and sucrase activities compared to piglets suckling CON sows. The cellular actions of IGF-I are exerted through type I IGF receptors and its bioactivity is regulated by IGFBP. Herein, we tested the hypothesis that IGF receptor binding and IGFBP expression would be differentially regulated in piglets suckling TG compared to CON sows. Jejunal and ileal samples were collected from piglets suckling CON or TG sows on d 7 and 21 postpartum (n = 10/d/trtmt). Intestinal IGFBP-2 and -5 mRNA expression were measured by quantitative real-time polymerase chain reaction in 3 randomly selected piglets/trtmt. Type I IGF receptor capacity (Bmax) and affinity (Kd) were determined by radioligand binding assays and Scatchard analysis (n = 4/d/trtmt). IGFBP-5 mRNA expression did not differ between CON or TG, regardless of segment or timepoint. IGFBP-2 was similar between CON and TG on d 21 and in the jejunum on d 7, however, ileal IGFBP-2 mRNA on d 7 was 30% greater ($P = 0.06$) in piglets suckling CON sows. Receptor affinity was unaffected by IGF-I. Receptor numbers were similar in piglets suckling CON and TG sows on d 7 and 21 in the jejunum. However, ileal receptor number was 3-fold greater in piglets suckling TG (61.32 ± 10.11) versus CON (19.79 ± 2.93) on d 21 ($P < 0.01$). In addition, when Bmax was compared between intestinal segments, piglets suckling IGF sows had greater receptor numbers in the ileum compared to the jejunum ($P < 0.02$). The up-regulation of IGF receptors in the ileum of piglets suckling TG sows supports previous work in our lab where we have shown that the greatest differences between piglets suckling CON versus TG sows were observed in the ileum on d 21 postpartum.

Key Words: IGF-I, Receptor, Binding Protein

W103 Growth rate, feed efficiency (FE), and IGFBP-2 and -3 in beef cattle treated with exogenous bovine (b) ST beginning at 200d, 250d and 300d of age. B. Velayudhan*, K. Govoni, T. Hoagland, and S. Zinn, *University of Connecticut*, *Storrs*.

To determine the effects of age at the start of bST treatment on the growth response to bST, 40 beef cattle (200±21d of age) were randomly assigned to one of four treatments (10 animals/treatment). Three groups received bST (33µg/kg BW) daily beginning at 200d, 250d or 300d of age until all animals reached 400d of age. Controls did not receive bST. Animals were housed in pens (five animals/pen; two pens per treatment) and fed a diet formulated for an ADG of 1.2kg/d. Feed intake (per pen) was measured daily and BW determined weekly. Blood samples (10mL) and ultrasound measurements were collected at 200d, 250d, 300d, 350d and 400d of age. Serum concentrations of IGFBP-2 and IGFBP-3 were determined by Western ligand blot. Overall, cattle gained 262kg BW with a treatment by week interaction ($P<0.01$), such that during the treatment period ADG was 13.1, 8.0 and 14.2% greater ($P<0.05$) in cattle treated with bST beginning at 200d, 250d and 300d, respectively, compared with controls during the same length of time. ADFI was 7% less ($P<0.05$) in bST-treated cattle than controls. Increases in ADG coupled with a reduction in ADFI resulted in increased FE (gain/feed; $P<0.01$) in bST-treated cattle compared with controls. Backfat thickness increased ($P<0.05$) over time and was less in the bST-treated cattle (treatment by week interaction; $P<0.05$). Rib eye area increased ($P<0.05$) over time, but the increases were similar across treatment groups. Serum concentrations of IGFBP-2 decreased while IGFBP-3 increased over time. In addition, bST treatment tended to increase concentrations of IGFBP-3 and decrease concentrations of IGFBP-2 compared with controls. In conclusion, bST treatment initiated between 200d and 300d of age increased ADG and FE and decreased backfat thickness in growing beef cattle. These increases were associated with increased concentrations of IGFBP-3 and decreased concentrations of IGFBP-2. In general, the magnitude of bST-induced change was greatest when treatment was initiated at 300d of age.

Key Words: Somatotropin, Growth, IGFBP-2 and -3

W104 Expression of porcine acid-labile subunit (pALS) of the 150-kilodalton ternary insulin-like growth factor complex and initial characterization of recombinant pALS protein. C. Y. Lee*[1], D. H. Lee[2], C. Chun[2], and S. H. Kim[3], [1]*Jinju National University*, *Jinju, Korea*, [2]*University of Seoul*, *Seoul, Korea*, [3]*Kyunghee University*, *Seoul, Korea*.

Acid-labile subunit (ALS) is a component of the 150-kDa insulin-like growth factor-binding protein-3 (IGFBP-3) complex, which, by sequestering the majority of IGFs-I and â•'II and thereby prolonging the half-life of them in plasma, serves as a circulating reservoir of IGFs in mammalian species. A pGEX-2T plasmid and a baculovirus expression constructs harboring a coding sequence for glutathione-S-transferase (GST)-porcine ALS (pALS) fusion protein were expressed in BL21(DE3) E. Coli and Sf9 insect cells, respectively. The expressed protein was purified by glutathione or Ni-NTN affinity chromatography, followed by cleavage of the fusion protein using Factor Xa. In addition, pALS and hIGFBP-3 were also produced in small amounts in the Xenopus oocyte expression system which does not require any purification procedure. A 65-kDa pALS polypeptide was obtained following the prokaryotic expression and the enzymatic digestion, but biochemical characterization of this polypeptide was precluded because of an extremely low expression efficiency. The baculovirus- as well as Xenopus-expressed pALS exhibited the expected molecular mass of 85 kDa which was reduced into 75 and 65 kDa following deglycosylation of Asn-linked carbohydrates by Endo-F glycosidase, indicating that the expressed pALS was properly glycosylated. Moreover, irrespective of the source of pALS, the recombinant pALS and hIGFBP-3 formed a 130-kDa binary complex which could be immunoprecipitated by anti-hIGFBP-3 antibodies. Collectively, results indicate that an authentic pALS protein can be produced by the current expression systems.

Key Words: Pig, ALS, IGF

W105 Effect of ovariectomy and estradiol administration on bovine skeletal muscle insulin-like growth factor-I (IGF-I) and β-adrenergic receptor (βAR) messenger RNA (mRNA) abundance. E. K. Sissom*[1], M. J. Meyer[2], Y. R. Boisclair[2], M. E. Van Amburgh[2], and B. J. Johnson[1], [1]*Kansas State Universiy*, *Manhattan*, [2]*Cornell Universiy*, *Ithaca, NY*.

Insulin-like growth factor-I is a potent stimulator of postnatal skeletal muscle growth. Estradiol (E_2) has been shown to affect the local production of IGF-I in skeletal muscle, as well as up-regulate the expression of the βAR subtypes in other tissues. The objective of this study was to determine the effects of E_2 and/or ovariectomy (OVX) on the steady-state mRNA levels of IGF-I and three βAR subtypes (β1, β2, β3) in semimembranosous muscle. Sixteen prepubertal Holstein heifers were used in a 2 x 2 factorial experiment with main effects of E_2 and OVX. Eight heifers were ovariectomized at approximately 4.6 mo of age (150 kg BW). Estrogen or excipient was administered following a 30 d postoperative recovery period. 17β-Estradiol solubilized in corn oil (0.1 mg E_2/kg BW) was given three consecutive days on 24 h intervals via subcutaneous injection. Heifers not receiving E_2, received a subcutaneous injection of the corn oil excipient. Approximately 54 h post initial E_2 dose, heifers were sacrificed and semimembranosous muscle was excised. Complimentary DNA was generated from total RNA isolated from these tissues. Transcriptional regulation of the genes encoding IGF-I, β1, β2, and β3AR was determined by real-time quantitative PCR. No interactions ($P > 0.10$) were observed between E_2 and OVX. There was no main effect of E_2 or OVX on the expression of the βAR subtypes, or of OVX on IGF-I mRNA. However, in both intact and OVX heifers, E_2 administration elicited a 58% increase ($P < 0.05$) in muscle IGF-I mRNA compared to non-E_2 treated heifers. These data suggest E_2 administration can increase local muscle production of IGF-I in pre-pubertal heifers. This increase in IGF-I production may lead to an increase in postnatal skeletal muscle growth.

Key Words: β-Adrenergic Receptors, Estradiol-17β, IGF-I

W106 Effects of restricted feed intake on plasma levels of IGF-I and abundance of hepatic IGF-I and GH receptor mRNA in channel catfish. B. Peterson* and B. Small, *USDA/ARS Catfish Genetics Research Unit*, *Stoneville, MS*.

Feed restriction and fasting of catfish are common management strategies during periods of environmental stress and disease. We have previously reported roles for GH and IGF-I in growth regulation of channel catfish, but effects of restricted feeding on the somatotropic axis are not known. Research was conducted to examine abundance of hepatic IGF-I and GH receptor (GHR) mRNA and plasma IGF-I in fed, restricted, and fasted channel catfish. One hundred and twenty fish (60.0 Â± 0.2 g) were randomly assigned to one of three treatments with four replicates each. The treatments were: 1) fed control (commercial catfish diet fed daily), 2) restricted (commercial diet fed every other day), and fasted (no feed). All fish were weighed and bled from the caudal vasculature on d 0, 21, and 42. On d 42, liver samples were excised from 8 fish per treatment (2 fish/tank), RNA was isolated, and relative abundance of hepatic IGF-I and GHR mRNA was determined by real time RT-PCR.

Final weights of the fed control, restricted, and fasted fish were 110.4, 78.8, and 40.6 g, respectively. Plasma levels of IGF-I were higher ($P < 0.001$) in the fed and restricted fish (7.5 ± 0.8 and 5.5 ± 0.6 ng/ml, respectively) compared to fasted fish (1.4 ± 0.6 ng/ml) at day 21. By d 42, differences in plasma levels of IGF-I were less dramatic between treatments, but tended to remain higher in fed controls ($P < 0.01$). Abundance of liver IGF-I mRNA was similar ($P > 0.05$) among treatments. However, GHR mRNA abundance decreased 60% in the both restricted and fasted fish compared to fed controls ($P < 0.001$). Results showed that restricting feed intake decreased plasma IGF-I without a significant change in abundance of IGF-I mRNA. Results also demonstrated that GHR mRNA is down regulated when feed is limited. Higher plasma levels of IGF-I in the fed controls support IGF-I's role in growth regulation of channel catfish. One of the mechanisms through which growth may be inhibited in food restricted catfish is through a reduction in GHR and thus IGF-I.

Key Words: IGF-I, GH Rreceptor, Channel Catfish

W107 Zinc finger binding protein 89 (ZBP-89) is a potential transcription factor for the bovine growth hormone receptor 1A promoter. H. Jiang*, Q. Xu, and L. Springer, *Virginia Tech*, *Blacksburg*.

Growth hormone receptor (GHR) 1A mRNA is a major GHR mRNA variant expressed in the bovine liver. The objective of this study was to identify DNA regions and transcription factors that might regulate GHR1A mRNA expression. With a deoxyribonuclease I footprint analysis, we detected a GHR1A promoter region that was able to bind to nuclear proteins from the bovine liver. Using this GHR1A promoter region as bait to screen a bovine liver cDNA library in a yeast-one hybrid analysis, we identified two cDNA clones that appeared to encode proteins binding to this GHR1A promoter region. Nucleotide sequencing and sequence analysis revealed that both cDNA clones encoded the bovine zinc finger binding protein 89 (ZBP-89), a transcription factor that has been reported to bind to several gene promoters involved in cell growth regulation. Electrophoretic mobility shift assays confirmed the ability of this GHR1A promoter region to bind to ZBP-89 protein from the bovine liver. In transient transfection analysis, cotransfection of a ZBP-89 expression plasmid enhanced ($P < 0.01$) reporter gene expression from a GHR1A promoter containing the identified ZBP-89-binding DNA region. These results together indicate that ZBP-89 may be a transcription factor that regulates the expression of GHR1A mRNA in the bovine liver.

Key Words: Promoter, Transcription Factor, Growth Hormone Receptor

W108 Effects of supply of excess amino acids on leucine utilization by growing steers. M. S. Awawdeh*, E. C. Titgemeyer, G. F. Schroeder, and D. P. Gnad, *Kansas State University*, *Manhattan*.

We examined the effects of excess N supply from supplemental AA on leucine (Leu) utilization. Six ruminally cannulated Holstein steers (161 kg) were utilized in a 6x6 Latin square with an additional period. All steers received a soyhull-based diet at 2.6 kg/d DM, ruminal infusions of 200 g/d acetate, 200 g/d propionate, and 50 g/d butyrate, abomasal infusion of 300 g/d glucose, as well as abomasal infusion of an AA mixture (238 g/d) containing glutamate, glycine, and all essential AA except Leu. Treatments were abomasally infused and arranged as a 2x3 factorial with two levels of Leu (0 or 4 g/d) and three AA supplements (no additional AA, CONTROL; 100 g/d nonessential AA + 100 g/d essential AA, NEAA+EAA; and 200 g/d essential AA, EAA). Periods lasted for 6 d, with 2-d adaptations and 4 d for excreta collection. Leucine increased ($P<0.05$) retained N from 24.0 to 28.0 g/d and decreased ($P<0.05$) urinary N from 54.9 to 51.1 g/d and urinary urea from 45.3 to 40.1 g/d. Both AA treatments increased ($P<0.05$) plasma urea and urinary urea N. NEAA+EAA decreased ($P<0.05$) retained N from 30.4 to 28.1 g/d and increased ($P<0.05$) urinary N from 37.8 to 59.7 g/d and urinary urea N from 28.0 to 49.3 g/d. EAA decreased ($P<0.05$) retained N from 30.4 to 19.5 g/d and increased ($P<0.05$) urinary N from 37.8 to 61.5 g/d and urinary urea N from 28.0 to 50.7 g/d. Because ruminal ammonia loading improved Leu utilization in a previous study, the decreases in retained N with the AA treatments were likely induced by AA imbalances rather than excess N, per se. Serum IGF-I concentrations were not affected ($P>0.4$) by treatment. Leucine increased ($P<0.05$) serum insulin, and both AA treatments tended ($P=0.1$) to increase serum insulin. Our data suggest that excess AA supply negatively impacts protein deposition by growing cattle when Leu is the limiting AA.

Acknowledgements: (This project was supported by National Research Initiative Competitive Grant no. 2003-35206-12837 from the USDA Cooperative State Research, Education, and Extension Service.)

Key Words: Amino Acids, Leucine, Growth

W109 The expression of genes related to adipocytes in Lee-Sung Pigs. S. T. Ding*, H. C. Wang, Y. H. Ko, and C. L. Chen, *National Taiwan University*, *Taipei, Taiwan*.

The purpose of this study was to detect differential expression of genes related to adipocytes in Lee-Sung pigs by suppression subtraction hybridization (SSH). Adipocytes and stromal vascular cells (S/V cells) from pig adipose tissues were isolated for mRNA extraction. The SSH kit from Clontech (PCR Select) was utilized to explore the differentially expressed genes. Subtractions were performed and the differentially expressed gene fragments were cloned into pGEM-T Easy TA cloning vector (Promega). cDNA from adipocytes was subtracted by the cDNA from the S/V cells. We have select 384 clones for gene sequence determination by a genetic analyzer (ABI 3730) and for further sequence analysis. These genes were subjected to a differential screening procedure to confirm the differential expression of genes between the two cell types in pigs. We found that at least 132 genes were expressed greatly in the adipocytes as compared with the S/V cells. Among these genes, 10 genes including 5 novel genes with the highest differences were selected and confirmed by Northern analysis. We found that angiotensin, calpin, stearoyl coenzyme A desaturase, and tumor necrosis factor α were highly expressed in the adipocytes as compared with S/V cells. The results confirmed that the genes involved in lipid metabolism were highly expressed in porcine adipocytes. However, specific functions of the novel genes discovered in the current study await further investigation.

Key Words: Adipocyte, SSH, Pig

W110 Role of the translational insulin signaling machinery in the anabolic effect of n-3 polyunsaturated fatty acids in growing steers. M. C. Thivierge*[1], L. Dombrowski[2], A. A. Gingras[1], and A. Marette[2], [1]*Université Laval*, *Quebec, QC, Canada*, [2]*Laval University Hospital Research Ctr.*, *Quebec, QC, Canada*.

Long-chain n-3 polyunsaturated fatty acids (LCn-3PUFA) in muscle membrane phospholipids are potentially involved in the regulation of protein anabolism in growing steers. Their amount is positively associated to increased muscle insulin sensitivity for amino acid utilization and altered protein metabolism. The current study focuses on the muscle cellular regulation of protein synthesis at the translational level of control. Two groups of 3 steers were used in a switchback design with 2 treatments randomized over 3 experimental periods of 5 wks. Steers were fed a basal diet composed of 44% forage and 56% concentrates. Two oil treatments were administrated continuously into the abomasum at 4% DMI: 1) control oil mixture (0.60 cotton:0.40 olive oil); or 2) refined Menhaden oil. The expression and phosphorylation state of insulin signaling components [the insulin receptor (IR), the PI3K-Akt-mTOR pathway and two modulators of translation initiation downstream of mTOR (p70S6k, 4EBP-1)] were investigated. Muscle of steers enriched with n-3LCPUFA tended to have higher amount of insulin receptors ($P = 0.12$). Although Akt phosphorylation on either Ser or Thr residues was not affected, mTOR phosphorylation was highly increased ($P=0.06$) in n-3LCPUFA enriched steers. Accordingly, phosphorylation of its downstream targets p70S6k ($P = 0.14$) and the (eIF)4E-binding protein 4E-BP1 ($P = 0.11$) both tented to be increased in steers fed n-3LCPUFA. These data strongly suggest that insulin signaling is involved in the n-3LCPUFA-mediated anabolic response. Moreover, the apparent lack of activation of the PI3K/Akt pathway suggests that the n-3LCPUFA-promoted mTOR-p70S6k-4EBP-1 anabolic pathway may be mediated by the increased amino acid availability at the cellular level, which would be sustained by higher whole body amino acid disposal. Supplemental energy demand required in this anabolic response was mediated through GLUT4 glucose transporters ($P = 0.04$).

Acknowledgements: Supported by CORPAQ, Fédération des producteurs de bovins du Québec and the Nutraceutical and Functional Food Institute.

Key Words: Insulin Sensitivity, Cellular Signaling, Steers

W111 Effect of myostatin on avian myogenic satellite cells and embryonic myoblasts. D. McFarland*[1], S. Velleman[2], J. Pesall[1], and C. Liu[2], [1]*South Dakota State University*, *Brookings*, [2]*Ohio State University*, *Wooster*.

Myostatin (GDF-8) inhibits the activation, proliferation, and differentiation of myogenic satellite cells. The relative importance of this growth factor is demonstrated in myostatin-null mice and cattle possessing defective myostatin genes. These defects result in greatly enhanced musculature. In the present study we

examined the effect of myostatin on turkey myogenic satellite cells and embryonic myoblasts. Compared with controls, proliferation of both turkey embryonic myoblasts and satellite cells was inhibited between 26 and 45% in serum-free medium containing 20 ng/ml myostatin. While individual turkey satellite cell clones differed in their responsiveness to myostatin ($P < 0.05$), there were no significant differences in the responsiveness of fast and slow growing cells as groups ($P > 0.05$). A slow growing clone that exhibited the greatest response to myostatin also exhibited the greatest depression of differentiation with this growth factor ($P< 0.05$). All other turkey satellite cell clones exhibited similar responses to the differentiation depressing effects of myostatin ($P > 0.05$). However, myostatin had no effect on turkey embryonic myoblast differentiation ($P > 0.05$). When exposed to myostatin, all fast growing clones and one slow growing clone increased their expression of decorin, a growth inhibitor ($P < 0.05$). The present study demonstrates that myogenic cells differ in their responsiveness to myostatin and suggest a role for decorin in myostatin action in muscle development.

Acknowledgements: Funded by the Midwest Poultry Consortium, South Dakota Poultry Industries Association, and the South Dakota and Ohio Agricultural Experiment Stations

Key Words: Myostatin, Muscle, Decorin

W112 A novel regulatory mechanism of muscle protein anabolism in steers. A. A. Gingras*[1], P. Y. Chouinard[1], Y. Couture[2], P. Julien[3], P. Dubreuil[2], A. Myre[1], K. Bergeron[1], T. A. Davis[4], and M. C. Thivierge[1], [1]*Université Laval, Qc, Canada*, [2]*Université de Montréal, Qc, Canada*, [3]*Laval University Medical Ctr (CHUL), Qc, Canada*, [4]*Baylor College of Medicine, Houston, Texas*.

Omega-3 long-chain polyunsaturated fatty acids (**n-3LCPUFA**) have been shown to improve insulin sensitivity in human pathologies, such as obesity and diabetes type II. The aim of this study was to investigate the ability of n-3LCPUFA to regulate protein anabolism in growing steers. Two groups of three Simmental x Red Angus steers were used in a switch back design with two treatments assigned over three 35-d periods. Steers were fed a basal diet composed of 13% grass silage, 31% corn silage and 56% concentrates. They were fitted with chronic catheters in the abomasum and in a mesenteric artery. Oil infusions (5% DMI) were continuously administrated into the abomasum (control oil: 40% olive: 60% cottonseed; n-3LCPUFA oil: 100% Menhaden oil). On the 5th wk of each period, hyperinsulinemic-euglycemic-euaminoacidemic clamps (10, 40, 160 mU insulin/kg·h) were performed to measure insulin sensitivity. A 9-h continuous infusion (1.667 μmol/kg·h) of L[1-^{13}C]phenylalanine (**Phe**) was conducted to assess protein metabolism. High dietary intake of n-3LCPUFA resulted in the incorporation of n-3LCPUFA into muscle phospholipids. With Menhaden oil infusion, n-3LCPUFA were increased ($P<0.001$) in muscle phosphatidylcholine from 11 to 23% (by weight). In muscle triglycerides n-3LCPUFA were increased ($P<0.01$) from 0.27 to 0.80%. Insulin-stimulated amino acid disposal tended to increase (+42%, $P=0.09$) with infusion of n-3LCPUFA. A 23% reduction ($P=0.04$) in whole body irreversible loss rate of Phe also occurred in n-3LCPUFA-enriched steers. Based on significant higher Phe isotopic enrichment ($P=0.03$) and on unaltered arterial concentrations of Phe (64 mM), it is likely that this reduction in Phe flux could result from a decrease in whole body proteolysis. These changes in hormonal or metabolic sensitivity in n-3LCPUFA-enriched steers may underlie the 18% decrease (tendency: $P=0.16$) of feed conversion resulting from a reduction ($P=0.05$) in food intake. These findings suggest that muscle n-3LCPUFA could act as a potent mediator of anabolism in growing steers.

Acknowledgements: Supported by CORPAQ and Fédération des producteurs de bovins du Québec. A special thank to Omega protein.

Key Words: Omega-3 Long-Chain Fatty Acids, Insulin Sensitivity, Steers

International Animal Agriculture

W113 Environmental factors and genetic parameters for birth weight in the indigenous Chiapas ovine breed. G. Campos[1], H. Castro-Gámez[1], R. López[1], R. Perezgrovas[2], and H. Castillo-Juárez*[3], [1]*Universidad Nacional Autónoma de México, Ciudad Universitaria, México D.F.*, [2]*Universidad Autónoma de Chiapas, Teopisca Center, Los Altos de Chiapas, México*, [3]*Universidad Autónoma Metropolitana, Calzada del Hueso, México D.F.*

The aim of this study was to estimate the heritability, the permanent environment effect and the breeding values for birth weight (BW) in a sheep flock from a Mexican local indigenous ovine breed named Chiapas. Fixed effects (environmental factors) affecting BW were also determined. This information is required for breeding purposes. The flock belongs to the indigenous Tzotzil community from the mountains of Chiapas, in the south of Mexico. In 1991 a breeding program supervised by the Teopisca Center from the University Autonomous of Chiapas was introduced in order to improve the quality of this flock based on the Totzil community breeding objectives and goals. Significant fixed effects were year of lambing, sex of the lamb, number of lambing ($P < 0.01$). An animal model, that included significant fixed effects, and DFREML software was used to estimate heritability and the permanent environment effect. The heritability of BW was 0.27 Ã‚Â± 0.10 and the permanent environment effect was 0.26 Ã‚Â± 0.05. The breeding values for BW ranged from Ã¢â‚¬â•œ0.27 to 0.40 kg. The permanent environment effect was rather large and similar in magnitude to the additive genetic variation observed, showing that the maternal environment is very important for the variation of BW, and that BW can be used in their breeding programs.

Acknowledgements: Thanks to the indigenous Tzotzil community of Chiapas.

Key Words: Genetic Parameters, Birth Weight, Indigenous Sheep Breed

W114 Design of breeding objective including trypanotolerance for African cattle smallholders. U. Janβen-Tapken*, Y. Li, and H. N. Kadarmideen, *Swiss Federal Institute of Technology, ETH Zentrum, Zurich, Switzerland*.

A major disease constraint on livestock productivity in Eastern Africa is Trypanosomosis which directly affects the livelihood of poor livestock keepers. The objective of this study was to design a breeding goal including trypanosomosis to increase trypanotolerance in cattle in pastoral, agro-pastoral and crop-livestock systems of selected sites in Kenya and Ethiopia. Genetic response was compared between selection indexes with and without packed red blood cell volume (PCV) as measurement of tolerance for the disease with higher percentage indicating higher tolerance level. Selection index (SI) I without PCV used two traits, milk yield (MY) and live weight (LW) compared to selection index II including PCV additionally.

According to the findings in the field (Narok district, Kenya) the following population structure for pastoralists was assumed in this study: Number of cows is 200 over 10 age-groups with a replacement of 20 cows each year. The mating ratio of sire is 1:10 with 2 sires for each age-group. With a survival rate of 80%, 160 offspring is produced per year.

Genetic parameters used for the calculations and genetic responses were: Phenotypic standard deviation for MY, LW and PCV of 35kg, 7.4kg, 2.92% and heritabilities of 0.23, 0.30, 0.26, respectively. Phenotypic correlations between the traits were 0.15, -0.05 and 0.0, and genetic correlations were 0.01, -0.01 and 0.0.

The SI II increases MY by only 0.14kg per year compared to SI I with 2.40kg but changes PCV by 7.02% compared to a negative change of -0.02% if PCV is not included in the index. Both SI reduce live weight slightly by 0.01 and 0.02

for SI II and SI I respectively. Although the increase in production level for SI II is not as high as for SI I, the increase in tolerance is considerable and might lead to a better survival rate and save costs under African environmental conditions.

Key Words: Trypanotolerance, Selection Index, Breeding Objective

W115 Using the n-alkane technique to estimate the herbage intake of steers grazing *Zoysia japonica* grassland. Y. Zhang*[1], Y. Togamura[2], and K. Otsuki[2], [1]*China Agricultural University*, *Beijing, PR China*, [2]*National Institute of Livestock and Grassland Science*, *Tochigi, Japan*.

The alkane technique was evaluated for estimating herbage intake of grazing steers in a natural *Zoysia japonica* grassland in Japan. Six steers continuously grazed *Z. japonica* grassland in which species coverage was measured to be 78.8% *Z. japonica*, 13.5% eastern bracken (*Pteridium aquilinum*), 6.2% other plants and 1.5% bare area by point method. The steers were dosed with a controlled release device (CRD) capsule (Captec TM, New Zealand) for the estimation of herbage intake. Fecal samples were collected once daily from the ground immediately after defecation. Over the same period, herbage samples were hand plucked. Steer BW was measured before and after the 15-d experimental period. Herbage and fecal samples were kept at -20°, freeze-dried, and milled through a 1 mm sieve. Concentrations of n-alkanes were determined by gas chromatography. Herbage intake was calculated using both the C{31}/C{32} and the C{33}/C{32} alkane pairs, based on the whole diet and fecal concentrations of these alkanes, and the C{32} release rate from the alkane-CRD. The effects of steers and alkane pairs (C{31}/C{32} or C{33}/C{32}) on intake were tested by Analysis of Variance using a completely random design. Relationships between steer BW changes and intakes were investigated by correlation. Herbage intake calculated by alkane technique was 1.6% to 2.4% of BW. Intake estimates based on either C{31} or C{33} alkanes did not differ ($P > 0.05$). Estimated intake of *Z. japonica* differed significantly between steers ($P < 0.05$), and was related significantly ($P < 0.05$) to the changes of steer BW ($r = 0.583$ and 0.651 for intake calculated by C{31}/C{32} and C{33}/C{32}, respectively). Herbage intake estimates were reasonable for the explanation for the BW changes according to the Japanese Feeding Standard for Beef Cattle. We conclude that herbage intake of steers grazing (*Zoysia japonica* grassland was estimated successfully with alkane technique.

Acknowledgements: The thanks are granted to Dr Elaine Grings from the Fort Keogh LARRL, USDA-ARS who presented his comments on the writing of paper.

Key Words: Steers, Intake, Grazing

Lactation Biology

W116 Udder morphology and milking characteristics in dairy goats milked once- or twice-daily. A. A. K. Salama[1], G. Caja*[1], M. Rovai[1], R. Casals[1], and A. Martí[2], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*Universidad Miguel Hernández de Elche*, *Orihuela, Spain*.

The effect of once- (**1x**) vs. twice- (**2x**) daily milking on udder morphology and milk emission during machine milking (42 kPa, 90 pulses/min) was studied in multiparous Murciano-Granadina dairy goats. Kids were removed from their mothers at birth and the goats milked 2x until the end of wk 2 when they were assigned to the milking frequency treatments: 1x (0900; n = 8), and 2x (0900 and 1700; n = 8) throughout lactation. Main udder and teat traits were measured 7 h after the a.m. milking at wk 2, 20 and 28 of lactation. Milk emission was recorded for each udder half during the a.m. milking on two consecutive days at wk 14 and 23 of lactation. Compared to 2x, 1x goats tended to have greater udder volume (1.67 vs. 1.53 L; $P < 0.14$) and udder depth (18.3 vs. 17.5 cm; $P < 0.06$). No differences were detected for teat traits. Stage of lactation affected ($P < 0.01$) all morphological traits studied when wk 2 and 28 were compared (udder: volume, 1.86 and 1.28 L; depth, 19.7 and 17.4 cm; teat: angle, 41 and 29°; length, 27 and 30 mm; floor distance, 25.3 and 26.2 cm). Interaction between week of lactation and milking frequency was only detected for teat length, where teats become longer as lactation advanced in 2x. All goats gave milk emission curves with a long plateau indicating a sustained high milk flow during machine milking. Peak (680 ml/min) and average (403 ml/min) milk flow rates did not vary according to milking frequency treatment and stage of lactation (wk 14 and 23). Udder halves of 1x goats yielded a greater volume of machine milk (560 vs. 365 ml; $P < 0.05$) and needed longer milking time (83 vs. 58 s; $P < 0.05$) than 2x goats. Machine milk and milking time decreased as lactation advanced, but differences between wk 14 and 23 were only significant for 2x goats (412 and 317 ml; 65 and 51 s, respectively). Results showed morphological udder changes in order to adapt milk storage capacity to milk yield according to stage of lactation and milking interval. On the contrary, milk flow did not vary according to the amount of milk stored, suggesting that teat sphincter features more than intramammary pressure condition milk flow in goats.

Key Words: Milking Frequency, Milk Flow, Udder Traits

W117 Effects of milking frequency prepartum on postpartum milk production, milk composition and dry matter intake in dairy cows. R. R. Rastani*[1], N. Silva del Rio[1], T. F. Gressley[1], G. E. Dahl[2], and R. R. Grummer[1], [1]*University of Wisconsin*, *Madison*, [2]*University of Illinois*, *Urbana*.

Forty-eight Holstein cows were utilized in a randomized block design to evaluate different dry period lengths and prepartum milking frequency on subsequent milk production, milk composition and dry matter intake. Lactating cows began the experiment 35 d prior to expected calving date, were milked 2x/d during a 7 d covariate period and were assigned to one of three treatments. Cows were milked 0x/d (0x), 1x/d (1x), and 4x/d (4x) for the last 28 d of gestation. If milk production decreased to less than 0.5 kg/milking or 1 kg/d, milking via machine ceased; however, teat stimulation continued 1x/d or 4x/d according to treatment assignment. All cows were milked 2x/d postpartum (wk 1 to 8). Prepartum DMI tended to be greater for 1x and 4x compared with 0x ($P < 0.10$). Prepartum, cows milked 1x produced 17% less than cows milked 4x (5.9 and 7.1 kg/d, respectively). There were no differences in prepartum and postpartum BCS and BW, and postpartum DMI. There was a parity by treatment interaction for postpartum milk production ($P < 0.05$). Postpartum milk production by multiparous cows through 56 days in milk was greater for 0x/d and 4x/d compared with 1x/d (44.6, 44.6, and 34.6 kg/d, respectively; $P < 0.02$). Postpartum milk production by primiparous cows was significantly decreased with increased milking frequency (39.8, 33.9, and 30.2 kg/d for 0x/d, 1x/d, and 4x/d; $P < 0.01$). Postpartum fat yield was greater for 0x compared with 1x and 4x (1.51 vs. 1.32 and 1.21 kg/d; $P < 0.01$). Postpartum protein yield tended to be greater for 0x compared with 1x and 4x (1.28 vs. 1.17 and 1.13 kg/d; $P < 0.10$). Continuous milking resulted in a loss of milk production in the subsequent early lactation with primiparous cows; however, increasing milking frequency to 4x/d in the last 28 days of gestation eliminated the previously observed loss in milk production associated with continous milking for multiparous cows.

Key Words: Dry Period Length, Continuous Milking, Milking Frequency

W118 Mid term lactational effects of once- versus twice-daily milking in Manchega and Lacaune dairy ewes. V. Castillo*, X. Such, G. Caja, E. Albanell, and R. Casals, *Universitat Autònoma de Barcelona*, *Bellaterrra, Spain*.

The effects of once- (x1) vs. twice-daily (x2) milking, throughout the milking period (wk 6 to 22) on milk yield, milk composition and somatic cell count

(SCC) were studied in a total of 60 dairy ewes (Manchega, MN; n = 32; and, Lacaune, LC; n = 28). After the weaning of the lambs (wk 5), ewes were assigned to two machine milking treatment: x1 (1830) or x2 (0700 and 1900). Treatments were switched at wk 14 according to a crossover design, but 8 MN and 5 LC ewes continued in group x2 as a control. Recording was individually conducted weekly for milk yield, biweekly for milk composition, and monthly for SCC. Cisternal milk was measured by using an oxytocin receptors blocking agent at wk 7, 12, 16 and 20. Cisternal milk varied according to breed (MN, 63%; and LC, 77%; $P < 0.01$) and milking frequency (x1, 75%; and x2, 66%; $P < 0.01$). According to their cisternal size, once daily milking resulted in a reduction ($P < 0.05$) in milk yield in early- (MN, 33%, and LC, 10%) and in late-lactation (MN, 11%, and LC, 9%), in both breeds. Milking frequency did not affect ($P < 0.001$) percentages of total solids (18.1 and 20.7% in MN; 16.6 and 17.5 % in LC), fat (6.7 and 7.9% in MN; 5.8 and 6.5% in LC) and protein (5.5 and 6.1% in MN; 5.0 and 5.5% in LC) in early- and late-lactation, respectively. In addition, the logSCC did not vary significantly ($P > 0.5$) according to the milking treatment, throughout the milking period. Our results showed that high yielding dairy sheep can be milked once daily throughout lactation. Reduction in milk yield was lowest in the highest milk yield level dairy breed which also had the greatest percentage of cisternal milk. Obtained results showed that genetic selection for milk yield also increased cisternal compartment and milkability of dairy sheep breeds. Moreover, losses in milk yield would be reduced if x1 is done during mid- or late-lactation. Once-daily instead of twice-daily machine milking reduces farmer working time with no negative effects on main milk components for cheese making or on udder health in dairy sheep.

Acknowledgements: This research has been supported by CICYT-Spain, Project AGL2002-03472.

Key Words: Once Daily Milking, Milk Production, Dairy Ewes

W119 Incidences of calving related disorders of Holstein cows supplemented with low dose of bST prepartum and during early lactation. M. S. Gulay*[1], M. Liboni[2], M. J. Hayen[2], and H. H. Head[2], [1]*Akdeniz University*, *Turkey*, [2]*University of Florida*, *Gainesville*.

Objective was to evaluate whether supplementing Holstein cows with bST (10.2 mg/d), beginning 21 d (±3 d) before expected calving and continued through 42 d (±3 d) postpartum, affected incidence rates of retained fetal membranes (RFM), metritis (MET), clinical mastitis (MAS), digestive problems (DP), ketosis (KET), milk fever (MF), displaced abomasum (DA) or lameness (LAM) during the first 60 d postpartum. Multiparous cows from two separate trials were combined for analyses. Cows in bST supplemented group (I; n=149) received biweekly injections of POSILAC® in ischiorectal fossa, whereas control cows (II; n=154) were not supplemented. A group of cohorts also was used in the statistical analysis (III; n=84). Disease frequencies were collected from farm records. Across all treatment groups the incidence rates (number of diseased cows divided by the total number of cows) for RFM, MET, MAS, DP, KET, MF, DA and LAM were 9.6, 16.7, 14.4, 4.2, 4.2, 3.2, 3.2 and 6.2%, respectively. Incidence rates of RFM, MET, MAS, DP, KET, MF, DA and LAM for TRT-I, II and III were 10.0, 8.4 and 12.1%; 12.9, 18.2 and 20.2%; 7.9, 17.5 and 19.1%; 1.4, 6.5 and 4.5%; 1.4, 5.2 and 6.7%; 1.0, 4.6 and 4.5%; 1.4, 3.9, and 4.5%; and 7.2, 5.2 and 6.74%, respectively. The proportions of sick cows in each group (number of cows having one or more cases of diseases divided by the total number of cows) were 31.4, 43.5 and 51.7%, respectively. Significant Chi-Square values ($P<0.05$) were detected between TRT-I and II for MAS, DIG, KET and MF, with a greater number of healthy cows in TRT-I than II ($P<0.04$). No differences were detected between TRT-II and III. The results indicated that a low dose of bST supplemented to Holstein cows during prepartum and early postpartum periods did not have a negative effect on postpartum calving disorders compared to control cows. Moreover, cows supplemented with bST were less likely to have calving related disorders than non-supplemented counterparts.

Key Words: Transition Cows, bST, Diseases

W120 Association between dry period length (30 or 60 d) and calving related disorders. M. S. Gulay*[1], M. J. Hayen[2], and H. H. Head[2], [1]*Akdeniz University*, *Turkey*, [2]*University of Florida*, *Gainesville*.

Objective was to evaluate effects of dry period length (60 d vs. 30 d) on incidence of calving related disorders of multiparous Holstein cows (n=84 treated cows and 27 cohorts) during the first 60 d postpartum. Treatments were arranged in a 3x2x2 factorial design that included dry period (60 d dry, 30 d dry, and 30 d dry+ECP), prepartum and postpartum bST supplementation (POSILAC®; 10.2 mg/d), and prepartum anionic or cationic diets. To accelerate mammary involution, estradiol cypionate (ECP; 15 mg) was injected intramuscularly at dry-off. Across all TRT groups [(n=112); cows in TRT-I (60 d dry, n=28), TRT-II (30 d dry, n=28), TRT-III (30 d dry+ECP, n=29), and TRT-IV (cohorts, n=27)] the overall observed incidence rates (number of diseased cows divided by the total number of cows) were: displaced abomasum (DA; 1.8%), retained fetal membranes (RFM; 9.8%), metritis (MET;10.7%), clinical mastitis (MAS; 9.8%), ketosis (KET; 2.7%), and lameness (LAME; 4.5%). Incidence rates of DA, RFM, MET, MAS, KET, and LAME for TRT-I, II, III and IV were 3.6, 0, 0 and 3.7%; 10.7, 3.6, 10.3 and 14.8%; 14.3, 7.1, 6.9, and 14.8%; 3.6, 3.6, 0 and 3.5%; 3.6, 7.1, 3.5, and 3.7%, respectively. The proportions of sick cows in a group (number of cows having one or more cases of diseases divided by the total number of cows) were 39.3, 28.6, 31.0 and 37.0%, respectively. No significant Chi-Square values ($P<0.1$) were detected among the three dry TRT groups and cohorts. Thus, results indicated that shortening dry period length with or without ECP did not increase incidence of calving related disorders.

Key Words: Dry Period Length, Transition Period, Diseases

W121 Assessing changes in mammary gland gene expression using a cDNA microarray in the dairy cow following administration of bovine somatotropin. J. Kelsey*[1], A. Nudda[1], A. Corato[1], E. Mosley[1], S. Mosley[1], B. Williams[1], J. Grimberg[1], D. Henderson[2], J. Hoying[2], K. Greer[2], and M. McGuire[1], [1]*University of Idaho*, *Moscow*, [2]*University of Arizona*, *Tucson*.

To determine gene expression changes in the mammary gland following bovine somatotropin (bST) treatment, four lactating Holstein cows (253±143 DIM) were used. Mammary tissue biopsies were taken on d -5, -2, 1 and 6 relative to a single 500 mg dose of bST (Posilac®, Monsanto, St. Louis, MO). Total RNA was isolated, amplified, converted to cDNA, labeled with Cy3 or Cy5 dye, and hybridized to the NBFGC bovine microarray (Michigan State University). Comparisons were made using a modified loop design with each cow on each day represented once. Milk yield was increased (30%; $P < 0.05$) by d 4 and remained elevated through the end of the study. Milk fat, protein and lactose content were not affected ($P > 0.1$). Microarray data were analyzed by two methods. In the first analysis, raw data were background adjusted using the procedure by Edwards (Bioinformatics 2003, 7:825) and normalized using Loess normalization. An empirical Bayes procedure to estimate individual gene shrunk variances was then used to create moderated t-statistics following an ANOVA model. The model included fixed treatment and dye effects, all second order interactions, as well as random cow and array effects. Treatment contrasts within gene were estimated and p-values adjusted using a false discovery rate procedure. Based on this analysis, two genes changed ($P < 0.05$). The second analysis began with a local background intensity subtraction and linlog transformation followed by Lowess normalization between the two channels of each array and among both channels of all arrays. A gene-by-gene fixed effects ANOVA followed which included array, dye and time terms in the model. P-values were determined using a shrunk variance consisting of a portion of the pooled variance for all genes and the individual gene variances. This analysis yielded a list of 495 genes that changed ($P < 0.05$); however, no false discovery rate procedure was employed and a random cow effect was not included. Statistical analysis of microarray data is a complex and evolving field.

Acknowledgements: Supported by USDA-IFAS (2001-52100-11211).

Key Words: Microarray, bST, Bioinformatics

W122 Fatty acid composition of porcine milk throughout lactation and comparison to human and bovine milk. S. Donovan*[1], S. Taylor[2], and E. DePeters[2], [1]*University of Illinois*, *Urbana*, [2]*University of California*, *Davis*.

Fatty acids (FA) in milk provide an important energy source, influence cell membrane FA composition and regulate neural development of the suckling neonate. Milk FA are derived from de novo mammary synthesis and plasma FA, which is influenced by dietary FA intake and hepatic FA synthesis, and FA synthesis by ruminal microbiota. The FA compositions of bovine and human milks are well characterized. Although the pig is an important production species and biomedical model Less is known of the FA composition of porcine milk. Thus, the FA composition of porcine milk throughout lactation was determined and compared to bovine and human milk. Milk samples were obtained from three sows fed a standard corn/soybean meal diet at farrowing (0 h), 12 h and d 1-4, 7, 14, 18, 21 and 24 postpartum. Human milk samples (n=8) were obtained between 1 and 3 months postpartum and bovine milk (n=3) from cows fed 40% alfalfa/60% concentrate. Fatty acids were determined by capillary gas chromatography and expressed as % of total fatty acids (g/100g). Longitudinal changes in porcine milk FA were analyzed by repeated measures ANOVA using the MIXED model within SAS and data are expressed at means ± SEM. No FA less than C10 and no docosahexaenoic acid (C22:n6) were detected in porcine milk. The predominant FA's in porcine milk, C18:1 cis 9 & 10 (33.7 ± 2%) and C16 (30.5 ± 3%), were unaffected by stage of lactation. Seven FA were affected ($P<0.001$) by stage of lactation. C18:2 decreased ($P<0.001$) from 18.2 ± 0.5% in colostrum to 10.9 ± 0.5% in milk. C17, C18:3, C20:4 and C22:5cis10 also decreased from colostrum to milk, whereas C10 and C12 increased over lactation. Porcine, human and bovine milk FA were compared by 1-way ANOVA. All FA tested differed ($P<0.001$) among the three species, except C22:n5. C4 and C6 were only found in bovine milk and C22:n6 in human milk. Nine (26%) FA were similar in human and bovine, 9 (26%) in human and porcine, and 8% in bovine and porcine. Twelve FA (35%) differed ($p<0.001$) among the species. In summary, the FA profile of porcine milk is influenced by stage of lactation and is more similar to human than bovine milk.

Key Words: Milk, Fatty Acid, Pig

W123 The effect of conjugated linoleic acid (CLA) on transcriptional activation of the Stearoyl-CoA desaturase gene in bovine mammary cells. A. F. Keating*[1,2], F. Q. Zhao[2], and J. J. Kennelly[1], [1]*University of Alberta*, *Edmonton, Canada.*, [2]*University of Vermont*, *Burlington*.

The majority of CLA present in bovine milk is produced by conversion of rumen-produced trans-vaccenic acid to CLA in the mammary gland by the action of the Stearoyl Co-A desaturase gene, however the regulation of this process is poorly understood. In this study, regulation of the Scd gene promoter was examined by creating truncated promoter luciferase reporter constructs and carrying out transient transfection of a bovine mammary cell line, Mac-T. Promoter fragments were designated F1 to F8 and were 212, 380, 416, 760, 996, 1264, 1523 and 1824bps in length respectively. Fragment F4, an area 732bp upstream of the proposed transcriptional start site, was shown to have the highest transcriptional activity of the truncated clones, with fragment F7 also showing high activity. These results also showed that an 35bp area ranging from 354 to 388bp from the proposed transcriptional start site was critical for activation of the Scd promoter (F2 and F3). The effect of CLA isomer treatment on the Scd promoter was also examined. Treatment with CLA isomers caused a marked reduction in the overall activity of the Scd gene promoter with differences in the isomer effect (Table 1).

Table 1. Effect of CLA isomers on Scd gene promoter.

Fragment	F1	F2	F3	F4
NT	10960	12212	109806	255815
c-9, t-11 CLA	1192	1333	5317	9804
t-10, c-12 CLA	1696	2910	5371	12746
F5	F6	F7	F8	
NT	173800	173800	209520	2481
c-9, t-11 CLA	3683	4875	10788	290
t-10, c-12 CLA	771	11361	8871	200

Relative Light Units from Scd promoter truncated constructs are shown.

Acknowledgements: This work was supported by the Dairy farmers of Canada and the CLA Network.

Key Words: Conjugated Linoleic Acid, Promoter Regulation

W124 Effects of body weight and plane of nutrition on histological development of mammary tissue in Holstein heifers. K. M. Daniels*[1], M. L. McGilliard[1], P. L. Boyle[1], M. J. Meyer[2], M. E. Van Amburgh[2], A. V. Capuco[3], and R. M. Akers[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Cornell University*, *Ithaca, NY*, [3]*USDA-ARS*, *Beltsville, MD*.

Our objective was to determine effects of rate of gain and body weight (BW) on udder development. Mammary tissue samples were available from heifers (n = 54) reared on one of two dietary treatments (Moderate (M) 650 g/d or High (H) 950 g/d of daily gain), and slaughtered at 150, 200, 250, 300, or 350 kg BW. At slaughter, mammary parenchymal samples were excised, preserved, prepared for histology, and stained with hematoxylin and eosin. Representative digital images of tissue sections were captured for analysis. Tissue areas occupied by interlobular stroma, epithelium, lumen, and intralobular stroma were measured (μm^2) and the numbers of epithelial and luminal structures per image were tabulated (Image-Pro Plus software, Version 4.5). Mean percentages of mammary parenchyma occupied by interlobular stroma, epithelium, lumen, and intralobular stroma were 28, 20, 7, and 45%, respectively; percentages did not differ by BW or treatment, nor was there an interaction between treatment and BW. Number of epithelial (31 ± 6 vs. 47 ± 5) and luminal (24 ± 5 vs. 38 ± 4) structures per image increased between 150 and 350 kg BW. For heifers slaughtered between 150 and 350 kg of BW, alterations in the rate of gain between 650 and 950 g/d, accomplished by feeding varying amounts of the same diet, had no significant effect on tissue characteristics or the pattern of mammary parenchymal development. Perhaps with other diets, changes in parenchymal tissue composition would be noted. These data support the hypothesis that the length of time between birth and slaughter, not plane of nutrition, plays the predominant role in determining the amount of mammary parenchyma a heifer will have.

Key Words: Heifer, Histology, Mammary

W125 Use of an immortalized bovine mammary epithelial cell line (MAC-T) to measure the mitogenic activity of extracts from heifer mammary tissue: effects of nutrition and body weight. K. M. Daniels*[1], P. L. Boyle[1], M. L. McGilliard[1], M. J. Meyer[2], M. E. Van Amburgh[2], and R. M. Akers[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Cornell University*, *Ithaca, NY*.

Our objective was to determine effects of rate of gain and body weight (BW) on the mitogenic activity of mammary gland extracts (MGE) prepared from bovine mammary parenchyma. Mammary tissue samples were available from heifers (n = 54) reared on one of two dietary treatments (Moderate (M) 650 g/d or High (H) 950 g/d of daily gain), and slaughtered at 150, 200, 250, 300, or 350 kg BW. Cytosolic MGE were prepared from frozen mammary parenchyma. Proliferation of the bovine cell line MAC-T, as affected by addition of MGE to

culture medium was measured by the incorporation of ^{3}H-thymidine into DNA. Addition of MGE markedly stimulated cell proliferation (5-fold vs. no addition and 1.5-fold greater than 5% fetal bovine serum). However, heifer BW did not impact response to MGE. Moreover, in contrast to a prior study, but in agreement with in vivo data (bromodeoxyuridine labeling) from a current study, we measured only a modest and generally non-significant effect of diet, irrespective of BW from 150 to 350 kg, on the proliferative response of MAC-T cells, irrespective of how the data were expressed i.e. parenchymal mass basis, protein basis, or DNA basis. Response trends were however similar i.e. greater proliferation with MGE from M heifers. Possible reasons for these differences may be attributable to differences in animal genetics and/or diet composition between past and present studies. Regardless, these data support the hypothesis that the length of time between birth and slaughter, not plane of nutrition, plays the predominant role in determining the amount of mammary parenchyma a heifer will have.

Key Words: Heifer, Mammary, Nutrition

W126 Use of ^{13}C-mass isotope distribution analysis (MIDA) to define precursors for lactose and amino acid synthesis by bovine mammary explants. B. J. Bequette*[1], S. L. Owens[1], S. W. El-Kadi[1], N. E. Sunny[1], and A. Shamay[2], [1]*University of Maryland*, *College Park*, [2]*The Volcani Center*, *Bet Dagan, Israel*.

Despite the fact that mammary uptake of carbon and N substrates balances with milk component outputs, the biochemical organization of substrate fluxes remains ill-defined. Our aim was to determine the contribution of glucose to lactose and to non-essential amino acid (AA) synthesis by the bovine mammary gland. Mammary explants (each 100 mg) from two late-lactation cows were incubated (for 0.5, 1, 2, 3 or 6 h) in Delbecco's Modified Medium (5 mL) containing all essential AA plus [U-^{13}C]glucose. For Cow 1, explants were incubated with 0.67, 3.33 or 14.4 mM [U-^{13}C]glucose and for Cow 2 incubations contained 1.11, 5.55 or 27.7 mM [U-^{13}C]glucose. After incubation, explants were separated from media, and ^{13}C-MIDA conducted on intracellular free AA. Media lactose was separated from free sugars and lactose hydrolyzed to glucose and galactose for ^{13}C-MIDA. From 1 h of incubation onwards, parameters were not different. The proportion of galactose derived from glucose increased (3 to 88%; $P<0.001$) with increasing glucose level, whereas all glucose in lactose derived from media glucose. The net contribution of glucose carbon to aspartate (2 to 10%), glutamate (5 to 11%) and glutamine (3 to 11%) synthesis increased ($P<0.05$) only slightly with glucose level. Thus, most of these AA derived carbon skeletons from essential AA catabolism. The proportion (~4%) of acetyl-CoA flux, and thus Krebs cycle energy generation, derived from glucose was not affected by glucose level. This study is the first to show that, within the physiological range of plasma glucose (3.33-5.55 mM), a significant portion (~55%) of galactose for lactose synthesis derives from non-glucose sources. Further, that essential AA are the major source for *de novo* AA synthesis, the supply of essential AA as precursors for mammary synthesis of non-essential AA, in addition to casein, may need to be considered as a potential limitation to milk protein yield by dairy cows.

Key Words: Mammary Gland, Lactose Synthesis, Glucose

W127 The effect of using a teat sealant to decrease intramammary infections at calving and to compare microbiological results from quarter and composite milk sampling. H. Bissette*, W. Gilson, W. Graves, J. Haslett, L. Ely, J. Fain, and S. Nickerson, *University of Georgia*, *Athens, GA*.

A study was conducted at the University of Georgia Dairy in Athens to evaluate the effect of an internal teat sealant at dry-off on new intramammary infections (IMI) at calving and to compare microbiological results of composite and quarter milk sampling to determine IMI status. Quarter and composite milk samples were taken at dry-off, calving and 10 d post calving. At dry-off, 20 cows were infused with a standard dry cow antibiotic (Tomorrow, Fort Dodge, Inc.) and vaccinated with *Escherichia coli* J-5 vaccine (Novartis, Inc., Larchwood, IA). Twenty animals were divided into 2 equal groups based on parity (primiparous and multiparous). Animals with each group were then randomly assigned to either treatment (infused with Orbeseal, Pfizer, Inc., Exton, PA) or control groups. Quarter and composite samples were taken at dry-off from 10 teat sealed cows and 10 controls, and frozen until cultured. Animals in the study were dried off from 9/18/2004 until 12/15/2004. A total of 63 of 80 quarters sampled was bacteriologically negative, 2 samples had *Staph. aureus*, 9 samples had coagulase negative staph (CNS), and 6 samples had environmental streps. For the 40 quarters treated with a teat sealant, 35 samples were negative, 1 had *Staph. aureus*, 3 had CNS, and 1 had an environmental strep at dry off. For the 40 quarters that were not treated with a teat sealant, 28 samples were negative, 1 had *Staph. aureus*, 6 had CNS, and 5 had environment streps at dry-off. At dry-off, 14 of 20 composites were negative, 2 had environmental streps, and 4 had CNS. Preliminary results of sampling at calving and 10 d are 4 of the 4 fresh treated cows were bacteriologically negative with 0 new IMI. 5 of the 8 fresh control cows were negative and 3 had a new IMI. At 10 d post calving, 5 of 7 control cows were negative and 2 had a new IMI. 79% of the composite samples correctly categorized the infection status of the cow. Two composite samples were contaminated during the collection process.

Key Words: Teat Sealant, Milk Sampling, Mastitis

W128 Composition and size of mammary glands of pregnant gilts according to gland anatomical location. F. Ji*[1], W. L. Hurley[2], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock, TX*, [2]*University of Illinois*, *Urbana*.

This study was to characterize the growth of mammary glands individually or as grouped by anatomical location during gestation in gilts. Thirty-five pregnant gilts (158.2±3.8 kg, Camborough-22, PIC) were allotted randomly to seven slaughter groups: d 0, 45, 60, 75, 90, 102, and 112 of gestation. Gilts were fed 2 kg/d gestation diet (3.1 Mcal ME/kg, 12.2% CP, as fed basis) and slaughtered according to their assignments to obtain mammary glands. Skin and extraneous fat pad were removed from mammary glands to obtain parenchymal mammary tissues. Obtained mammary tissues were further separated into individual glands. Individual mammary glands were weighed and bisected in an approximate midsaggital section to measure the cross-sectional area (CSA). Half of the each mammary gland was sampled, ground, and pooled according to anatomical location. The first two pairs of glands were pooled as ′anterior′. The 3rd, 4th, and 5th pairs of glands were pooled as ′middle′. The 6th, 7th, and 8th pairs of glands were pooled as ′posterior′. Weight of individual glands, and CSA increased ($P < 0.01$) cubically from d 45 to 112 of gestation. Individual dry matter (DM) and crude protein (CP) contents in anterior, middle, and posterior increased ($P < 0.05$) cubically from d 45 to 112 of gestation. Weight of individual glands in middle (345.9 g) was higher ($P < 0.05$) than that in posterior (241.3 g) at d 112 of gestation. Content of CP in middle glands (138.8 g) was higher ($P < 0.05$) than those in anterior (101.5 g) and posterior (97.2 g) at d 112 of gestation. Weight gains of individual glands, CP accretions in individual glands, and CSA of individual glands accelerated ($P < 0.01$) after d 70.5, 81.6, and 67.0 of gestation, respectively based on non-linear regressions from NLREG program. This study indicates that the growth of individual mammary glands and CP accretion in individual mammary glands mainly occurred during late gestation (after d 70), and individual mammary glands located in the middle (3rd, 4th, and 5th pairs) gained more weight and proteins during gestation than those located in the anterior or posterior.

Acknowledgements: Financial support from CJ Corp.

Key Words: Mammary Glands, Gestation, Sows

W129 Mineral and trace element content of porcine milk throughout lactation and comparison to human and bovine milks. S. Donovan*[1], S. Taylor[2], E. DePeters[2], and B. Lonnerdal[2], [1]*University of Illinois*, *Urbana*, [2]*University of California*, *Davis*.

The concentrations of minerals and trace elements in milk are tightly regulated through mammary transporters as well as their binding to milk proteins. The

pig is an important production species and biomedical model, however the mineral or trace element content of pig milk and mammary transport systems have not been well characterized. We analyzed the mineral and trace element content of porcine milk throughout lactation and compared it to bovine and human milk. Milk was obtained from three sows at farrowing (0 h), 12 h and d 1-4, 7, 14, 18, 21 and 24 postpartum. Human milk (n=8) was obtained between 1 and 3 months postpartum and bovine milk (n=3) from cows in midlactation. Milk samples were analyzed by atomic absorption (Ca, Mg, Na and K), colorimetric assay (P) and trace elements by Inductively Coupled Plasma Emission Spectroscopy (Cu, Fe and Zn). Longitudinal changes in porcine milk were analyzed by repeated measures ANOVA using the MIXED model within SAS and data are expressed at means ± SEM. All minerals and trace elements were affected ($p<0.001$) by stage of lactation, with the exception of Fe. Ca increased ($P<0.001$) 3-fold from porcine colostrum (563 ± 87 ug/L) to mature milk (1664 ± 96 ug/L). Mg (91 ± 4 vs. 121 ± 4 ug/L) and P (1252 ± 40 vs. 1562 ± 31 ug/L) also increased ($p<0.001$) from colostrum to mature milk. Milk K initially increased between 0 and 24 h, then declined from 1314 ± 46 ug/L in colostrum to 1035 ± 44 ug/L in mature milk ($p<0.001$). Na also decreased ($P<0.001$) from colostrum (651 ± 45 ug/L) to mature milk (329 ± 17 ug/L). Zn decreased from colostrum (10.2 ± 1.0 ug/L) to mature milk (5.3 ± 0.2 ug/L), as did Cu (2.6 ± 0.3 vs 1.1 ± 0.1; $P<0.001$). Compared to human milk, porcine milk contained 2- to 5-fold higher ($p<0.001$) concentrations of all minerals. Porcine milk was also higher in Ca, P, Cu, Fe and Zn than bovine. Mg was similar and Na and K were lower ($P<0.001$) between porcine and bovine. The high content of minerals and trace elements in porcine milk suggest high capacity transport systems in pig mammary gland that merit further investigation.

Key Words: Milk, Minerals, Pig

W130 Effect of vaccenic acid/conjugated linoleic acid-enriched butter on plasma lipoproteins in the cholesterol-fed hamster. A. L. Lock[1], C. A. M. Horne[2], D. E. Bauman*[1], and A. M. Salter[2], [1]*Cornell University*, *Ithaca, NY*, [2]*University of Nottingham*, *Sutton Bonington, LEICS, UK*.

Butter naturally enriched in *cis*-9, *trans*-11 CLA (rumenic acid; RA) and vaccenic acid (VA) has been shown to be an effective anticarcinogen; however, there has been no examination of the effects of a naturally-derived source of VA and RA on atherosclerosis-related biomarkers. The current study was designed to determine the effect of VA/RA-enriched butter (VA/RA-BT) on plasma lipoproteins and tissue fatty acid profiles in the cholesterol-fed hamster as the biomedical model. Male Golden Syrian hamsters were fed diets containing 0.2% cholesterol and 20% added fat as, treatment (TRT) 1: control (20% standard butter; STD-BT), TRT 2: 5% STD-BT + 15% VA/RA-BT or TRT 3: 15% STD-BT + 5% partially hydrogenated vegetable oil (PHVO). The content of RA and VA was 3.61 and 15.36 g/100 g fatty acid, respectively, in the VA/RA-BT and 0.44 and 1.39 g/100 g in the STD-BT. Diets were fed for 4 wk after which plasma lipoproteins were isolated, cholesterol quantified, and tissue fatty acid profiles determined. The concentration of RA in the liver and epididimal and perirenal fat depots was 0.33, 0.52, and 0.58 for TRT 1; 2.07, 3.35, and 2.98 for TRT 2; and 0.67, 0.85, and 0.80 g/100 g for TRT 3, respectively ($P < 0.001$). The concentration of VA was 0.32, 0.74, and 0.64 for TRT 1; 2.41, 5.11, and 4.53 for TRT 2; and 0.78, 1.66, and 1.51 g/100 g for TRT 3 for liver and epididimal and perirenal fat depots, respectively ($P < 0.001$). Total ($P < 0.001$) and LDL ($P < 0.01$) cholesterol concentrations were significantly reduced in TRT 2 and 3 compared to TRT 1. However, VLDL concentrations were significantly reduced in TRT 2 animals compared to those in both TRT 1 and 3 ($P < 0.01$). HDL was not different among TRT. The ratio of potentially atherogenic lipoproteins (VLDL+IDL+LDL) to anti-atherogenic HDL was lower in animals fed VA/RA-BT (0.60, TRT 2) than those fed either control diet (1.70, TRT 1) or the diet containing PHVO (1.04; TRT 3; $P < 0.001$). Thus, increasing the VA/RA content of butter results in a beneficial plasma lipoprotein profile that is associated with a reduced risk of atherosclerosis.

Acknowledgements: Supported by the National Dairy Council

Key Words: CLA, Vaccenic Acid, Atherosclerosis

Nonruminant Nutrition: Enzyme Supplementation and Methodology

W131 Nutrient digestibility in microbial phytase supplemented corn-soybean based diets in two phases of growing pigs. H. Krebs*[1], C. T. Kadzere[1], Z. Liu[1], and E. van Heugten[2], [1]*North Carolina A&T State University*, *Greensboro*, [2]*North Carolina State University*, *Raleigh*.

Phytate phosphorus (P) makes up 40 to 90% of P in cereal grains and in oilseeds and is unavailable to swine except when supplementary phytase is in the diet. In a 4 x 4 CRD study, 16 male castrated pigs were assigned to four homogenous groups of four animals each to evaluate the effects of microbial phytase on nutrient digestibility in pigs in Phase I (PI) and in Phase II (PII). Each group was fed one of four diets (DI to DIV) differing only in P, calcium (Ca), and phytase content. The average weights of pigs were 19 kg and 39 kg at the start of PI and PII collection periods, respectively. In PI, DI (negative control) contained 0.1% less P and Ca than DII and no phytase; DII (positive control) which had 0.6% P and 0.7% Ca as recommended for growing pigs (10-20 kg) by NRC and 0.0% phytase; DIII and DIV had both 0.1% less P and Ca than DII and had 0.0125% and 0.025% supplemental phytase, respectively. The amount of phytase in PII was similar to that in PI diets. PII diets had 0.1% less P and Ca in DI, DIII, and DIV than the NRC recommendation of 0.5% P and 0.6% Ca for growing pigs (20-50 kg) as in DII. A pig on DII in PI was removed from the study. Fecal samples were collected on d 25 to d 31 in PI and on d 60 to d 66 in PII and analyzed. There were no differences in nutrient digestibility in PI. There were differences ($P < 0.05$) in ash, protein, and fiber digestibility in PII. In PII, pigs on DIII had the highest (75.9%) and those on DI the lowest (65.8%) ash digestibility. Protein digestibility was highest (90.3%) in DIII pigs and lowest (83.0%) in DII. Fiber digestion was highest (68.6%) in DIII and lowest (57.8%) in DII. Nutrient digestibility was higher ($P < 0.05$) in PII than in PI. Microbial phytase in corn-soybean based diets did not influence nutrient digestibility in PI but did in PII. Data presented shows that phytase at the lower level improved digestibility of protein and fiber. It is hard to understand why this was not the case with the higher level.

Key Words: Phytase, Swine, Nutrition

W132 Effect of microbial phytase in corn-soybean based diets on total and soluble fecal phosphorus excretion in two phases of growing pigs. Z Liu[1], C. T. Kadzere*[1], H. Krebs[1], and E. van Heugten[2], [1]*North Carolina A&T State University*, *Greensboro*, [2]*North Carolina State University*, *Raleigh*.

The effect of microbial phytase in corn-soybean based diets on total phosphorus (TP) and soluble phosphorous (SP) excretion were evaluated in growing male castrate pigs in Phase I (PI) and Phase II (PII) in a 66-d 4 × 4 CRD study. Pigs (n = 16) were assigned to four equal groups of four pigs each and groups were fed one of four diets (DI to DIV) differing only in phosphorus (P), calcium (Ca), and phytase. The average pig weights were 19 kg and 39 kg at the start of PI and PII collections, respectively. In PI, DI (negative control) contained 0.1% less P and Ca and no phytase; DII (positive control) had 0.6% P and 0.7% Ca as recommended for growing pigs (10-20 kg) by the NRC and no phytase; DIII and DIV both had 0.1% less P and Ca than DII, and had 0.0125% and 0.025% supplementary phytase, respectively. Phytase levels in PII diets were the same for corresponding PI diets. PII diets had 0.1% less P and Ca in DI, DIII, and DIV than in DII with the NRC recommended level of 0.5% P and 0.6% Ca for grow-

ing pigs (20-50 kg). A pig on DII was removed from the study. Fecal samples were collected on d 25 to d 31 and on d 60 to d 66 in PI and PII. TP was determined after digestion in HNO_3 by ICAP spectrophotometry. Similarly, SP was obtained by the ICAP method after filtration through a 0.45 µm membrane. TP in PI was 17.3, 21.7, 14.8, and 14.5 mg/g for pigs on DI, DII, DIII, and DIV and was 19.3, 18.2 17.1 and 14.1 mg/g in PII for pigs on DI, DII, DIII and DIV respectively. TP excreted by pigs on DIII and IV was lower ($P < 0.05$) than DI and DII. The SP in PI was 3.8, 3.2, 3.1, and 3.2 mg/g for pigs on DI, DII, DIII, and DIV and was 1.8, 1.7, 2.1, 2.1 mg/g for pigs in PII on DI, DII, DIII, and DIV respectively. The values were not different ($P > 0.05$). Microbial phytase reduced TP excretion in PI and PII but did not influence SP in either phase.

Key Words: Phytase, Phosphorus, Excretion

W133 Effect of phytase activity of the diets on the faecal and urinary phosphorous excretion in adult roosters. J. Tossenberger[1], L. Babinszky*[1], and I. Kühn[2], [1]*University of Kaposvár, Department of Animal Nutrition*, *H-7400 Kaposvár, POB 16, Hungary*, [2]*AB-Enzymes GmbH*, *D-64212 Darmstadt, Germany*.

The effect of phytase on P excretion of poultry has been customarily determined in studies with intact birds based on collection of excreta. By using cannulation techniques, it is possible to measure faecal and urinary P excretion separately. The aim of our trials was to study how different dietary phytase activities influence faecal and urinary P excretion of adult roosters. The studies were conducted with a total of 16 adult Shaver Star Cross 288 roosters (four birds/treatment) in two replicates (n = 8/treatment). Prior to the trials a simple T-cannula was implanted in the terminal colon. Nutrient contents of the corn-soy based diets met the 1994 NRC recommendations. The Ca content of the basal diet was 4.9 g/kg, and its P content was 3.0 g/kg. The trial included four treatments. Treatment 1 diet contained no phytase supplementation. In treatments 2, 3 and 4 diets were supplemented with a bacterial 6-phytase (trichoderma reesei) at the rate of 125, 250 and 500 PPU/kg, respectively. Measured phytase activity of the diets was 0, 166, 311 and 695 PPU/kg. Trial data were analyzed by means of ANOVA. According to our data, 125 PPU/kg phytase supplementation led to a P digestibility increase from 31% (control) to 44% ($P \leq 0.05$). Higher phytase dosages did not improve P digestibility ($P \geq 0.05$). As a result of 125 PPU/kg phytase supplementation daily urinary P excretion was increased from 13 mg/kg$^{0.75}$ (control) to 23 mg/kg$^{0.75}$ ($P \leq 0.05$). Further increase of phytase dosages did not increase any further urinary P excretion ($P \geq 0.05$). From total phosphorous excretion 16.5, 28.4, 31.7 and 32.5% (treatments 1, 2, 3, and 4, respectively) was excreted via urine. As a result of 125 PPU/kg phytase supplementation P retention increased by 38%. Higher phytase dosages did not lead to an increase in retention ($P \geq 0.05$). Thus, our data also call the attention to the fact that adult roosters excrete their P surplus in the urine, similarly to pigs.

Key Words: Rooster, Phosphorous Digestibility, Urinary Excretion

W134 Effect of combination of phytase and xylanase on the growth performance and nutrient digestibility of growing pigs. O. A. Olukosi*[1], J. S. Sands[2], and O. Adeola[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*.

Growth performance and nutrient digestibility responses to an *E. coli* derived-phytase (ECP) and xylanase were investigated in pigs receiving corn, soybean meal, wheat middling and canola meal-based diet. Forty-eight 10-kg pigs were used in the 28-d feeding trial. They were blocked by weight and sex and randomly allocated to six dietary treatments. The six diets were a positive control (PC) with adequate level of non-phytate P (2.7 g/kg), a negative control (NC) with low non-phytate P (1.8 g/kg), the NC with ECP added at 500 or 1,000 FTU/kg, NC with xylanase added at 2,500 U/kg, and NC with a combination of xylanase and ECP added at 2,500 U/kg and 500 FTU/kg, respectively. Nutrient digestibility was determined during d 10 to 14 and 24 to 28. Low levels of non-phytate P in the NC treatment depressed final body weight (FBW) and daily gain (DG) of pigs but ECP linearly increased ($P < 0.05$) these to a level comparable with the PC diet. Xylanase alone had no effect on FBW or DG of pigs but the combination of xylanase and ECP increased ($P < 0.05$) these response criteria to that obtained in the PC diet. The treatments had no effect on feed intake or gain:feed. There was linear effect ($P < 0.01$) of ECP on digestibility of Ca, P and ash. Xylanase alone increased ($P < 0.05$) the digestibility of P but combination of ECP and xylanase increased the digestibility of P, Ca, and ash above the xylanase alone treatment. The treatments had no effect on the digestibility of nitrogen and energy. It is concluded from this study that addition of a combination of xylanase and *E. coli* phytase improved performance of pigs on a low non-phytate P diet but the effect was likely more from the phytase because when phytase alone was added, there was improved performance, whereas xylanase alone did not improve performance.

Key Words: Phtase, Xylanase, Pigs

W135 Effect of a multi-enzyme preparation administered through drinking water in broiler chickens. S. Maisonnier-Grenier, F. Rouffineau, P. Dalibard, S. Jakob*, and P.-A. Geraert, *Adisseo France SAS*, *Commentry*.

The effect of a fungal multi-enzyme preparation produced by *Penicillium funiculosum* (Rovabio™ Excel) upon the apparent metabolizable energy (AMEn) has been demonstrated in numerous trials. Up to now, NSP-enzymes were mainly incorporated into the feed to express its effect on the feed after ingestion. However, due to very high temperatures during special feed treatment (extrusion or expansion) other possibilities to distribute the enzyme have to be found in order to enlarge its use to all feeds. A simple method to supply the exogenous enzyme to poultry is the distribution through the drinking water. The present study was performed to prove the convenience and efficacy of enzyme distribution via the drinking water for broiler chickens. A trial was performed to validate the efficacy of enzymes in drinking water upon the AMEn. Thirty male Ross broiler chicks (d 12 to d 22) were fed a wheat-soy based diet (wheat, 597 g/kg; soybean, meal 260 g/kg; palm oil, 50 g/kg) and equally distributed to three different treatments: a control treatment (C) and two experimental treatments (E1 and E2). A multi enzyme preparation, Rovabio™ Excel, was sprayed either directly on the diet after pelleting (E1) or included in the drinking water (E2). The energy balance was performed between 19 and 22 d of age using the European Reference Method for AMEn. During the experiment, feed intake and growth was measured. Statistical analysis was performed using one way ANOVA. Both, the enzyme supplementation in feed and via water increased ($P < 0.05$) the AMEn and reduced the FCR between 12 and 22 d of age. The improvement was higher for chicks receiving the enzymes through drinking water as compared to the supplementation by feed. It can thus be concluded that Rovabio™ Excel can be supplied through the drinking water with the same efficacy on a wheat-based diet as when supplied through the feed.

	Control	+ Rovabio in diet	+ Rovabio in water	P
AMEn (MJ/kg)	11.73 ± 0.31	12.48 ± 0.26	12.74 ± 0.26	0.04
FCR	1.95 ± 0.05	1.90 ± 0.02	1.88 ± 0.04	0.38

Key Words: Enzyme, Drinking Water, Broiler

W136 Effect of an enzymatic compound in turkeys under two feeding systems on their productive performance. I. A. García-Galicia[1,2], A. L. Rentería-Monterrubio*[2], G. B. Galicia-Juárez[1], M. L. Gorostiola-Herrera[1], F. Salvador-Torres[2], and J. C. García-López[3], [1]*Dirección General de Educación Tecnológica Agropecuaria*, *Distrito Federal, México*, [2]*Facultad de Zootecnia, UACH*, *Chihuahua, Chih.,México*, [3]*Alltech de México*, *Distrito Federal, México*.

Two hundred White turkeys, nine weeks old, were randomly distributed in four poultry pens: (T1) 50 poults in confinement with no enzyme as the control group, (T2) 50 poults in grazing with enzymatic compound (Allzyme VegPro®), (T3) 50 poults in grazing without enzymatic compound, and (T4) 50 poults in grazing with enzymatic compound to determine the effects of the feeding sys-

tem and the addition of an enzymatic complex (0.1%) to the diet during 8 weeks on the productive performance. The commercial diet based on corn and soybean covered the 1994 NRC nutritional requirements, and the grassland used consisted of oat, barley alfalfa and native plants (30, 30, 30 and 10, respectively). The statistic analysis was based on a 2 x 2 factorial arrangement (enzyme x feeding system), analyzing the average daily gain (ADG), live weight (LW), feed intake (FI), forage intake (FGI), and carcass yield (CY). In LW, the interaction between the main effects ($P \geq 0.05$) was not found (see table below), while the effects of the enzyme and grazing showed higher values during the test. ADG and CY showed interactions ($P \leq 0.05$), with a positive effect of the enzyme only in confinement. The FI was not altered by the main effects or by its interaction, while the FGI was increased ($P \leq 0.05$) by the effect of the enzyme. It is concluded that the presence of exogenous enzymes in the turkey diet increases the LW and CFI, with a positive effect over ADG only in confinement. The grazing also has a positive effect on LW.

Productive performance of turkeys in finisher under two feeding systems, with or without an enzymatic compound in the diet

	Treatment				
Variable	T1	T2	T3	T4	P
ADG (g)	81 ± 3[a]	107 ± 3[b]	125 ± 3[c]	132 ± 3[c]	0.01
CY (%)	71.07 ± 0.33[a]	75.87 ± 0.36[b]	77.30 ± 0.35[c]	77.38 ± 0.36[c]	0.001

	Effect					
	Without enzyme	With enzyme	P	Confinement	Grazing	P
LW (kg)	10.282 ± 0.17[a]	10.885 ± 0.17[b]	0.016	9.850 ± 0.017[a]	11.316 ± 0.17[b]	0.001
FGI (g of DM)	38 ± 1[a]	31 ± 1[b]	0.008			

[a,b,c]Means differ ($P < 0.05$) within the same row.

Acknowledgements: Thanks to Alltech de México

Key Words: Turkeys, Enzymes, Grazing

W137 Development of an analytical method for the analysis of acid proteases in feed samples. P. Glenney* and K. Filer, *Alltech, Inc.*, *Nicholsville, KY.*

Exogenous enzymes can be added to poultry and swine diets to increase the nutrient availability of feed ingredients. Proteases are a common class of enzymes that are utilized for this purpose. Detection of acid proteases after they have been added to the feed is difficult. The purpose of this work was to develop a method for the detection of an acid protease after it was applied to poultry feed. The approach used for this work was to adapt an assay based on the hydrolysis of hemoglobin. A completely randomized design was utilized. Two treatments, 6 hours and 24 hours, were utilized with enzyme levels at 15,000; 7,500; 3,750 and 1,875 HUT/kg. The change in absorbance produced in the assay vs. enzyme activity was graphed and the R^2 value for each curve calculated and compared using Student's *t* test. The assay that produced the largest R^2 value and had a change in absorbance at 275 nm of at least 0.500 units for the sample that contained the highest enzyme activity would be utilized to estimate the activity of four poultry feeds containing protease. The samples were two commercial and two mixed in the lab. If the R^2 value for the curves were not different then the 6 hour assay would be used to estimate blind samples. The R^2 values for the 24 hour assay, 0.99517, and the 6 hour assay, 0.99437, were not different ($P > 0.05$). The range of the change in absorbance for the 6 hour assay was 0.143 ± 0.022 units at 1,875 HUT/kg to 0.534 ± 0.029 units at 7,500 HUT/kg. The 24 hour assay showed a range of 0.196 ± 0.015 units to 0.704 ± 0.037 units. Two blind samples in the lab were mixed to contain 7,500 HUT/kg and 15,000 HUT/kg. The estimated activity for each sample was 8,003 ± 152 HUT/kg (6.7% over) and 14,157 ± 322 HUT/kg (5.6% under). A commercial sample from North America was estimated to contain 2,512 ± 188 HUT/kg (33% less) and a sample from South America was estimated to contain 8,248 ± 1,495 HUT/kg (10% more). The results indicate that the assay can be useful in providing an estimate of the protease activity present in a poultry feed.

Key Words: Acid Protease, Enzymes, Feed

W138 New strategies guarantee success in mycotoxin control. U. Hofstetter*[1], V. Starkl[1], D. Schatzmayr[1], G. Schatzmayr[1], and E. M. Binder[2], [1]*Biomin GmbH*, *Herzogenburg, Austria*, [2]*Erber AG*, *Herzogenburg, Austria*.

Mycotoxins are toxic chemical products formed by fungal species that pose a potential threat to animal health as many of these toxins are immunosuppressive, estrogenic or genotoxic. Especially swine, are known to be affected with kidney problems (e.g., porcine nephropathy), increased water consumption, increased urine production and decreased feed consumption and daily weight gains due to Ochratoxin A (OTA). The most common approach to counteract mycotoxins is adsorption by minerals. But mycotoxins are completely different in their chemical structure, and thus it is impossible to deactivate all mycotoxins by using only a single strategy. One investigated solution is detoxification by biotransformation. Specific enzymes can change the toxic group of a mycotoxin into a non-toxic metabolite under intestinal conditions. For deactivation of trichothecenes, a strictly anaerobic bacterium *Eubacterium BBSH 797* has been isolated out of rumen fluid, and a newly-discovered yeast strain *T. mycotoxinivorans* is capable of detoxifying ochratoxins. As all mycotoxins are hepatotoxic agents and can cause immunosuppression in animals, plant and algae extracts were selected. A product based on the three above mentioned strategies proved to be a solution to help to counteract the diverse mycotoxin problems in swine. Its efficacy to alleviate the negative effects of OTA on weaning piglets was proven by several feeding trials (Table). Performance criteria like final weight, average daily weight gain (ADWG) and feed conversion ratio (FCR) were improved. Currently the most common mycotoxins like aflatoxin, zearalenone, ochratoxin A and all trichothecenes can be detoxified by a selected blend of minerals, *BBSH 797* and *T. mycotoxinivorans*.

Trial design and trial results (day 1-49)

	A	B	C	D
Product	-	-	+	+
OTA [ppb]	-	500	500	-
Final weight [kg]	32.65	30.78	32.07	33.10
ADWG [g]	457.7	379.8	445.4	465.5
FCR	2.44	2.35	2.30	2.24

Key Words: Mycotoxin, Biotransformation, Weaning Piglets

W139 Influence of weaning on caecal microbiota of pigs: use of real-time PCR and t-RFLP. M. Castillo*[1], S. M. Martín-Orúe[1], E. G. Manzanilla[1], M. Roca[2], and J. Gasa[1], [1]*Departament de Ciència Animal i dels Aliments, Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*, [2]*Centre de Recerca en Sanitat Animal*, *Bellaterra, Barcelona, Spain*.

The development of the healthy microbiota in the young pig is determinant to avoid post-weaning disease and to reach an optimal growth performance. The objective of this trial was to monitor the microbial changes of caecal population associated with early-weaning. Twelve pigs (20 ± 2 days) from six different littermates were selected from a commercial source. Animals from the same littermates were divided in two groups: a control group (L) that remained with the sow and an experimental group (F) that was weaned and fed a commercial post-weaning diet. After one week, animals were sacrificed and samples from caecal digesta were taken and preserved in ethanol until analysis. Microbial counts for enterobacteria and lactobacilli were determined by quantitative-PCR using 16S rDNA specific primers and SYBR Green® dye. Microbial profiles

were assessed by terminal restriction fragment length polymorphism (t-RFLP) using fluorescently labeled 16S rDNA forward primer (FAM0008) and restriction enzyme *HhaI*. Dendograms, according to the similarity of the community profiles, were constructed using UPGMA method and the Fingerprinting II® software. Weaning promoted a decrease in lactobacilli population that resulted in a significant increase in enterobacteria:lactobacilli ratio (0.27 vs. 1.67 log/log 16S rDNA copy number; $P = 0.05$). Biodiversity of microbial ecosystem (number of bands) was similar between both experimental groups (49.34 for L and 53.40 for F, respectively; $P = 0.22$), however the band patterns were clearly grouped in two different clusters by dendogram analysis. Some particular bands were consistently present or absent in each of the groups. Results obtained showed weaning as a challenging point on the process of establishment of the indigenous microbiota in the caecum. Changes consisted primary of a substitution of some microbial species by others.

Key Words: Microbiota, Weaning Pig, PCR

W140 Available energy from fermentation in the hindgut in growing pigs fed with different levels of dietary fiber. M. Anguita[1], N. Canibe[2], J. F. Pérez*[1], and B. B. Jensen[2], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*, [2]*DIAS, Research centre Foulum*, *Tjele, Denmark*.

An experiment, combining in vivo and in vitro ethodologies, was carried out to asses the available energy to the pig from hindgut fermentation. Six male pigs (Danish Landrace x Yorkshire x Duroc) were fitted with a simple T-shaped cannula at the terminal ileum and offered, following a Latin-square design, three diets with increasing levels of non-starch polysaccharides (NSP): Low fiber diet (LFD, 7.7% NSP), standard fiber diet (SFD, 16.0% NSP) and high fiber diet (HFD, 24.0% NSP). After adapting the animals to the diet, samples from ileum and feces were collected and analyzed for dry matter, energy, crude protein and chromic oxide. Freeze dried ileal samples were fermented in vitro in a batch system for 48 hours. The pH was automatically adjusted to 6.0, and temperature was kept constant at 38°C. Anoxic conditions were maintained by sparing cultures of high purity N_2. Available energy (MJ/kg DM feed) from fermentation was calculated from the amount of SCFA produced in vitro and the in vivo ileal flow of DM. Results from the in vivo experiment, reflected that the inclusion of fiber promoted a decrease ($P < 0.001$) in the energy digested (MJ/kg DM feed) in the foregut (15.3, 12.32, and 10.93 for LFD, SFD, and HFD, respectively), and to an increase ($P < 0.001$) of the energy digested in the hindgut (1.61, 2.97 and 3.53 for LFD, SFD and HFD, respectively). The in vitro data showed that, although the amount of SCFA produced per gram of DM of ileal effluent was not different ($P = 0.26$), the calculated SCFA production per kg DM feed was higher ($P < 0.001$) with increased levels of fiber, due to the higher flow of DM at the terminal ileum. The results from the present study showed that growing pigs receiving diets with NSP levels between 7.7 and 24.0% obtained between 7.1 and 17.6% of their available energy from fermentation in the hindgut.

Key Words: Pigs, Energy, Fermentation

W141 An automated algorithm to estimate body protein and lipid deposition patterns in growing pigs from growth and feed intake curves. G. Vander Voort* and K. de Lange, *University of Guelph*, *Guelph, Ontario, Canada*.

The evaluation of alternative management strategies for growing-finishing pigs requires accurate estimation of nutrient accretion patterns. The objective of this research was to develop an automated algorithm to establish body protein (Pd) and body lipid deposition (Ld) curves in growing pigs. Daily BW gain and feed intake curves for 40 individual pigs (30 to 110 kg BW) were established using random regression methodology. Daily records of ad libitum feed intake and BW were obtained with computerized feed intake and BW recording equipment for individual pigs housed in groups. A dynamic nutrient partitioning model, with a 1-day iteration interval, was used to represent utilization of ME and lysine intake for growth, while three pig type parameters were varied: maximum Pd (Pdmax, g/d), which was assumed constant up to the BW at which Pdmax starts to decline (BWdecl, kg; thereafter maximum Pd declined as represented by a Gompertz function) and constraints on the ratio between whole body lipid and whole body protein (minBL/BP, MJ ME^{-1}; linearly related to daily ME intake). For each pig and based on the observed feed intake curve, 1,000 different growth patterns were generated by varying the pig type parameters. Best fit pig type parameters were chosen based on minimizing the sum of squared differences between simulated and recorded daily BW gain. Data from three pigs were not deemed reliable. The difference between observed and recorded daily BW gain was homogenous across BW with a mean of 10 g/d (SD, 10). In this group of pigs, Pdmax was 164 g/d (SD, 32), BWdecl was 76.7kg (SD, 15.2), while minBL/BP was 0.033 MJ ME^{-1} (SD, 0.013). The automated algorithm was effective in establishing Pd and Ld curves in individual pigs.

Key Words: Pigs, Protein, Deposition

W142 Dual-energy x-ray absorptiometry for determination of body composition in a porcine model of obesity development. C. A. Baldwin* and T. S. Stahly, *Iowa State University*, *Ames*.

The precision and accuracy of the Dual Energy X-ray Absorptiometry (DEXA) estimates of the weight and tissue (fat, lean and bone mineral) content of two body depots (carcass and internal organs) were evaluated in thirty-three heavy weight pigs (133-265 kg) serving as a model for obesity development. DEXA (Hologic, fan beam) scanning accurately estimated the carcass weight (+2%) relative to that determined by gravimetric weighing. DEXA underestimated the fat tissue contents of both the carcass and organ depots (-19 and -26%) and overestimated the lean tissue contents (13 and 27%) relative to those estimated from chemical analysis of the fat and protein contents of the depots. However, DEXA precisely detected changes in carcass and organ depot weights (R^2 = 0.99 and 0.99, respectively) and less precisely predicted changes in the depot's chemically determined fat (R^2 = 0.95 and 0.73) and protein content (R^2 = 0.88 and 0.84). Specifically, for each 1 kg change in carcass and organ depot weights, DEXA predicted the changes with a 95% confidence (two SE of estimate) within ± 0.008 and 0.026 kg, respectively. For each 1 kg change in the two depot's chemically determined fat content, DEXA predicted the change within ± 0.092 and 0.338 kg, respectively. In conclusion, DEXA precisely predicted changes in body depot weight and fat and lean tissue contents in large, heavy weight pigs being used in a model of obesity development. The precision was less in the internal organ depots than carcass depots.

Key Words: DEXA, Obesity, Pigs

W143 Hepatic gluconeogenesis and muscle intermediary metabolism in hybrid striped bass (HSB) determined by ^{13}C-mass isotopomer distribution analysis. B. J. Bequette*, S. L. Owens, N. E. Sunny, S. W. El-Kadi, and L. C. Woods, *University of Maryland*, *College Park*.

High dietary carbohydrate is not well tolerated by carnivorous fish, resulting in unregulated plasma glucose and enlarged and dysfunctional livers. The metabolic basis underlying this limited ability to use dietary glucose remains sketchy at best. Our aim was to generate a metabolic profile of the pathways of glucose synthesis and muscle glucose utilization in carnivorous fish. HSB (M. chrysops × M. saxatilis; 65 g; n=10) were fed (3% of BW) twice a day for 1 mo a diet of 39% crude protein (fish meal), 30% dextrin, and 9% fish oil. For the last 5 d, [U-^{13}C]dextrin replaced 18% of diet unlabelled dextrin. Fish were killed and tissues collected after 1 d (n = 4), 3 d (n = 3) and 5 d (n = 3) of feeding the tracer diet. Isotopomer steady-state labeling of plasma glucose, and various tissue (liver, muscle) amino acid (AA) pools (alanine, aspartate, glutamate) was attained by day 1 of tracer feeding. Absorbed glucose was 272 ± 24 mg/d, gluconeogenesis from AA was 321 ± 61 mg/d, and glucose recycling was 66 ± 15 mg/d. In the liver, 26.7% (± 1.7) of the 3-carbon pool derived from glucose catabolism. Here, the 3-carbon pool contributed to 60.4% (± 11.8) of acetyl-CoA and to 30.8% (± 5.2) of oxaloacetate fluxes, and thus only 16.6% (± 3) and 7.8% (± 0.7) of these fluxes, respectively, derived from glucose catabolism in the liver. In muscle, 28.9% (± 3.5) of the 3-carbon pool derived from glucose catabolism. Here, the

3-carbon pool contributed to 70.7% (± 7.2) of acetyl-CoA and to 2.2% (± 0.8) of oxaloacetate fluxes, with only 20.2% (± 1.5) and 0.7% (± 0.3) of these respective fluxes derived from glucose catabolism in muscle. In this study, despite high rates of dietary glucose absorption, gluconeogenesis (from AA) was maintained, and at rates similar to glucose absorption. In liver and muscle, glucose catabolism made a minor contribution to overall Krebs cycle metabolism, and thus fatty acids and (or) AA were the largest contributors to energy generation in these fish tissues.

Key Words: Striped Bass, Glucose, Stable Isotope

Nonruminant Nutrition: Minerals

W144 Genetic background and phosphorus nutrition affect bone strength and gene expression in young pigs. L. Hittmeier, R. Lensing, L. Grapes, M. Rothschild, and C. Stahl*, *Iowa State University*, *Ames*.

Phosphorus (P) is essential to bone growth and turnover; however, little research has focused on the genetic mechanisms controlling P utilization. In this study, 36 gilts (6.63 ± 0.78 kg) from six litters (three gilts/litter) were sired by two lines known differ in bone structure [one considered heavier-boned (HB) and the other lighter-boned (LB)]. Pigs were assigned to three dietary treatments: P adequate (0.41% available P for 2 wk), repletion (0.14% available P for wk 1, 0.41% available P for 2 wk), or P deficient (0.14% available P for 2 wk). After 14 d, pigs were harvested and bone marrow was collected for analysis of gene expression by real-time PCR, and radial bones were collected for breaking strength analysis. In HB, but not LB pigs, the P deficient diet caused a decrease in ADG ($P < 0.01$) compared to the other treatments. In the LB line, repletion pigs had higher ADG ($P < 0.01$) than the other treatments. For both lines, P deficiency caused a reduction in radial bone strength ($P < 0.01$). The LB and HB lines responded similarly to P deficiency in the expression of *OXTR* and *IGF1*. In HB, but not LB pigs, diet affected the expression of *VDR* ($P < 0.04$), *CALCR* ($P < 0.05$), and *IGFBP3* ($P < 0.06$), and there was a trend of increased *IL6*, *Sox-9*, and *TFIIB* expression with P deficiency. Expression of *BGLAP*, *OPG*, *RANKL A-Raf-1* and *IGFBP5* was not affected by sire line or diet. Data were analyzed using a mixed model with line, diet, and line × diet fit as fixed effects. Based on this study, the HB pigs were more responsive to dietary P than LB pigs. Differences in growth and gene expression within the bone marrow suggest a difference in the homeorhetic control of P utilization between these genetic lines. In addition, a better understanding of the role genetics plays in P homeorhesis will enable selection for pigs that will require and excrete less P, as well as allow for the recommendation of specific genetic lines for producers with different waste management strategies.

Acknowledgements: This work was funded in part by the IAHEES, the Office of Biotechnology, and Sygen International.

Key Words: Bone, Gene Expression, Phosphorus

W145 Effect of dietary phosphorus on the gene expression related to energy metabolism in porcine muscle. A. Qu*, L. Grapes, M. Rothschild, and C. Stahl, *Iowa State University*, *Ames*.

Phosphorus (P) plays a vital role in growth and development, however little research has focused on the genetic mechanisms controlling P utilization. We examined the influence of two sire lines, selected primarily for either meat quality (MQ) or growth performance (GP), and dietary P on the expression of a variety of genes related to energy metabolism in muscle. These genes were identified in a previous oligonucleotide microarray study. Thirty-six gilts (21 d of age, 6.63 ± 0.78 kg) from six litters (three pigs/litter) for each sire line were allotted into three dietary treatment groups: P adequate (+P, 0.41% available P), P repletion (RP, 0.14% available P for wk 1, 0.41% available P for wk 2), or P deficient (-P, 0.14% available P) for 2 wk. Using real-time PCR, we quantified the gene expression of glycogen synthase, succinate dehyrdrogenase, and the succinate dehydrogenase iron-sulfur protein in porcine muscle. The relative gene expression levels in muscle samples from all gilts were analyzed using a mixed-model which included the fixed effects of sire line, diet and sire line by diet interaction. Phosphorus deficiency caused an increase ($P < 0.05$) in the expression of glycogen synthase regardless of genetic background. However, the increase tended to be greater in the GP sired pigs. In MQ, but not GP, sired pigs fed the -P diet had lowered ($P < 0.05$) and those fed the RP diet tended ($P < 0.06$) to have lowered expression of the succinate dehydrogenase iron-sulfur protein. Also the MQ sired pigs in the -P group had higher ($P < 0.05$) levels of succinate dehydrogenase mRNA, while dietary P did not effect its expression in GP sired animals. Our results demonstrated that there are significant nutrition × genetic interactions that affect gene expression in porcine muscle. Elucidating these interactions may enable selection for pigs that will require and excrete less P, as well as allow for the recommendation of specific genetic lines for producers with different waste management strategies.

Acknowledgements: This research was funded in part by the IAHEES, the Office of Biotechnology at Iowa State University, and Sygen International.

Key Words: Phosphorus, Energy Metabolism, Gene Expression

W146 Phosphorus utilization is improved in the growing Enviropig™(Cassie line). A. Ajakaiye*, R. G. Meidinger, M. Z. Fan, D. A. Murray, J. Zhang, M. Mundia, J. P. Phillips, S. P. Golovan, J. M. Kelly, R. R. Hacker, and C. W. Forsberg, *University of Guelph*, *Guelph, Ontario, Canada.*

The objectives of this study were to determine phosphorus (P) utilization by the Enviropig™ (EP) during the growing phase and to compare the values obtained with that derived from the Yorkshire pigs (YK). Six of each EP and YK growing barrows, with average initial BW of 24 and 20 kg, respectively, were fed three diets according to a cross-over (split-plot design). The main plot was the breed and diet was the subplot. There were three diets, six pigs and three periods, with two pigs/diet/period for a total of six replicates/diet. The diets were formulated on the basis of available P with Ca:P maintained at 2:1. The diets consisted of diet A, a control diet with supplemental PO_4^{3-}; diet B, no supplemental PO_4^{3-}; and diet C, no supplemental PO_4^{3-} and 2% lower CP. Each experimental period consisted of 14 d with 10-d adaptation and 4-d collection of urine and representative fecal samples. Data collected were subjected to analysis of covariance using the mixed models procedure with initial BW as a covariate. Fecal P values were significantly reduced ($P < 0.05$) in EP by up to 39% on diet A, 70 % with the diet B, and 68% with the diet C compared to the YK. Apparent P digestibility was increased ($P < 0.05$) in EP than in the YK. Also, the total manure P excretion was reduced when EP was fed the diet with low P and low CP compared with YK (2.82 ± 0.99 vs. 4.56 ± 0.96 g/pig/day; 3.37 ± 1.05 vs. 4.28 ± 0.94 g/pig/day), respectively. The increase ($P < 0.10$) in urine P observed in the EP (4.13 ± 0.84 g/pig/day) vs. YK (-2.0 ± 0.96 g/pig/day) fed diet A is due to the supplemental inorganic P in the diet since the EP does not require supplemental inorganic P in their feed. These data support that the Enviropig™ breed would cost less to feed because neither supplemental P nor phytase enzyme needs to be included in the diet. Furthermore, the reduced P in the manure from the Enviropig™ is more compatible with stringent nutrient management legislation.

Key Words: Enviropig™, Yorkshire, Phosphorus

W147 Phosphorus and calcium utilization by the G1 generation Enviropig™ lines fed a diet without supplemental inorganic phosphorus. A. Ajakaiye*, R. G. Meidinger, M. Z. Fan, S. P. Golovan, J. P. Phillips, R. R. Hacker, and C. W. Forsberg, *University of Gulph*, *Guelph, Ontario, Canada.*

Our previous research has shown that there were differences in the capabilities of different lines of phytase Enviropig™ (EP) in the utilization of phosphorus (P) and calcium (Ca) during the finishing phase. Therefore, the objective of this study was to examine the effects of lines and genders on salivary phytase activities, total fecal P and Ca contents in the growing EP pigs in comparison with results of the Yorkshire pigs (YK) fed a corn and soybean meal-based low-P diet. Thirty EP (15 boars and 15 gilts) derived from three G1 generation founder lines of Jacques (JA), Wayne (WA) and Gordie (GO) and 19 YK (eight boars and 11 gilts) were fed a conventional corn and soybean meal-based grower diet with no supplemental PO_4^{3-} while meeting other nutrient requirements according to the 1998 NRC. All the pigs were fed ad libitum with free access to water. During the trial, three replicate fresh fecal samples were collected from each pig daily over a 3-d period. Saliva samples were also collected from each of the EP pigs during this period. There were differences ($P < 0.10$) between boars and gilts in salivary phytase activity (303.57 ± 63.77 vs. 144.96 ± 63.77 umol/mL/min). The total fecal Ca was also different (0.89 ± 0.05 vs. 1.03 ± 0.04% on DM basis; $P < 0.05$). However, the total fecal P was not different (0.81 ± 0.05 vs. 0.92 ± 0.05% on DM basis). Variations in salivary phytase activity (JA, 46; WA, 460; and GO, 167 umol/mL/min), total fecal P (JA, 0.63; WA, 0.46; and GO, 0.82% on DM basis) and fecal Ca (JA, 1.02; WA, 0.66; and GO, 1.17%, on DM basis) contents were observed among the lines. The Enviropig™ lines had lower ($P < 0.05$) fecal P (0.64 ± 0.08 vs. 1.60 ± 0.05% on DM basis) than the YK pigs. The Enviropig™ are more effective and efficient in reducing total fecal P contents than the YK pigs. Enviropig™ are thus substantially more environmentally friendly than the Yorkshire pigs.

Key Words: Enviropig™, Phytase Activity, Genders

W148 Dietary selenium sources in swine: maternal transfer to embryos. M.-È. Fortier[1], H. Quesnel[2], J.-F. Bilodeau[1], A. GiguÈre[3], J.-P. Laforest[1], and J. J. Matte*[3], [1]*UniversitÈ Laval*, *QuÈbec, Canada*, [2]*Institut de la Recherche Agronomique*, *St-Gilles, France*, [3]*Agriculture et Agroalimentaire Canada*, *Lennoxville, QuÈbec, Canada*.

This project aimed to determine the effect of selenium (Se) as inorganic Na-selenite (MSe) or organic Se-yeast (OSe) on maternal Se transfer to embryos, embryonic antioxidant status [Ferric Reducing Antioxidant Power (FRAP) and glutathione peroxidase activity (GSH-Px)] and litter performance. Forty-nine gilts received one of the three dietary treatments, starting at first pubertal estrus and lasted up to 30 days post-AI (AI at the fourth estrus): control (C: basal diet (Se = 0.2 ppm) without added Se) (n = 16), MSe (C + 0.3 ppm Na-Se) (n = 16) and OSe (C + 0.3 ppm Se-yeast) (n = 17). Sows had received, on days 14 and 15 of third estrus, a hormonal challenge to synchronise and stimulate ovulation. At slaughter, embryos and corpora lutea (CL) from 35 gravid sows (C = 12, MSe = 13 and OSe = 10) were weighed and measured. There was no treatment effect on mean litter size and embryonic survival, as well as on embryonic antioxidant status ($P > 0.23$). Se content of individual embryo was higher for Se treated sows than for C ($P < 0.04$). Total litter and individual Se content of embryos were, respectively, 62.6% and 44.7% higher for OSe than MSe ($P < 0.01$). The within-litter variation of Se in embryos tended to be lower ($P = 0.07$) when Se was supplied to sows. Embryonic FRAP was more uniform within OSe than MSe litters ($P = 0.01$). The length, weight and protein content of embryo were, respectively, higher by 5.5%, 11.5% and 11.6% in OSe than MSe sows ($P < 0.05$). The within-litter variation of embryonic lengths was in general low but better ($P = 0.06$) in MSe (4.8%) than in C and OSe sows (6.1%). There was no treatment effect ($P > 0.18$) on weight, diameter, total number, Se content, FRAP and total GSH-Px of CL. However, Se-GSH-Px in CL was higher for Se than for C sows ($P = 0.02$). The protein content of CL tended to be higher for OSe than MSe ($P = 0.06$). It appears therefore that the uterine transfer of selenium to embryos was improved with OSe as compared to MSe and this was concomitant with a better development of embryos. The results on CL deserve more studies in order to better understand the OSe effects on embryonic development and/or ovulation.

Key Words: Selenium, Embryos, Sow's Gestation

W149 The comparative effects of organic and inorganic selenium on selenium transfer from sows to nursing pigs. I. Yoon*[1] and E. McMillan[2], [1]*Diamond V Mills, Inc.*, *Cedar Rapids, IA*, [2]*MapleLeaf Foods Agresearch*, *Burford, Ontario, Canada*.

The effects of dietary Se sources on the transfer of Se to the sow's milk and nursing pigs were examined by feeding sows with diets containing no supplemental selenium (Se) or supplemental Se from either inorganic (sodium selenite) or organic (Se-enriched yeast, SelenoSource™ AF) sources. Both inorganic and organic Se sources were added to the diet at 0.3 ppm Se. A non-Se fortified corn-soybean meal basal diet served as a negative control (approximately 0.2 ppm Se). Sows were fed their treatment diets from 60 d prepartum to parturition and through a 14-d lactation period. Six sows from each treatment were bled at 60 and 30 d prepartum, at farrowing and at 14 d postpartum to measure serum Se concentration. Colostrum was collected within 12 h postpartum and milk at 14 d of lactation. Piglets from twelve litters on each treatment were bled at birth and at weaning and serum was analyzed for Se concentration, IgG and glutathione peroxidase (GSH-Px) activity. Sow serum Se concentration declined throughout gestation and gradually increased during lactation period. Sows fed organic Se maintained numerically higher serum Se than sows fed non-supplemented diet. The effect was close to a significant ($P < 0.06$) at farrowing. Colostrum Se content was increased ($P < 0.01$) when the organic source was provided but was not increased when inorganic Se was supplemented. The effect was maintained ($P < 0.01$) throughout lactation. Serum Se was increased ($P < 0.01$) by organic Se but not by inorganic Se in newborn piglets. The supplemental Se effect disappeared by 14 d of age in piglets. Pig serum IgG and GSH-Px activity were not affected by dietary Se source. The results demonstrated that organic Se is more effective than inorganic Se in maintaining higher serum Se level of sows until farrowing and in increasing colostrum and milk Se and serum Se of nursing pigs.

Key Words: Selenium Yeast, Sodium Selenite, Sow and Piglet

W150 Supplementation of potassium-diformate (Formi®), as an alternative to antibiotics, on growth performance, morphological changes of small intestine and immune responses in weanling Pig. M. S. Yun, W. S. Joo*, H. F. Long, W. G. Park, and Y. Y. Kim, *Seoul National University*, *Seoul, South Korea*.

This experiment was conducted to investigate the effect of potassium-diformate (KDF), as an alternative to antibiotics, on growth performance, morphological changes of small intestine, and immune response in weanling pig. A total of 120 weanling pigs [(Landrace x Yorkshire) x Duroc; weaned at 25 d of age] were allotted to six treatments in a randomized complete block (RCB) design with five replicates and four pigs per pen. Treatments were: 1) N-CON (basal diet), 2) P-CON (basal diet + 0.1% antibiotics), 3) F0.3 (basal diet + 0.3% Formi®), 4) F0.6 (basal diet + 0.6% Formi®), 5) F0.9 (basal diet + 0.9% Formi®) and 6) F1.2 (basal diet + 1.2% Formi®). Diets were formulated with corn-soy and all nutrients were met or exceeded the 1998 NRC requirements. Eighteen pigs (three pigs per treatment) with 7.90 kg body weight were housed in an individual metabolic crate for digestibility trial. After 7 days of adaptation period, pigs were subjected to a 5-day collection period for nutrient digestibility. A total of 36 weanling pigs were sacrificed to measure morphological changes, GI-tract pH and microbial alteration. During the 5-week feeding trial, growth performance was not significantly affected by treatments, but positive control, F0.3 and F0.9 groups showed improved ADG, and consequently, heavier final BW was observed. Potassium diformate supplementation had influence on the pH of stomach digesta, and it decreased linearly as dosage levels increased ($P < 0.01$). In blood assay, all pigs had similar blood urea nitrogen (BUN) concentration patterns, while F0.3 and F0.9 had significantly lower serum IgA concentration compared to the other treatments ($P < 0.05$). Potassium-diformate supplementation had no effect on the small intestinal morphological changes for villus height and crypt depth. Nutrient digestibility tended to increase as KDF was provided although there was no significant difference. These results showed that the addition of KDF to the weanling diet was not differed from antibiotics supplementation group in growth but improved humoral immune responses and tended to improve nutrient digestibility.

Key Words: Weanling Pig, Antibiotic Alternative, Potassium-Diformate

W151 Diet acidity fails to match zinc oxide in improving weaner pig performance. H. Miller*[1], P. Blanchard[2], and P. Toplis[3], [1]*University of Leeds*, *Leeds, West Yorkshire, UK*, [2]*Frank Wright Ltd*, *Ashbourne, Derbyshire, UK*, [3]*Primary Diets Ltd*, *Ripon, North Yorkshire, UK*.

Newly weaned piglets fed zinc oxide (ZnO) in their diet have better performance and reduced incidence of diarrhoea. We hypothesised that similar effects could be achieved by feeding diets that created more acidic stomach conditions, either by adding acid to the diet or by reducing inorganic phosphate and replacing it with phytase. We therefore compared a diet containing ZnO with those containing either formic acid or phytase, or both. Two hundred forty eight pigs (62.5% Large White, 25% Landrace, and 12.5% Duroc) were weaned at 27 ± 0.2 d and 8.2 ± 0.13 kg liveweight into 32 slatted floor pens each of seven or eight pigs balanced for liveweight, sex and litter across treatments. Piglets were offered ad libitum access to diets (16 MJ DE/kg, 1.5% lysine) containing 0.2% ZnO (Z), 0.6% formic acid (A), 500 FTU/kg phytase (P) or 0.6% formic acid and 500 FTU/kg phytase (C) for 18 d following weaning. Thereafter all pigs received standard commercial diets through to slaughter. During the 18 d trial period, Z pigs grew more rapidly, ate more and converted feed more efficiently than all other treatments, and C pigs were next followed by A and finally P. Daily gains were 343, 302, 282, and 227 g (± 12.8, $P \leq 0.001$), daily feed intakes were 409, 362, 350 and 302 g (± 15.4, $P \leq 0.001$) and feed conversion ratios were 1.19, 1.20, 1.25 and 1.35 (± 0.029, $P \leq 0.01$) for Z, C, A and P, respectively. This performance advantage was maintained through to slaughter at 101 ± 7.7 kg liveweight with Z pigs killed 3.4 d earlier than C and 7.4 d earlier than A or P pigs ($P < 0.05$). The results indicate that ZnO gave a clear advantage to weaner pigs when provided in the diet for the first 18 days post weaning. The combination of formic acid plus phytase, whilst not as good as ZnO, provided a better start than either product alone indicating a synergism between the two additives. Improvements in immediate post weaning performance were maintained through to slaughter indicating the importance of the early weaner diet.

Key Words: Zinc Oxide, Acid, Phytase

W152 The effect of dietary natural mineral liquid complex on growth performance and blood characteristics in broilers. B. J. Min*, O. S. Kwon, K. S. Son, J. H. Cho, Y. J. Chen, H. J. Kim, J. S. Yoo, and I. H. Kim, *Dankook University*, *Cheonan, Korea*.

This experiment was conducted to investigate the effect of dietary natural mineral liquid complex on growth performance and blood characteristics in broilers. The natural mineral liquid complex was extracted from *Artemisia princes, Pinus densiflora* Sieb. and biotite. A total of six hundred forty eight broilers were randomly allocated into four treatments with six replications and fed for five weeks. Dietary treatments included: 1) CON (basal diet), 2) Min0.2 (basal diet + 0.2% mineral liquid complex), 3) Min0.4 (basal diet + 0.4% mineral liquid complex) and 4) Min0.6 (basal diet + 0.6% mineral liquid complex). Through the whole period, weight gain, feed intake and feed conversion ratio were not affected by mineral complex. In liver weight measured at the end of experiment, Min0.4 and Min0.6 treatments were heavier than Min0.2 treatment ($P < 0.05$). There were no significant differences in total protein, albumin and iron level in serum among the treatments ($P > 0.05$). Hemoglobin concentration in serum was increased in Min0.4 and Min0.6 treatments compared with Min0.2 ($P < 0.05$). GOT and GPT level in serum was decreased in Min0.4 and Min0.6 treatments compared with CON ($P < 0.05$). Broilers fed Min0.4 diet had the highest Mg concentration in serum compared with broilers fed other diets ($P < 0.05$). Mg concentration in breast muscle was higher in broilers fed Min0.4 diet than that fed CON or Min0.2 diets ($P < 0.05$). Also, in Fe concentration, Min0.4 treatment was the highest among the treatments ($P < 0.05$). In leg muscle, K concentration was increased in Min0.6 compared with other treatments ($P < 0.05$). In conclusion, 0.4% of natural mineral liquid complex supplementation in broilers diet increased liver weight and some mineral concentration in blood and muscle.

Key Words: Natural Mineral Liquid Complex, Broiler, Blood Characteristic

W153 Magnesium absorption from drinking water in rats. A. Ohata*, H. Ohmori, T. Matsui, and H. Yano, *Kyoto University*, *Kitashirakawa-oiwake, Sakyo-ku, Kyoto, Japan*.

Magnesium (Mg) is an essential mineral for animals and plays important roles in many biological processes. Livestocks and humans obtain minerals from drinking water. However, mineral bioavailability in drinking water has not been clarified. We compared the fractional absorption of Mg in water with that in diet using stable isotopes of Mg in rats. Male Wistar rats were given the AIN93G-based diet (control diet) for 12 h and fasted for 12 h in a day. Experiment 1: Rats were orally administered a solution containing 1 mg ^{26}Mg and dysprosium (Dy) 2 h after the initiation of feeding period and a solution containing 1 mg ^{25}Mg and ytterbium 4 h after the initiation of fasting period. Experiment 2: Rats were divided into two groups that obtained isotopic Mg from diet or water. One group was given the diet containing 1 mg ^{26}Mg and Dy in the first 4 h of feeding period and was given the control diet in the following 8 h. The other group was orally administered a solution containing 1 mg ^{26}Mg and Dy 2 h before feeding period. This group was given a low Mg diet in the first 2 h of feeding period then given the control diet. Thus, the daily intake of Mg was adjusted. Feces were collected for 5 d after the administration of isotopic Mg in each experiment. Fecal Mg was determined by an atomic absorption spectrometer after wet digestion. Mg isotope ratio and the unabsorbable markers were determined by an ICP/MS. The absorption of ^{25}Mg and ^{26}Mg was calculated from the unabsorbable markers, total Mg and isotopic Mg in feces. The absorption of ^{26}Mg was 69.8 ± 3.0% in the solution administered in the feeding period, which did not differ from the absorption of ^{25}Mg in the solution administered in the fasting period (65.6 ± 4.3%). The absorption of dietary ^{26}Mg was 71.9 ± 4.4% that was similar to the absorption of ^{26}Mg administered as the solution in the fasting period (72.8 ± 4.0%).

Key Words: Magnesium, Stable Isotope, Absorption

W154 Developmental regulation of brush border hydrolase and iron transporter gene expression in pig small intestine. X. Xiao*, E. A. Wong, and K. E. Webb, Jr., *Virginia Tech*, *Blacksburg*.

Piglets from each of seven sows were killed at birth (d 0), during lactation (d 1, 3, 7, 14, 21) and post-weaning (d 22, 24, 28, 35). Duodenum, jejunum and ileum were collected for RNA isolation. The abundance of mRNA was determined by Northern blotting for three protein hydrolases, aminopeptidase A (APA) and N (APN) and dipeptidyl peptidase IV (DPP IV), three carbohydrate hydrolases, lactase-phlorizin hydrolase (LPH), sucrase-isomaltase (SI) and maltase-glucoamylase (MGA), and two iron transporters, divalent metal ion transporter 1 (DMT1), and iron-regulated transporter 1 (IREG1). During lactation, APA, APN, and DPP IV mRNA abundance increased then decreased (quadratic, $P < 0.001$) with age, being highest at d 3 or 7. Post-weaning, abundance of these mRNA transiently increased then declined, followed by a slight increase to d 35. Abundance of APA, APN, and DPP IV mRNA was not different among segments during lactation, and was highest ($P < 0.05$) in the jejunum and/or ileum post-weaning. During lactation, LPH mRNA abundance increased then decreased (quadratic, $P < 0.001$) with age, being highest at d 14, and SI mRNA abundance increased linearly ($P < 0.001$) with age, whereas MGA mRNA abundance remained unchanged. Post-weaning, LPH and SI mRNA abundance initially increased and then declined, followed by an increase to d 35, and MGA mRNA abundance increased with age. During lactation, LPH and MGA mRNA abundance was higher ($P < 0.05$) in the jejunum and ileum than the duodenum, and SI mRNA abundance was higher ($P < 0.05$) in the duodenum and jejunum than the ileum. Post-weaning, LPH, MGA, and SI mRNA abundance was higher ($P < 0.05$) in the jejunum and ileum than the duodenum. The mRNA of DMT1 and IREG1 was predominantly distributed in the duodenum from d 0 through 35. In the duodenum, DMT1 and IREG1 mRNA abundance increased with age during lactation and then rapidly decreased after weaning. These results indicate a differential spatial and developmental regulation of these genes along the small intestine.

Key Words: Transporter, Hydrolyase, Gene Expression

W155 Effects of early gestational undernutrition in the cow on fetal growth and placentomal composition. S. Ford*[1], C. Sanders[1], K. Vonnahme[2], and B. Hess[1], [1]*University of Wyoming*, *Laramie*, [2]*North Dakota State University*, *Fargo*.

Impacts of early gestational undernutrition followed by realimentation on fetal and placentomal growth were determined. Multiparous beef cows bred to the same bull and carrying female fetuses (N=30) were fed in equal numbers to either meet NRC requirements (control; C) to gain weight (average = + 4.25% of BW) or fed below NRC (nutrient restricted; NR) to lose weight (average = -6.8% of BW) from d 30 to d 125 of gestation. On d 125, ten C and NR cows were necropsied, and the remaining 5 NR cows were realimented to achieve similar BW to C cows when necropsied on d 250 of gestation. At necropsy, placentomes were separated into caruncular (CAR) and cotyledonary (COT) components and pooled. On d 125, while fetal weights of C cows averaged 948 ± 17g, fetal weights of NR cows fell into 2 distinct groups: Group 1 cows had fetal weights similar to those of C cows (974 ± 10g), while fetal weights of Group 2 cows were reduced (773 ± 22g;P<0.05). Group 1 and Group 2 cows both exhibited reduced (P<0.05) CAR weights when compared to C cows (291 ± 20 and 315 ± 16 vs. 413 ± 19g, respectively). In contrast, COT weight of Group 2 cows were reduced (P<0.01) when compared to Group 1 and C cows (193 ± 11 vs. 286 ± 14 and 333 ± 13g, respectively). On d 250, fetal and CAR weights were similar for NR and C cows averaging 26.5 ± 0.6kg and 2764 ± 100g, whereas COT weights of NR cows remained low (1388 ± 86 vs. 2175 ± 126g; P<0.05). CAR and COT vascular densities were similar for placentomes of NR and C cows on d 125. On d 250, NR and C cows had similar COT vascular density; CAR vascular density increased (P<0.01) in NR cows. Early maternal undernutrition had variable impacts on fetal growth by d 125. Decreased fetal weights on d 125 were associated with decreased COT weight. The return of all NR cow fetal weights to those of C cows after realimentation was related to increased growth and vascularity of CAR tissues. Supported by USDA NRI Grant # 2003-35206-12814.

Key Words: Maternal Undernutrition, Placentome Development, Fetal Growth

W156 Production system under which ewes are selected alters nutrient availability to the fetus in response to early pregnancy undernutrition. G. Wu*[1], W. Shi[1], T. Spencer[1], B. Hess[2], P. Nathanielsz[3], and S. Ford[2], [1]*Texas A&M University*, *College Station*, [2]*University of Wyoming*, *Laramie*, [3]*University of Texas*, *San Antonio*.

Maternal nutrient deprivation during early to mid gestation is implicated in fetal growth restriction, cardiovascular and metabolic dysfunction and health of the resulting offspring. Recently, we reported that when ewes from the University of Wyoming flock (UW ewes; sedentary lifestyle and more than adequate nutrition) were fed 50% of NRC requirements (nutrient restricted; NR) or 100% of NRC (control fed; C) from d 28-78 of gestation, fetal weights, as well as glucose and essential AA concentrations in maternal and fetal blood were markedly reduced in NR vs. C pregnancies. Our objectives were to compare the ability of ewes selected under a markedly different production system to alter the impact of maternal undernutrition on fetal nutrient availability and growth. We utilized range ewes of similar age, breeding, size and body condition from Baggs, Wyoming (Baggs ewes; nomadic lifestyle and limited nutrition), and subjected them to the same maternal undernutrition as UW ewes. On d 78 of gestation, ewes were euthanized and maternal uterine and fetal umbilical plasma obtained. All AA were analyzed by HPLC and quantified on the basis of authentic standards (Sigma Chemicals) using Millenium-32 Software. On d 78, fetal weights were similar for NR (279 ± 13g) and C (272 ± 8g) Baggs ewes. Concentrations of glucose (47 ± 2 vs. 54 ± 2 mg/dl) and 7 essential AA (VAL, LEU, ILE, THR, PHE, LYS and TRP) were reduced (P<0.05) in maternal plasma of NR vs. C Baggs ewes. In contrast, fetal plasma concentrations of glucose (14 ± 2 vs 13 ± 2 mg/dl) and all essential AA were similar between the NR and C Baggs ewes. These data suggest that placentomal blood flow and (or) glucose and AA transport systems were augmented in NR Baggs ewes. Supported in part by NIH - INBRE Grant # P20RR016474-04

Key Words: Sheep Production System, Maternal Undernutrition, Fetal Growth

W157 Effect of eicosapentaenoic acid on lipid composition and prostaglandin synthesis in bovine endometrial cells in vitro. J. W. Green*[1], J. K. Ahola[2], T. E. Engle[3], and P. D. Burns[1], [1]*University of Northern Colorado*, *Greeley*, [2]*University of Idaho*, *Caldwell*, [3]*Colorado State University*, *Fort Collins*.

Eicosapentaenoic acid(EPA) has been reported to inhibit bovine endometrial prostaglandin (PG) $F_{2\alpha}$ synthesis in vitro. However, the cellular and molecular mechanisms by which EPA regulates prostaglandin synthesis in this cell type are largely unknown. The objective of experiment 1 was to investigate the effect of EPA on lipid composition in bovine endometrial cells in vitro. Cells were grown to 80 to 90% confluence in 120 mm dishes containing 40% Ham's F-12 medium, 40% Eagle minimum essential medium, 10% fetal bovine serum, 10% heat-inactivated horse serum, 200 U/L insulin, 10 mL/L antibiotic/antimycotic solution, and 343 mg/L D-valine at 37°C under a humidified atmosphere of 95% air and 5% CO_2. Culture medium was supplemented with 0, 0.1, 1, or 10 μM EPA (n = 3 replicates/dose). Cells were removed from dishes, washed 3 times with PBS, freeze dried, and long chain fatty acids were methlylated and subjected to GC. There was an effect of dose of EPA on lipid composition ($P < 0.05$). Weight percent of EPA increased, while weight percent of arachidonic acid decreased with increasing dose of EPA added to culture medium ($P < 0.05$). The objective of experiment 2 was to determine the effect of EPA on total PGF synthesis. Cells were cultured in six-well dishes as described in experiment 1 and grown to 80 to 90% confluence with or without 10 μM EPA (n = 6 wells/dose of EPA). Cells were serum starved for 18 h prior to treatment then treated for 6 h with or without 100 ng/mL phorbol ester (n = 3 wells/treatment). Medium was collected and assayed for total PGF ($PGF_{1\alpha}$, $PGF_{2\alpha}$, and $PGF_{3\alpha}$) by enzyme immunoassay. There was no effect of EPA on basal PGF secretion ($P > 0.10$), while EPA attenuated phorbol ester-stimulated PGF secretion ($P < 0.05$). These data indicate that EPA may partially attenuate PGF secretion by reducing available arachidonic acid for 2-series PGF synthesis.

Acknowledgements: This research was supported in part by a grant from Omega Protein Inc., Hammond, LA

Key Words: Bovine Endometrial Cells, Prostaglandin, Eicosapentaenoic Acid

W158 Leukocyte populations and cytokine mRNA expression in quarter milk fractions of dairy cows at different SCC levels. H. Sarikaya*, G. Schlamberger, and R. M. Bruckmaier, *Physiology Weihenstephan, Techn. Univ. Munich*, *Freising, Germany*.

To investigate the distribution of lymphocytes, macrophages and neutrophils (PMN) and the mRNA expression levels of the proinflammatory cytokines TNFα and IL-1β in different udder compartments, quarter milk of different somatic cell counts (SCC) was divided into 3 fractions (C: cisternal, A1: first 400g alveolar and A2: remaining alveolar milk) during the course of machine milking. Quarters were assigned to 4 groups according to their SCC: I) <12,000 (n=6), II) 12,000-100,000 (n=8), III) 100,000-350,000 (n=7), IV) >350,000 (n=8), resp. Cell populations were classified microscopically after panoptic staining. SCC decreased from highest levels in C to lowest levels in A1 and increased thereafter to A2 in all groups. Lymphocytes dominanted by far in group I (77±5, 78±5, 77±7% in C, A1, A2, resp.), whereas the content of macrophages and PMN was low (p<0.05). In contrast, the proportion of lymphocytes was low in all fractions of groups II, III and IV (2-40%). Macrophages in C were highest in group II and decreased to groups III and IV (58±3%, 46±4, 33±5%, resp., p<0.05). The content of macrophages decreased during milking in all groups.

In contrast, the proportion of PMN in C was low in group II and was elevated in groups III and IV (18±4, 41±5, 61±5, resp., $p<0.05$). An increase of PMN content during milking (A1, A2) was observed in all groups. The mRNA expression of TNFα and IL-1β (measured via real-time qRT-PCR) were similar in C, A1 and A2 in all groups, but cytokine mRNA expression was higher with increasing SCC ($p<0.05$).

In conclusion, the milk fraction during the course of milking has a crucial influence on the distribution of leukocyte populations in addtion to SCC level. The surprisingly low content of macrophages and PMN and concomitantly low cytokine mRNA expression in quarters with SCC <12,000 might cause a reduced immune response to invading pathogens. Contrary, the increased percentage of macrophages and PMN in quarters with higher SCC is also reflected by high cytokine mRNA expression.

Key Words: Milk Fractions, Leukocytes, mRNA Expression

W159 Effects of feeding pattern on plasma ghrelin concentrations in pigs. C. Brown*, R. Harrell, and C. Whisnant, *North Carolina State University*, *Raleigh*.

The independent role of ghrelin regulation continues to be controversial. Ghrelin, a 28 amino acid peptide identified as the endogenous ligand for growth hormone (GH) secretoagogue receptor, is found in the gastrointestinal tract, predominantly the stomach. Ghrelin stimulates GH secretion, increases feed intake, adipose tissue, and decreases gastric acid. The aim of this study was to determine if a change in meal patterns might affect ghrelin levels in barrows. Twelve crossbred barrows (67.1 + 4.5 kg BW) were used. The pigs were placed on their corresponding diets on day 0. Six pigs were placed on continuous access to feed using a typical finishing diet and the treatment group was fed 2.73 kg of feed at 1200 and the remaining feed was removed at 1600. Catheters were placed in the jugular vein on day 7 and samples were taken on day 8, 9, and 11. Plasma ghrelin concentrations were measured every 15 minutes for 4 hours and then every 30 minutes the remaining 2 hours on days 8 and 9 using a commercially available RIA for active ghrelin. A glucose challenge (500 mg/kg BW) was administered on day 11 and a sample was taken before the infusion and then every 15 minutes for 3 hours after the infusion. Data were analyzed by PROC GLM and SAS using treatment and time and the treatment by time interaction in the model.

Average daily gain during the experiment was 0.43 kg and 0.87 kg for the limited compared to continuous access to feed groups. Plasma ghrelin concentrations increased (20%) ($P<.01$) prior to feeding and decreased (20%) after feeding ($P<.01$) relative to baseline in the meal fed pigs. Ghrelin concentrations were decreased after glucose infusion ($P<.01$). Concentrations decreased by 40% after the initial infusion and then remained steady for approximately 2 hours post-infusion. In agreement with reports from other species, ghrelin increased before and decreased after feeding in meal-fed animals. Ghrelin may be an important regulator of feed intake in swine.

Key Words: Ghrelin

W160 Improved development and quality of embryos collected from superovulated Holstein cows in response to repeated subcutaneous injections of vitamin E and selenium. G. Martin-Castaneda*, C. Diaz-Mora, S. Padilla, R. Banuelos, R. M. Rincon, F. J. Escobar, J. M. Silva-Ramos, and C. F. Arechiga, *Universidad Autonoma de Zacatecas*, *Zacatecas, Zac. Mexico*.

Present study tried to determine the effect of a subcutaneous therapy of vitamin E and selenium administered during the peripartum period of Holstein cows on stage of development and quality of embryos collected transcervically. Study included 12 cows alloted into 2 groups: Control (n=6), cows receiving 10 ml of physiologic saline solution (PSS, Lapisa). Mu-Se (n=6), cows receiving 10 ml injection of Mu-Se containing 500 mg of vitamin E and 50 mg of Selenium (MU-SE, Schering Plough). Both groups received 5 subcutaneous injections during the peripartum period, on d -21, 0, 30, 60, 140 (i.e., d 0=calving). Cows receiving Mu-Se tended to have a diminished superovulatory response according to the number of corpus lutea (CL) detected by rectal palpation on the date of embryo collection (Control=89 vs. Mu-Se=76). However, number of embryos collected was similar for both groups (Control=16 vs. Mu-Se=13), $P>0.05$). We obtained an embryo collection efficiency of 17.58% (29 embryos out of 165 CL´s). Data was analyzed by Chi-square.

Administration of Mu-Se had a positive influence on embryonic development (Control=3 and 13 vs Mu-Se= 9 and 4, on developmental stages of blastocyst and morula, respectively ($P<0.05$). Another positive influence of MU-SE was demonstrated on quality of embryos collected (Quality 1= 3 vs. 8; Quality 2= 2 vs. 2; Quality 3= 3 vs. 1; Quality 4= 8 vs. 2; for Control and Mu-Se, respectively. Such a positive effect of Mu-Se on stage of development and quality of embryos collected, led us to obtain a greater number of embryos able to be cryopreservated (i.e., quality 1 and 2). Number of embryos able to be cryopreservated was 100% higher in the MU-SE group. (Control=5 vs. Mu-Se=10).

In conclusion, subcutaneous administration of a vitamin E and selenium therapy on d -21, 0, 30, 60, 140 (i.e., d 0 = calving), in Holstein cows exposed to superovulation, increases the developmental stage and quality of embryos collected 7 d after insemination.

Acknowledgements: Authors acknowledge the support of Leche al Dia and dairy producers associated

Key Words: Dairy Cows, Vitamin E, Embryo

W161 Specific gGlutamate and nucleoside transport activities of Madin-Darby bovine kidney (MDBK) cells are inhibited by the ergopeptide bromocriptine. E. Miles*, J. Boling, and J. Matthews, *University of Kentucky*, *Lexington*.

This study was conducted to determine (1) the proteins responsible for uptake (pmols/well/4 min) of L-glutamate (GLU) and uridine (URD) by monolayer and/or polarized MDBK cells and (2) if these activities were affected by extracellular bromocryptine (BRCP;100 μM), a model ergopeptide agonist of type-2 dopamine receptors (D_2R). GLU (1 μM) uptake by monolayer and polarized MDBK cells was predominantly (> 83%; $P < 0.001$) by EAAC1-like activity (Na^+-dependent, high-affinity). Using monolayers, GLU (1 μM) uptake was inhibited ($P < 0.001$) 26-31% by BRCP and BRCP plus 10 μM domperidone (DOM, D_2R antagonist), and 13% ($P < 0.001$) by BRCP plus 100 μM alpha-ergocryptine (ERCP, D_2R agonist). Thus, EAAC1 activity may be stimulated by D_2R-dependent and inhibited by D_2R-independent mechanisms. The expression of Na^+-dependent (CNT) and Na^+-independent (ENT) nucleoside transport activities was characterized for polarized MDBK cells. ENT-like uptake of URD (2 μM) accounted for 87% ($P <0.05$) of apical and 70% ($P <0.001$) of basolateral URD uptake. Apical ENT activity was inhibited ($P < 0.05$) 81 and 93% by 1 μM and 10 μM S-(4-Nitrobenzyl)-6-thioinosine (NBTI), respectively, whereas basolateral ENT activity was inhibited 45 ($P < 0.001$) and 84% ($P < 0.001$), respectively, by NBTI. Basolateral CNT activity was inhibited 100 ($P < 0.002$), 76 ($P < 0.01$), and 52% ($P < 0.05$) by adenosine, guanosine, and thymidine, respectively. Apical URD (0.3 μM) uptake was inhibited ($P < 0.001$) 83% by BRCP, 90% by BRCP plus ERCP, and 88.7% by BRCP plus DOM. In contrast, basolateral uptake of URD was only reduced ($P < 0.01$) 29% in the presence of BRCP plus ERCP. Thus, ENT-1 is the predominant apical URD transporter expressed by MDBK cells and BRCP inhibits its activity through D_2R-independent mechanism(s). In contrast the activity of basolateral CNT1, CNT3, and/or ENT2 is inhibited by BCRP in a D_2R-like manner. In conclusion, transport of GLU and URD are altered by BCRP.

Key Words: Cow, Glutamate Transport, Nucleoside Transport

W162 An observational analysis of twin births, calf sex ratio, and calf mortality in Holstein dairy cattle. N. Silva del Rio*[1], S. Stewart[2], P. Rapnicki[2], Y. M. Chang[1], and P. M. Fricke[1], [1]*University of Wisconsin*, *Madison*, [2]*University of Minnesota*, *St Paul*.

To assess twinning trends across time, a data set of calving records from Jan 1996 to Sep 2004 comprising 6,226 herds with 2,901,697 calving events was extracted from Minnesota DHIA archives. Cows with parity >7, herds with <100 total calving events, and 489,559 incomplete calving records were removed. The final analysis included 2,318,601 calving records from 4,123 herds representing 1,088,962 Holstein cows and 96,222 twin births (4.1%). Twinning trends across time were analyzed using a logistic regression model including the main effects of calving season (Jan-Mar, S1; Apr-Jun, S2; Jul-Sep, S3; Oct-Dec, S4) and parity (nulliparous heifers, P1; primiparous cows, P2; multiparous cows, P3+) with year as a covariate and all possible interactions. Twinning increased (P<0.01) from 3.4% in Jan 1996 to 4.7% in Sep 2004. The interaction of parity by yr was significant for both linear (P<0.01) and quadratic (P=0.01) terms with a greater increase in twinning by yr for P2 (4.0 to 5.8%) and P3+ (5.2 to 7.1%) than for P1 (1.1 to 1.3%) cows. Odds ratios for twin births in S1, S2, and S3 were 0.85, 1.11, and 1.07, respectively, compared to S4. Based on chi-square analysis, sex ratio (Bull, B; Heifer, H) for singleton calves was 53.4% B, 46.6% H which differed (P<0.01) from 50:50 B:H, whereas sex ratio for twin calves was 30.1% B:B, 43.6% B:H, 26.3% H:H, which differed (P<0.01) from 25% B:B, 50% B:H, 25% H:H. Calf mortality for singleton births was greater (P<0.01) for P1 (10.5%) than for P2 (5.0%) and P3+ (5.3%) cows. Calf mortality for twin births in which one or both calves were stillborn was greater (P<0.01) for P1 (38.4%) than for P2 (26.6%) and P3+ (27.2%) cows, and was greater (P<0.01) for B:B (19.3%) than for H:H (11.0%) twins. Although specific factors cannot be implicated, the increase in twinning across time suggests a concurrent change in one or more causative factors associated with twinning during this time period.

Acknowledgements: Supported in part by USDA NRI grant 2002-02033 to PMF

Key Words: Twinning, Calf Sex Ratio, Calf Mortality

W163 Effects of diet energy concentration and fat addition on reproductive performance and hormone profiles of beef cows. J. E. Rossi*[1], N. M. Long[1], W. M. Graves[2], G. M. Hill[1], and B. G. Mullinix, Jr.[1], [1]*University of Georgia*, *Tifton*, [2]*University of Georgia*, *Athens*.

Two experiments evaluated pre-breeding dietary energy concentration and fat addition on reproductive performance in multiparous cows. In Exp 1, Angus cows (n=27; 26.9 ± 1.6 d post-partum) were fed either bermudagrass hay ad libitum (H) or were limit fed a corn based (C) diet for 56 d immediately preceding the breeding season. Treatment diets were ended on the first day of the breeding season. Cows were allowed to graze bermudagrass pasture and bred natural service for 75 d. Exp 1 and 2 were analyzed as a completely randomized design using the PROC MIXED function of SAS. Cow BW loss was greater (P = 0.04) for C (-53 kg) than for H (-8.4 kg) cows. Initial body condition score (BCS; 1=emaciated, 9=obese) was similar (P = 0.96) between cows fed C (5.5) and H (5.5) diets. Likewise, final BCS was similar (P = 0.84) between cows fed C (5.4) and H (5.4) diets. Days to estrus was similar (P = 0.94) between treatments, 52.4 and 52.9 d for C and H; respectively. Insulin concentration was similar at d 0 and 28 (P > 0.85) but greater (P = 0.03) for C than for H cows at d 56. In Exp 2, Angus cows (n = 40; 11.7 ± 1.3 d post-partum) were used to evaluate dietary energy concentration and fat addition on reproductive performance. Dietary treatments were arranged in a 2x2 factorial and fed for 56 d immediately preceding the breeding season. Diets consisted of bermudagrass hay offered ad libitum with either 2.1 kg/d whole cottonseed (HF) or 2.5 kg/d of corn and soybean meal mixture (HNF), and limit fed corn based diets with (CF) or without (CNF) 2.1 kg/d whole cottonseed. Final BCS was similar (0.79) among treatments, 5.1, 5.0, 5.1 and 5.1 for HNF, HF, CNF, and CF; respectively. Days to estrus was similar (P = 0.11) among treatments. Insulin concentration between C and H diets was similar at d 0 (P = 0.35) and 28 (P = 0.12), but greater at d 56 (P = 0.03) for cows fed C versus H diets. A corn based diet increases insulin concentrations compared with feeding a hay based diet. Overall reproductive performance is not affected by pre-breeding dietary energy concentration or dietary fat addition in mature cows in adequate body condition.

Key Words: Beef Cows, Fat, Reproduction

W164 NEFA and glucose levels in serum of periparturient dairy cows are indicative of pregnancy success at first service. M. Burkhart*, R. Youngquist, J. Spain, J. Sampson, J. Bader, R. Vogel, W. Lamberson, and A. Garverick, *University of Missouri*, *Columbia*.

Higher serum levels of non-esterified fatty acids (NEFA) and lower serum levels of glucose indicate a negative energy balance in periparturient dairy cows. The objective of this study was to determine the relationship between NEFA and glucose levels in periparturient dairy cows and subsequent fertility (i.e. pregnancy). Prior to calving, Holstein (n=82) and Guernsey dairy cattle (n=7) were housed on pasture and fed a total mixed ration (TMR). After calving, cows were housed in a free stall barn and fed a TMR to meet or exceed NRC (2001) recommendations. Serum and plasma samples were taken at approximately 10, 7, and 3d prepartum and 3, 7, 14, and 21d postpartum. At 37d±7d postpartum, cows began one of two timed artificial insemination protocols that included Presynch treatments ($PGF_{2\alpha}$, 14d later $PGF_{2\alpha}$, 14d later GnRH, 7d later $PGF_{2\alpha}$, 2d later GnRH). Cows (n=33) classified as anestrus by absence of a corpus luteum at first GnRH received a CIDR, which was removed at the third $PGF_{2\alpha}$. Cows were randomly assigned by parity (1st and 2nd+ lactations) to be bred either at the last GnRH (CoSynch) or 24h after the last GnRH (OvSynch). Pregnancy was determined at 32d and again at 60d post-insemination by ultrasound. Data were analyzed using a mixed model analysis of variance for repeated measures. Across all days, blood NEFA levels were lower ($p < 0.001$) and glucose levels were higher ($p < 0.001$) for cows that subsequently became pregnant at first service versus those that remained open. Means ±SE (µmol/L) of pregnant and open cows at 3d postpartum were 491±70 and 757±49 of NEFA and were 56.4±1.4 and 52.6±1.4 of glucose, respectively. Logistic regressions were used to predict incidence of pregnancy based on NEFA and glucose levels from individual days. The prediction with the highest likelihood ratio was from 3d postpartum NEFA levels; $\beta_0 = 0.61 \pm 0.49$, $\beta_1 = -0.002 \pm 0.0007$. By using an inverse link function, a cow with a NEFA level of 491 µmol/L is predicted to have a 0.40 chance of pregnancy at first service. Nutritional status during the periparturient period may affect subsequent fertility.

Key Words: Conception Rate, NEFA, Glucose

W165 Effects of limb origin and twenty-four hour storage on contractile response of bovine lateral saphenous vein to norepinephrine. J. L. Klotz*[1], A. C. Vevoda[2], L. P. Bush[2], and J. R. Strickland[1], [1]*FAPRU, USDA-ARS*, *Lexington, KY*, [2]*University of Kentucky*, *Lexington*.

Vasoconstriction has been associated with several symptoms of fescue toxicosis thought to be alkaloid induced. A multi-myograph system permits rapid screening of compounds for vascular activity. However, prior to investigation of bovine vascular effects generated by tall fescue alkaloids using a myograph system, it was necessary to validate several procedural aspects. Experiments were conducted, using dose-response to norepinephrine (**NE**), to determine if lateral saphenous veins taken from the left limb differed from those taken from the right and to evaluate viability of tissue following 24 h storage at 2-8°C. Segments (2-3 cm) of vein were collected from both left and right legs of healthy mixed breed cattle (n = 7) at local abattoirs. Tissue was placed in Krebs-Henseleit oxygenated-buffer and kept on ice or stored at 2-8°C until used. Veins were trimmed of excess fat and connective tissue, sliced into 2-3 mm sections and suspended in a myograph chamber containing 5 mL of oxygenated Krebs-Henseleit buffer (95% O_2/5% CO_2; pH = 7.4; 37°C). Tissue was allowed to equilibrate at 1 g of tension for 1.5 h prior to addition of NE. Increasing doses of NE were administered every 15 min following buffer replacement. Data were normalized as a percent of contractile response induced by maximal dose of NE ($5x10^{-4}$M) for profiling. Veins from both left and right limbs demonstrated contractions in a dose-response manner ($P < 0.01$), but did not differ between limbs. There were no differences in dose-response to NE between tissue tested the day of dissection and tissue exposed 24 h later. Maximal contractile response to NE did not differ between day for left (d1 = 20.1; d2 = 15.8 g; SE = 3.9) or right limbs (d1 = 18.2; d2 = 15.1 g; SE = 2.4). Limb of origin and overnight storage of tissue did not appear to affect tissue responsiveness to NE. Thus, future experiments will not be limited to a single limb and experiments can be extended beyond day of dissection.

Key Words: Bovine, Norepinephrine, Saphenous Vein

W166 Effect of estradiol cypionate® (ECP) on milk production in lactating dairy cows. A. Gümen*, J. P. Powell, A. H. Souza, A. P. Cunha, J. N. Guenther, P. M. Crump, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

Previous research indicated that early postpartum treatment with ECP increased milk production in multiparous cows and this was tested in 2 expts. There were an unexpectedly high number of cows with disease conditions (DA, 9.5%; mastitis, 42%; Johne's-positive, 16%) and the rate was unrelated to treatment. Each of these conditions was found to decrease milk production and subsequent analyses only included cows without these conditions. In expt 1, cows were randomly assigned to 1 of 3 treatments: 1) three injections of ECP (4 mg) weekly for 3 weeks (3X; n=13), 2) one injection of ECP (1X; n=19) and 3) control (untreated; n=18) beginning at days 1-4 post-calving. Ovulation was determined by weekly ultrasound. Time to first ovulation (average of 28 to 34 d) and milk production (43.4 to 44.5 kg average during first 20 wks) were similar among treatments. In expt 2, cows were randomly assigned to 1 of 3 treatments: 1) twice weekly treatments with 4 mg of ECP for 3 wks (4mg; n=21) 2) twice weekly (first injection with 4 mg following by 5 injections of 2 mg) treatments with ECP (2mg; n=18) and 3) control (untreated; n=25). Time to ovulation was delayed ($P<0.05$) with 4mg treatment (51.4±3.0 d) compared to 2mg (44.6±3.4 d) and control (43.4±3.0 d). Milk production began to be greater ($P<0.05$) at 5 wk after calving in cows treated with 2mg (40.3 kg) compared to controls (36.7 kg). From weeks 5 to 10, cows in 2mg (47.8 kg) tended to produce more ($P<0.07$) milk than control cows (42.9 kg) with 4mg also tending to be greater (46.4 kg; $P=0.16$) than controls. Milk production during the entire treatment period was numerically but not statistically higher in 2mg (44.4 kg) compared to controls (40.3 kg) with 4mg intermediate (42.5 kg). Analysis of treatment effects in cows with disease problems had similar trends but with lower milk production and more variability. Thus, multiple treatments with lower doses of ECP may increase milk production but further trials are needed to evaluate the repeatability of this response.

Key Words: ECP, Milk Production, Early Postpartum

W167 Effects of increasing energy density and cooling treatment on ovarian function in postpartum dairy cows under heat stress conditions. J. Y. Wang* and J. C. Kung, *Tunghai University*, *Taichung, Taiwan*.

The objective was to examine the effect of incrementing energy density and cooling treatment on ovarian function of postpartum dairy cows under heat stress conditions. Holstein cows (12 primiparous and 22 multiparous) were assigned randomly in a 2x2 factorial experiment consisting of a fat supplementation and water sprinkling treatment. The bypass fat was gradually increased from 100g to 400g/d at 4 weeks before calving, and increased at calving to 450g until 60 days after parturition. The automated cooling system which actuated sprinkling (30sec) was followed by forced ventilation (4.5min) and cows were cooled from 8:00 to 16:00. All cows were fed complete ration and residues were weighed back after each feeding. Ovaries were examined by transrectal ultrasonography from calving until ovulation. The data were analyzed following the GLM procedure of SAS. Results showed that the cooling system could effectively reduce rectal temperature ($P<0.05$) and achieve an earlier recovery of energy balance. The average energy balance from week 1 to week 8 postpartum was -18.3Mcal±0.6Mcal/d vs. -25.2± 0.6Mcal/d in the cooled group versus the control group ($P<0.01$). Cooled and fat treated cows had less first class (3-5mm) follicles than the controls (3.88± 1.34 vs.8.13 ±1.13; $P<0.05$). However, fat supplemented cows developed more second (6-9mm) and third (>9mm) class follicles than the control cows. The interval from parturition to first ovulation was shorter ($P<0.06$) in the fat supplemented and cooled cows than the untreated cows. But there was no difference in the interval from parturition to the second ovulation and in the interval between the first and second ovulations. These results indicate that fat supplementation and evaporative cooling may have potential in improving postpartum ovarian function under heat stress conditions.

Key Words: Cooling, Fat, Ovarian Function

Production, Management and the Environment: Health and Reproduction

W168 Biosecurity practices related to cattle purchases. F. Hoe and P. Ruegg*, *University of Wisconsin*, *Madison*.

Wisconsin dairy producers (n = 1102) were surveyed in the fall of 2004 using a mailed questionnaire. A total of 583 farms responded for a response rate of 53%. Overall, herds contained 92 (169.4) lactating cows with a rolling herd average of 8,991 (1,748) kg and a bulk tank somatic cell count (BTSCC) of 245,963 (109,083) cells/ml. Responders were categorized based on the number of lactating cows: very small herds (< 50 cows; n = 279); small (51-100 cows; n = 199); medium (101-200 cows; n = 42); and large (> 200 cows; n = 36). The number of lactating cows was not reported for 27 herds. During the 3 years preceding the survey, 43.7% of the herds reported that they purchased cattle, with more medium (61.0%) and large (77.1%) herds reporting cattle purchases as compared to very small (40.4%) and small herds (39.1%). Overall, little was known about the source of purchased cattle. Only 38.9%, 50.8% and 13.2% of responding herds reported that they asked source herds for information about Johnes disease status, BTSCC or previous Mycoplasma infections, respectively. Medium and large herds were 6.6 times more likely to obtain information about Mycoplasma status as compared to smaller herds. Overall, 48.8% performed a reproductive exam before housing purchased cattle in existing cow groups. Medium and large herds were more likely to perform reproductive exams on purchased cattle ($P = 0.04$, OR = 1.9). Few herds performed diagnostic tests on purchased cattle. Only 18.3% of the responders tested for Johnes disease, 12.7% tested for BVD, 5.2% tested for bovine leukemia, 30.6% performed SCC or CMT, and < 10% tested milk for mastitis pathogens. As herd size increased, the frequency of diagnostic testing increased ($P < 0.005$). Only 44.0% and 18.5% of medium and large herds respectively reported that no diagnostic testing was performed for purchased cattle as compared to > 55% of the smaller herds. Many differences in biosecurity practices were identified based on herd size, suggesting that producers from larger herds were more aware of and able to take preventive actions regarding biosecurity risks associated with purchased cattle.

Key Words: Biosecurity, Cattle, Purchase

W169 Biosecurity practices used during dairy herd expansion. J. Dalton*[1], R. Norell[2], and M. Chahine[3], [1]*University of Idaho*, *Caldwell*, [2]*University of Idaho*, *Idaho Falls*, [3]*Twin Falls Research and Extension Center*, *Twin Falls*.

The Idaho dairy industry has undergone rapid growth recently. In December 2004, there were 435,000 lactating cows in Idaho, an increase of 163,000 cows in seven years. Consequently, the demand for dairy cattle has increased in order to fill new and remodeled facilities. A survey of Idaho dairy producers was performed to identify biosecurity practices used during herd expansion. Dairy producers, (n = 40; representing each geographical dairy region of the state), which had completed expansion within the last seven years, were selected as participants. Producers were asked questions regarding number and source of cattle purchased; pre-purchase health testing of cattle; use of quarantine for purchased cattle; and diseases contributing to treatments and (or) removal of cows following expansion. The range in herd size, after expansion, was 95 to 5,300 lactating cows. Twenty-three dairy producers (57.5%) reported purchasing greater than 101 animals, while seven dairy producers (17.5%) reported purchasing greater than 1001 animals. Twenty dairy producers (50%) purchased cattle from one source, while the remaining 50% of respondents reported up to four sources for purchased cattle. The majority of producers (80%) did not require health testing (non udder related) of new cattle prior to purchase. Of the

29 dairy producers who purchased lactating cattle, 89.7% tested animals for evidence of udder health. Only 20 dairy producers (50% of respondents) reported that new cattle were quarantined. The most significant producer-identified diseases contributing to treatments and (or) removal of cows following expansion were mastitis, hairy heel warts, Johne's disease, and bovine virus diarrhea. The results of this survey suggest: 1) many dairy producers have not identified the value in pre-purchase health testing (non-udder related) and quarantine prior to introduction into the existing herd, and 2) educational opportunities exist to ensure a safe and profitable milk supply.

Key Words: Biosecurity, Dairy, Expansion

W170 Do dairy producers manage dairy bulls to limit biosecurity and infertility risk? J. Dalton*[1], R. Norell[2], and M. Chahine[3], [1]*University of Idaho*, *Caldwell*, [2]*Idaho Falls Research and Extension Center*, *Idaho Falls*, [3]*Twin Falls Research and Extension Center*, *Twin Falls*.

Despite the benefits of AI, such as reducing disease transmission, allowing for genetic selection, and increasing the milk yield of dairy cattle, many dairy producers use natural service bulls, either as the sire of choice, or as a clean-up bull after a few AI services. A survey of Idaho dairy producers was conducted to identify bull management practices aimed at limiting biosecurity and infertility risk. Dairy producers, (n = 40; representing each geographical dairy region of the state), which had completed expansion within the last seven years, were selected as participants. Producers were asked questions regarding whether bulls had been introduced into the herd; source of purchased bulls; vaccine administration prior to introduction into the herd; use of quarantine for purchased bulls; and whether a breeding soundness evaluation had been performed prior to purchase. Twenty-nine dairy producers (72.5%) reported purchasing bulls for natural service. The predominant source of bulls was a breeder of registered cattle. Although twenty-three dairy producers (79.3%) administered vaccines to incoming bulls prior to introduction to the herd, only 12 dairy producers (41.4%) reported that new bulls were quarantined. The majority of producers (72.4%) did not require a breeding soundness evaluation prior to purchase. The results of this survey suggest: 1) purchasing of bulls for natural service is common, 2) dairy producers have not identified the value of quarantine and breeding soundness evaluations prior to introduction into the herd, and 3) educational opportunities exist to enhance dairy producers understanding of the benefits of AI and management skills to limit biosecurity and infertility risk.

Key Words: Biosecurity, Dairy, Bulls

W171 Optimum month of pregnancy to maximize average daily milk production in Holstein cows. M. Terre*[1] and A. Bach[2,1], [1]*Unitat de Remugants-IRTA (Institut de Recerca i Tecnologia Agroalimentàries)*, *Barcelona, Spain*, [2]*ICREA (Institució Catalana de Recerca i Estudis Avançats)*, *Barcelona, Spain*.

In many species, the onset of pregnancy has a negative impact on lactation. Because most dairy systems have the objective of an annual calving, artificial insemination is initiated around 80 d after calving. A database with 15,022 complete lactations of Spanish Holstein cows was used to assess the optimum stage of lactation in which pregnancy should take place to maximize average daily milk yield (ADY). Monthly milk production records from 60 DIM and above were used to perform a linear mixed-effects model with month of lactation where pregnancy occurred (DIMP = 2, 3, 4, 5, 6 and over 7 mo), DIM, and the interaction of DIMP and DIM as fixed effects, and cow as random effect. This model was used to analyze separately data from primiparous (PM) and multiparous (MP) cows, according to their milk yield level: high (H), moderate (M), and low (L), resulting in 6 different data sets. Also, ADY of 36 virtual pens (6 DIMP levels for each of the 6 data sets) were modeled for a period of 5 years using the predicting equations obtained. The slope of the fitted line describing milk production decay with DIM decreased ($P < 0.001$) as DIMP increased, indicating that pregnancy in early lactation had a more negative impact on milk persistency than pregnancy in later lactation. Predicted ADY for modeled pens of cows with 2 and 3 DIMP were greater than that of cows with 4, 5, 6 and over 7 DIMP for all 6 groups. However, ADY of simulated pens of MPH cows with 2 DIMP was 3, 6, 8, and 12% greater than that of pens of MPH cows with 4, 5, 6, and over 7 DIMP, respectively. But ADY of simulated pens with PMH cows becoming pregnant on the 2nd mo of lactation was only 1, 2, 3 and 5% greater than that of pens with PMH cows with 4, 5, 6 and over 7 DIMP, respectively. These results confirm that to ensure pregnancy of MP cows between 2 and 3 months after calving is optimum, but in PM cows, pregnancy could be delayed without resulting in an important decrease in milk yield.

Key Words: Yield, Pregnancy, Model

W172 Assessment of voluntary waiting period and frequency of estrus synchronization among herds. R. H. Miller*[1], H. D. Norman[1], M. T. Kuhn[1], and J. S. Clay[2], [1]*Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*, [2]*Dairy Records Management Systems*, *Raleigh, NC*.

Lactation stage when cows are first inseminated (voluntary waiting period, **VWP**) and extent of estrus synchronization (**ES**) were examined. Data were 5,551,562 lactations with first inseminations from 1995 to 2002. Annual herd means were computed for days in milk until first service (**D1**). For each herd-year, cumulative distribution of D1 was grouped as ≤30, ≤40, ≤50, ≤60, ≤75, ≤90, ≤120, ≤150, and ≤200 d. For 3377 herds on DHI test, mean D1 were 89, 91, 92, and 95 d for 1995 through 1998, respectively. For 1995, cumulative frequencies were 1, 3, 9, 22, 45, 64, 84, 93, and 98% for the 9 lactation stages; corresponding frequencies for 1998 were 1, 3, 8, 19, 40, 58, 80, 90, and 97%. First insemination was later in lactation in 1998 than in 1995. Herd VWP was defined as days in milk when 10% of cows had been inseminated for the first time. For 1995, cumulative frequencies of herds with VWP of ≤30, ≤40, ≤50, ≤60, ≤75, and ≤90 d were 1, 7, 33, 78, 98, and 100%; corresponding frequencies for 1998 were 1, 5, 28, 72, 96, and 99%. Thus, >50% of herds had VWP of <60 d. Intraclass correlation of D1 was 0.70, which suggested consistency in lactation stage at first insemination across years within herds. To identify ES herds, a χ^2 was calculated for each herd-year to detect differences in frequencies of first inseminations by weekday. Herd-years were classified into 4 groups: 1) $\chi^2 < 22.46$, 2) $22.46 \leq \chi^2 < 100$, 3) $100 \leq \chi^2 < 250$, and 4) $\chi^2 \geq 250$. In 1995, 91.2, 8.0, 0.8, and 0.1% of herds were in those groups, respectively; corresponding percentages for 2001 were 77.2, 15.7, 4.4 and 2.7. If groups 3 and 4 contained ES herds, then ES frequency steadily increased from 0.9% in 1995 to 7.1% in 2001. Mean herd D1 and services per cow were 95.4 and 2.1 for group 1 versus 74.0 and 2.5 for groups 3 and 4. Fertility data from ES herds may require different treatment than those from herds using traditional estrus detection.

Key Words: Estrus Synchronization, Voluntary Waiting Period

W173 Viability of *Salmonella enterica* Typhimurium and *Escherichia coli* O157:H7 in finishing swine manure slurries with and without a urease inhibitor and a plant essential oil. J. E. Wells* and V. H. Varel, *USDA-ARS, U.S. Meat Animal Research Center*, *Clay Center*.

Pathogens are commonly found in animal waste and their viabilities in manures are a concern for the environment and food safety. To determine the effects of urine and feces content, and treatments with a urease inhibitor and/or an odor-reducing compound, selected strains of *Salmonella enterica* Typhimurium and *Escherichia coli* O157:H7 were inoculated into swine manure slurries. Fresh (overnight) feces were collected from pens of swine fed a finishing ration, blended with urine and additives (n = 3 reps/trt), and inoculated with *S. enterica* Typhimurium strain 14028 (nalidixic acid-resistant) and *E. coli* O157:H7 strain 43895 (streptomycin-resistant). On d 0, a 1 g sample of the inoculated slurry was diluted and viable counts were determined by plating onto agar with either nalidixic acid or streptomycin. Viable counts were determined daily until no longer detectable. In slurries containing approximately 1:1 or 2:1 of urine and feces, the decrease in viability of *Salmonella* and *E. coli* were similar and few viable cells were found after 14 d. When the urine content of the slurry was increased to 5:1, both *Salmonella* and *E. coli* died off faster (5.7- to 6.0-fold, *P*

< 0.01) than the 1:1 slurries and few viable cells were detectable after 2 d. When the urease inhibitor, N-(n-butyl) thiophosphoric triamide (NBPT), was added to the slurries, pathogen viability was not affected in the 1:1 manure slurry where urea content was low. However, in the 2:1 and 5:1 slurries where urea was higher, NBPT addition prolonged the viability of *Salmonella* and *E. coli* up to 10 d ($P < 0.05$). Thymol addition, regardless of NBPT treatment or the urine to feces ratio, dramatically decreased ($P < 0.01$) pathogens and few viable counts of *Salmonella* or *E. coli* O157:H7 were observed after d 1. These experiments suggest that urea hydrolysis in swine waste may control pathogen levels and the inhibition of this biological process may promote pathogen viability unless antimicrobial compounds are also utilized.

Key Words: Swine, Manure, Pathogens

W174 Pregnancy rates and progesterone concentrations following ovsynch and cidr ovulation synchronization and timed artificial insemination protocols in postpartum cows. M. Aali*[1], K. Cheng[1], G. Giritharan[1], N. Dinn[1], and R. Rajamahendran[1], [1]*Kuwait Institute for Scientific Research*, *Safat, Kuwait, Kuwait*, [2]*University of British Columbia*, *Vancouver, British Columbia, Canada*, [3]*University of British Columbia*, *Vancouver, British Columbia, Canada*, [4]*University of British Columbia*, *Vancouver, British Columbia, Canada*, [5]*University of British Columbia*, *Vancouver, British Columbia, Canada*.

The objective of this study was to compare pregnancy rates (PR) and progesterone (P_4) concentrations following Ovsynch and CIDR ovulation synchronization and timed artificial insemination (AI) protocols in postpartum dairy cows. Two hundred and twenty seven postpartum Holstein cows were randomly divided into Ovsynch (n=111) and the CIDR (n=116) treatment groups. The Ovsynch protocol consisted of an initial injection of Gonadotropin Releasing Hormone (GnRH, 100µg) followed by an injection of Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$, 25mg) 7 d later and a second injection of GnRH (100µg) 48 h after $PGF_{2\alpha}$. The CIDR protocol consisted of insertion of a CIDR vaginal device and an injection of P_4 (100mg) and estradiol-17β(E_2, 5mg) on the first day of treatment, a $PGF_{2\alpha}$ injection (25mg) 7 d later, removal of CIDR 24 h after $PGF_{2\alpha}$, and a second E_2 injection (5mg) 48 h after $PGF_{2\alpha}$. Artificial insemination for Ovsynch and CIDR groups of cows was performed at 64 and 76 h after $PGF_{2\alpha}$, respectively. Pregnancy was diagnosed by ultrasonography at d 35 after AI. Milk samples were taken from the beginning of treatment until d 35 after AI for P_4 determination. Pregnancy rates (based on ultrasound at d 35) for Ovsynch and CIDR groups of cows were 32±14.9% and 42±14.25, respectively (P>0.05). Ovulation synchronization rates (based on milk P_4 level < 1ng/ml on the day of AI and > 1ng/ml on day 7 post AI) for Ovsynch and CIDR groups of cows were 61.3±13.1% and 74.8±8.66%, respectively (P>0.05). Progesterone profiles from the time of AI until d 35 after AI were similar (P>0.05) between Ovsynch and CIDR group cows. Ovsynch and CIDR protocols are very promising methods to eliminate estrus detection and carry out fixed-time AI in cycling heifers and postpartum cows and have the potential to enhance PR and the success of AI programs.

Acknowledgements: Faculty of Agricultural Sciences, University of British Columbia, Vancouver, BC, Canada. Kuwait Institute for Scientific Research

Key Words: Ovsynch, CIDR, Synchronization

W175 Effect of hCG on the pregnancy rate of beef cows synchronized with GnRH, progesterone, and prostaglandin $F_{2\alpha}$. M. L. Borger and W. A. Greene*, *The Ohio State University*, *Wooster*.

The main objective of this study was to investigate the effect of the addition of hCG to a common synchronization program on pregnancy rates (PR). Eighty-four beef cows were allotted to two similar groups (hCG and Saline) based upon breed, age, postpartum interval, and postpartum cyclicity (as determined by ultrasonography). All cows received an intravaginal releasing device (CIDR), containing 1.38 g progesterone, and 100 µg GnRH i.m. on d 0. On d 7, CIDRs were removed and all cows received 25 mg $PGF_{2\alpha}$ i.m. Cows were observed for estrus 0730 and 1930 and were artificially inseminated (AI) 10-14 h after estrus was observed. If estrus was not observed, cows were timed AI (TAI) and received 100 µg GnRH i.m. 70-72 h after $PGF_{2\alpha}$. Seven days post-AI, the hCG cows received 3 ml (3000 IU) human chorionic gonadotropin i.m. and the Saline cows received 3 ml saline i.m. Following the synchronization period, repeat breedings were done until d 52. Cows were pregnancy diagnosed by ultrasonography on d 106. hCG and Saline groups had similar (P>.05) PR to synchronization (50.0 and 64.3%) and overall PR (78.6 and 90.5). Anestrous (n=34) and cycling cows had similar (P>.05) estrus detection rates following synchronization (50.0 and 52.0%), PR to synchronization (55.9 and 58.0%), and overall PR (85.3 and 84.0%). PR to synchronization were similar (P>.05) for cows AI after estrus observation (58.1%, n=43) and cows TAI (56.1%). There was no benefit to the addition of hCG to a beef synchronization program.

Key Words: Synchronization, Beef

W176 Relationship of calf respiratory and digestive disease and age at first calving in a large commercial Holstein herd. K. Rossini*[1], M. McGilliard[1], R . Pearson[1], R. James[1], W. Swecker[1], and G. Bethard[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*G&R Dairy Consulting, Inc.*, *Wytheville, VA*.

Calf health data and first lactation records for 2556 cows born in a commercial Holstein dairy herd between June 1998 and June 2001 were studied to determine the effects of calfhood disease on survival and performance. Data were not available for calves that left the herd before calving. A total of 2083 calves contracted respiratory disease within 1 yr of age or digestive disease within 45 d of age at least once, 865 calves had digestive disease only, 292 had respiratory disease only, and 191 calves had both diseases. Occurrence of calfhood digestive disease doubled the chance of calfhood respiratory disease. Single incidences of disease occurred in 56% of calves (digestive), and 30% of calves (respiratory), whereas multiple incidences occurred at rates of 21% (digestive) and 17% (respiratory). Age at first calving increased 0.53 mo with multiple occurrences of respiratory disease versus none. In the absence of respiratory disease, there was a 0.28 mo increase in age at first calving as digestive disease increased from none to multiple occurrences. Similarly, with one occurrence of respiratory disease, an increase in digestive disease from none to multiple occurrences resulted in 0.32 mo increase in age at first calving. The pattern did not hold for multiple occurrences of digestive disease, as calving age was oldest for one occurrence of respiratory disease, rather than multiple occurrences. Overall, heifers were oldest at first calving, at or above 25 mo, when they had a history of multiple cases of respiratory disease. Calves born in the winter calved at 25.4 mo, whereas calves born in spring calved at 24.5 mo. Relative to no disease, respiratory disease delayed calving the most for calves born in the spring, from 23.9 mo of age for no occurrence to 25.4 mo for multiple occurrences. No significant effect of disease was detected for 305-d milk yield, fat yield, or SCC, but protein yield decreased by 0.05 kg/d with increased calf respiratory disease. Calfhood disease had no influence on subsequent illness as a cow in first lactation.

Key Words: Calf Disease, Age at Calving, Morbidity

W177 Environment effects on immunoglobulins (IgG, IgM) in dairy cattle and subsequent calf development in the sub-tropics. C. N. Lee* and M. Watson, *University of Hawaii-Manoa*, *Honolulu*.

Previous studies in temperate regions had shown that heat stress results in the decrease of IgG in serum and colostrum. The objectives of this study were: a) to evaluate the concentrations of dam's serum and colostrum IgG and IgM in primiparous and multiparous Holstein cows calving in the cool months and hot-humid months for vaccinated and non-vaccinated herds and b) the subsequent growth rates of calves. Forty-one dam-calf pairs from a commercial herd that practiced routine vaccination and eleven primiparous dam-calf pairs from non-vaccinated herd were used in the study. Serum samples from dam and calves were harvested at calving, 24h and 7d postpartum. Colostrum samples were daily for 5 consecutive days following parturition. Calf growth rate was monitored weekly for 6 weeks after birth. IgG and IgM concentrations were quanti-

fied using immunodiffusion (RID) kits. The THI for summer or cool months were similar in both locations although temperatures and humidity differences were observed. Vaccinated animals had higher IgG and IgM in serum (2778mg/dl, 405mg/dl) and colostrum (1416mg/dl, 135mg/dl) vs. serum of controls (1636mg/dl, 160mg/dl) or colostrum of controls (705mg/dl, 69mg/dl) ($p<0.01$). Similar trends for IgG and IgM were reflected in the calves of the respective groups. No seasonal variations of IgG and IgM were observed in the vaccinated herd. For the vaccinated animals, the level of serum IgG increased from the first to the third lactation and tapered off by the 4th -6th lactation while the serum IgM for the 3rd or more lactations were higher than the first two lacations. No differences in IgG and IgM were found colostrum with respect to lactations. Calves in the none vaccinated herd gained 34kg in 42 days while the vaccinated calves gained only 11kg. ($p<0.01$). Calf performance within a herd was not affected by season. No calves were lost in the study. The findings suggested that beside immunoglobulins, other factors pertaining to good calf management are important for healthy growth rates.

Acknowledgements: The study is supported by UDSA Animal Health grant #HAW00258-A.

Key Words: IgG, IgM, Dairy Calves

W178 Vaginal and rumen temperature during the estrous cycle. A. Kennedy* and S. Mathew, *University of Manitoba*, *Winnipeg, MB, Canada*.

A pilot study was conducted to determine if rumen temperature can be used to predict estrus in dairy cows. Four rumen fistulated first-calf heifers that were 71 to 161 d post-partum were fitted with one temperature radiotransmitter in the vagina and one in the rumen. Temperatures were recorded at 4 min intervals for 72 days during which time the heifers were either synchronized using the Ovsynch method (cycles 1 and 3) or not synchronized (cycle 2). All heifers were bred by AI after the second synchronized cycle. Milk samples were collected 4 times weekly to track the CL regression which preceeds estrus. In total, 13 periods of CL regression were observed. Due to equipment failure, vaginal and rumen temperature values were available only for 8 and 7 periods of CL regression, respectively. Various prediction equations were tested to maximize efficiency and accuracy of estrus prediction using vaginal and rumen temperatures. A rise in vaginal temperature of at least 0.3C (true positive) was found during all 8 periods of CL regression studied and 5 of 7 periods of CL resgression were associate with a rise in rumen temperature. Mean rise in rumen temperature was 0.51C at estrus. A very high number of false positives were found for both vaginal (20)and rumen (26) temperatures. The results suggest that high variability in vaginal and rumen temperatures when heifers are not in heat may limit usefulness in estrous prediction.

Key Words: Estrus, Rumen, Temperature

W179 Variability of double ovulation during estrous cycles in lactating Holstein cows. R. Silcox*, J. Brinkerhoff, J. Milner, J. de Almeida, and K. Genho, *Brigham Young University*, *Provo,UT*.

We have previously characterized the incidence of double ovulation in lactating Holstein cows (22%) by making a single observation in a large number of animals within two herds. This study was designed to characterize the variability in the incidence of double ovulation within and between individual lactating cows within one high producing herd (>13,000 kg rolling herd average). The ovaries of 133 lactating cows calving between May-August were ultrasonically scanned weekly beginning 28 days postpartum and continuing until the cows became pregnant or left the herd. Number, size, and location of CL and of follicles greater than 10 mm in diameter or of the two largest follicles were recorded. Date of AI and pregnancy status were updated weekly. Body condition score and milk production were recorded monthly. Cow pregnancy status and number of fetuses present were determined 28-35 days after breeding. The ovaries of 117 cows were observed through 3 or more estrous cycles (mean number of cycles/cow=7.1; range 3-14 cycles). Two hundred-ninety of the 830 cycles observed were accompanied by double ovulation (35%) and 97/117 cows (83%) had at least one cycle with double ovulation. Four cows had double ovulation during every cycle observed. Lactation number affected the overall frequency of double ovulation ($P<.05$) with 1st lactation cows having fewer cycles with double ovulation than did 2nd or 3rd and greater lactation cows (24% versus 40% and 43%, respectively). There were 102 cows that became pregnant, of which 38 (37%) established pregnancy during cycles with double ovulation, 18 (18%) of which became pregnant with twins or triplets. Thus, establishment of pregnancy during cycles with double ovulation results in twins <50% of the time. We conclude that the incidence of double ovulation in lactating Holstein cows is variable within individual cows, some experiencing double ovulation frequently while others do so rarely, despite being exposed to similar environmental conditions.

Key Words: Double Ovulation, Lactation, Cattle

W180 Prevalence of mastitis pathogens in milk samples in Ragusa, Sicily from 2000 through 2004. J. D. Ferguson*[1], M. Gambina[2], G. Azzaro[2], and G. Licitra[2,3], [1]*University of Pennsylvania*, *Kennett Square*, [2]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [3]*D.A.C.P.A. University of Catania*, *Catania, Italy*.

Between Oct., 2000 and Nov., 2004 12814 milk samples (quarter or composite) from 2431 cows from 80 herds in Ragusa Province, Sicily were cultured by the milk microbiology laboratory at CoRFiLaC, Ragusa, Sicily. Milk sample collection and organism isolation followed procedures outlined by the Federation Internationale De Laiterie International Dairy Federation (FIL-IDF), Laboratory Methods for Use in Mastitis Work, Document 132. Major pathogens were classified as follows: *Streptococcus agalactiae*, environmental streptococci, *Staphylococcus aureus*, staphylococcal species, coliforms, and other organisms. Samples were considered contaminated if bacteria isolated were not a major mastitis pathogen or multiple organisms were cultured from one milk sample. Herds that submitted less than 10 milk samples (five herds) were deleted from the analysis of herd factors associated with prevalence of organism isolates. Herds were classified based on bedding type (none, straw, sawdust, sand) and housing type (bedded pack or free stalls) for lactating dairy cows. Production records from the Ragusa milk recording center were used to calculate mean somatic cell count and production for each herd on test. Herds were classed into five categories based on mean linear score (mls), (number of herds): Group 1 (6), mls<3.0; Group 2 (21), mls 3.0, 3.9; Group 3 (19), mls 4.0, 4.57; Group 4 (12), mls >4.58; Group 5 (18) mls not available as herds not on official test.

Prevalence of isolation for all samples was as follows: percent of herds with positive sample, percent of samples: no growth, 1.25%, 63.06%; *Streptococcus agalactiae*, 37.5%, 1.37%; environmental streptococci, 86.3%, 6.79%; *Staphylococcus aureus*, 87.5%, 15.33%; staphylococcal species, 82.5%, 14.02%; coliforms, 51.3%, 1.56%; and other organisms, 63.8%, 3.54%. The influences of season and herd factors such as housing and bedding, and mean somatic cell count were examined on prevalence of isolation of mastitis organisms.

Key Words: Mastitis, Microbiology, Dairy Cows

W181 The relevance of cows leaking milk in German dairy farms. M. Kollmann*, M. Rovai, and R. M. Bruckmaier, *Physiology Weihenstephan, Techn. Univ. Munich*, *Freising, Germany*.

The importance of milk leakage in dairy cows was studied in a survey in Bavaria, the south-eastern state in Germany. A questionnaire was sent to 56717 farms which was returned by 1116 farms representing approx. 35850 cows. The breeds are Simmental, Brown Swiss and Holstein- Friesian (73%, 7% and 3% of the farms, resp.). 26% of the farms kept < 20 cows, 60% 20-50 cows, 13% 50-100 cows and only 0.3% of farms had more than 100 cows. Milk yield in these groups had an average of 5750, 6600, 7150, and 7350 kg/y, resp., i.e. increased with herd size. Milk leakage occurred on 83% of all farms. The proportion of leaking cows varied from 1 - 50%. Leaking occurred in most farms shortly before milking (39%). However, 22% of farmers observed leaking already more than one h before milking. An influence of lactation number on milk leakage was denied by 47% of the farmers. Most other farmers (41%)

stated that leaking occurs mainly in older cows. An effect of lactation stage was obvious for most farmers. Most milk leakage was observed in the postpartum period by 66% of farmers, whereas in later stages leaking was observed in < 10% of farms. Milk leakage occurring mainly in cows with high milkability was stated by 76% of the farmers. Only some answered that leaking occurrs in cows with average (19%) and low (3%) milkability. 49% of farmers stated that milk leakage is a problem of high yielding cows mainly. A significant correlation ($p<0.01$) between herd milk yield the frequency of milk leakage could be calculated. The handling of leaking cows was different from not-leaking in 9% of the farms, mostly reflected in a shortening or omission of udder preparation before milking. The theory that milk leakage was a risk factor for mastitis was abandoned by 70% of the farmers. 87% of farmers did not acknowledge leaking as a risk factor for the health of the herd. In conclusion, milk leakage occurs frequently in dairy farms of all herd sizes. In most cases and in contrast with some scientific results, farmers do not consider milk leakage as an animal health problem.

Key Words: Milk Leakage, Survey, Dairy Cows

W182 Relationship of cow cleanliness during the close-up period and milk quality following calving. M. Chahine*[1], J. K. Reneau[2], R. J. Norell[3], J. C. Dalton[4], and J. M. Lukas[2], [1]*University of Idaho*, *Twin Falls*, [2]*University of Minnesota*, *St. Paul*, [3]*University of Idaho*, *Idaho Falls*, [4]*University of Idaho*, *Caldwell*.

The objective of the study was to determine the effect of cow cleanliness during the close-up period on milk quality following calving during the summer season. Seven open-lot commercial herds located in Southern Idaho were used in the study. A scoring system from 1 to 5 was selected. Score 1 indicates a cow that is absolutely clean while a score 5 indicates a very dirty cow. A total of 681 close-up cows were hygiene scored at least twice during the close-up period. Each cow was scored for cleanliness of udder (HU) and lower rear legs (HL). Udder and lower rear legs scores were averaged and a composite score was created (HUL). SCC data were obtained from DHI and converted to a linear score (LS). HU, HL, and HUL were correlated to SCC and LS using PROC CORR and regression analyses were conducted using PROC REG of SAS. SCC for the 681 cows on their first DHI test date following calving averaged 251 x 10^3 cells/ml. HU, HL, and HUL averaged 2.3 ± 0.02, 3.1 ± 0.01, and 2.7 ± 0.01, respectively. HU were significantly correlated to HL ($P < 0.001$, $R^2 = 0.57$). There were no significant correlations between SCC and the hygiene scores ($P > 0.05$). LS was significantly correlated to HU and HUL ($P < 0.03$) but not correlated with HL ($P > 0.05$). However, using a linear regression model in which HU and HUL were the explanatory variables and LS was the dependent variable resulted in a very low R^2 ($R^2 < 0.10$). Thus, the dependence of first SCC and LS following calving on hygiene scores during the close-up period in the high desert area of Southern Idaho is either absent or relatively small in cattle housed in open-lot facilities during the dry summer season.

Key Words: Milk Quality, Hygiene Scores, Cleanliness

Ruminant Nutrition: Feed Additives and Feedstuffs

W183 Tea saponins affect in vitro fermentation and methanogenesis in faunated and defaunated rumen fluid. W.-L. Hu*, Y.-M. Wu, J.-X. Liu, and Y.-Q. Guo, *Zhejiang University*, *Hangzhou, P. R. China*.

The effect of tea saponins (TS) on rumen fermentation and methane emission was examined using an in vitro gas production technique named Reading Pressure Technique. Three levels of TS addition (0, 0.2, 0.4mg/ml) were evaluated in the faunated and defaunated rumen fluid. Compared to the control, TS addition decreased the 24h gas production in the faunated rumen fluid, but had a minor effect on gas yield in the defaunated rumen fluid. The TS significantly reduced methane production in vitro. In the faunated rumen fluid, 0.2 or 0.4mg/ml TS decreased the 24h methane emission by 12.7% or 14.0%, respectively. Rumen fluid pH value was affected neither by TS addition nor by defaunation. The TS addition had only minor effects on volatile fatty acids, but the yield and pattern of volatile fatty acids were greatly affected by defaunation. While the molar proportion of acetate was not affected by defaunation, the propionate was significantly increased and the butyrate significantly decreased. Ammonia-N concentration and microbial protein yield were influenced by TS inclusion and defaunation. Inclusion of 0.4mg/ml TS increased the microbial protein mass by 18.4% and 13.8% and decreased the ammonia-N concentration by 8.3% and 19.6% in the faunated and defaunated rumen fluid, respectively. Protozoa counts were significantly reduced by TS inclusion. The current study demonstrated the beneficial effect of TS on methane production and rumen fermentation, and indicated that this may due to the effect of the associated depression on protozoa counts.

Acknowledgements: This work was supported in part by Co-ordinated Research Projects from Joint FAO/IAEA Division, IAEA (Contract No. 12665/R0).

Key Words: Tea Saponin, Ruminal Fermentation, Methane

W184 Feed intake, nutrient digestibility, milk production, and milk composition in cows fed cinnamaldehyde, yucca saponins extract, and condensed tannins. C. Benchaar*[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [3]*Laval University*, *Quebec, QC, Canada.*

Four lactating cows (BW=730 kg; DIM=87 d) were used in a 4x4 Latin square design (3 wk/period) to study the effects of no additive (CO), or cinnamaldehyde (CIN, 1g/d), yucca saponins extract (YUC, 60 g/d), and condensed tannins (CT, 150 g/d) addition on feed intake, nutrient digestibility, milk production, and milk composition. Cows were fed for *ad libitum* intake a TMR consisting of 40% of grass silage and 60% of concentrate (DM basis). Effects of treatments were determined (PROC MIXED, SAS) by orthogonal contrasts: CO vs. all additives, CIN vs. (CT+YUC) and CT vs. YUC. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. DMI was similar between CO and supplemented diets (22.9 kg/d), but was lower (- 1.7 kg/d) with YUC than with CT. Apparent DM (63.7%), OM (65.9%) and NDF (54.8%) digestibilities were similar between CO and supplemented diets. Digestibility of CP tended to be lower (58.2 vs. 61.2%) and that of ADF was reduced (45.3 vs. 49.9%) with CT than with YUC. Milk production (33.1 kg/d), 4%FCM (34.5 kg/d), BW change (0.73 kg/d), milk fat content (4.31%), and milk protein content (3.52%) remained unchanged between treatments. Lactose content tended to decrease with supplemented diets as compared with CO (4.44 vs. 4.52%), and tended to be lower for CT+YUC compared to CIN (4.42 vs. 4.45%). Milk urea nitrogen was similar between CO and supplemented diets (17.8 mg/dl) and tended to decrease with YUC compared to CT (16.3 vs. 18.3 mg/dl). Except for milk protein yield which tended to increase with CIN compared to CT+YUC (1.17 vs. 1.10 kg/d), yields of other milk components did not differ among treatments. This study suggests that the addition of CIN, CT and YUC has small effects on nutrient digestibility, milk production and milk composition in dairy cows. More investigation is needed to evaluate the potential of adding plant extracts compounds in dairy cow diets to improve feed efficiency.

Key Words: Plant Extracts, Digestion, Milk

W185 Effects of cinnamaldehyde, yucca saponins extract and condensed tannins on fermentation characteristics, and ciliate protozoal populations in the rumen of lactating dairy cows. C. Benchaar*[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, QC., Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB., Canada*, [3]*Laval University*, *Quebec, QC., Canada*.

Four ruminally cannulated lactating cows (BW=730 kg; DIM=87 d) were used in a 4x4 Latin square design (3 wk/period) to study the effects of no addition (CO), or the addition of cinnamaldehyde (CIN, 1g/d), yucca saponins extract (YUC, 60 g/d), and condensed tannins (CT, 150 g/d) on ruminal fermentation characteristics and ruminal ciliate protozoal populations. Cows were fed for *ad libitum* intake a TMR consisting of 40% of grass silage and 60% of concentrate (DM basis). Effects of treatments were determined (PROC MIXED, SAS) by orthogonal contrasts: CO vs. all additives, CIN vs. (CT+YUC) and CT vs. YUC. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. Ruminal pH was unaffected by treatments (6.67). Ruminal ammonia concentration tended to be lower with supplemented diets than with CO (142.4 vs. 159.5 mg/l). Total VFA concentration was unaffected by dietary supplements (134.5 *mM*). Molar proportions of acetate, propionate and butyrate were similar between CO and supplemented diets. However, acetate tended to be higher for CIN than for CT+YUC (65.2 vs. 64.9%). Compared to YUC, CT tended to reduce acetate (64.7 vs. 65.1%). Propionate was higher with CT+YUC than with CIN (19.8 vs. 19.2%). Butyrate was not changed by dietary treatments (11.2%). Acetate:propionate ratio was similar between CO and supplemented diets (3.33), but it was lower for CT+YUC compared to CIN (3.29 vs. 3.41). Total protozoa numbers were similar between CO and supplemented diets (7.0×10^5/ml), but tended to be lower with CT+YUC compared to CIN (6.3 vs. 8.6×10^5/ml). Treatments had no effect on the numbers of *Dasytricha*, *Diplodinium*, *Entodinium*, *Ophryoscolex*, and *Ostracodinium*. However, *Isotricha* numbers were reduced by CT+YUC compared to CIN (1.5 vs. 2.9×10^5/ml). This study suggests that plant extracts have small effects on ruminal fermentation characteristics and protozoa numbers. Further work is required to evaluate the potential of plant compounds to manipulate ruminal fermentation in dairy cows.

Key Words: Plant Extracts, Ruminal Fermentation, Protozoa

W186 Effects of cinnamaldehyde, yucca saponins extract and condensed tannins on ruminal in sacco degradation of soybean meal, grass silage, and corn in lactating dairy cows. C. Benchaar*[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, QC., Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB., Canada*, [3]*Laval University*, *Quebec, QC., Canada*.

Four ruminally cannulated lactating cows were used in a 4x4 Latin square design to study the effects of no additive (CO), or cinnamaldehyde (CIN, 1g/d), yucca saponins extract (YUC, 60 g/d), and condensed tannins (CT, 150 g/d) addition on ruminal in sacco degradation of soybean meal, grass silage and corn. Cows were fed for *ad libitum* intake a TMR consisting of 40% of grass silage and 60% of concentrate (DM basis). Effects of treatments were tested (PROC MIXED, SAS) by orthogonal contrasts: CO vs. all additives, CIN vs. (CT+YUC) and CT vs. YUC. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. For soybean meal, the rapidly degradable fraction (a) of CP tended to increase for supplemented diets compared to CO (13.7 vs. 11.1%). The slowly degradable fraction (b) and the degradation rate (c) were not different among treatments (88.9% and 7.87%/h, respectively). However, the lag time (L) was higher with the plant extracts compared to CO (3.0 vs. 1.2 h). The effective degradability (ED) of CP tended to be lower with supplemented diets than with CO (54.3 vs. 57.7%). For grass silage, ADF degradation kinetics were similar among treatments. The NDF fraction (a) was similar between CO and supplemented diets (2.1%), but tended to be lower with YUC than with CT (1.37 vs. 2.75%). The fraction (b) of NDF tended to decrease with plant extracts (76.4 vs. 83.6%). The NDF degradation rate was similar between treatments (2.9%/h). (L) was not different between CO and supplemented diets, but tended to be lower with YUC compared to CT (0.82 vs. 3.1 h). The ED of NDF was similar among treatments (31.8%). For corn DM degradation, (a) (b) and (c) were not changed by treatments. (L) tended to be lower with CT than with YUC (0.11 vs. 2.0 h). The ED tended to be lower with supplemented diets than with CO (58.9 vs. 60.6%) and with CT compared to YUC (57.8 vs. 60.2%). This study suggests that feeding cows with plant extracts modifies ruminal degradabilities of soybean meal CP and corn DM. The effect on grass silage NDF degradability is however small.

Key Words: Plant Extracts, Ruminal In Sacco Degradation, Feed Components

W187 Ruminal degradation kinetics of corn silage with different additives. P. A. Katsuki[1], E. S. Pereira[2], B. M. O. Ramos[1], F. B. Moreira[1], E. L. A. Ribeiro[1], M. A. Rocha[1], A. P. Pinto[1], V. R. Loyola[1], R. Salmazo[1], T. R. Casimiro[1], T. C. Alves[1], and I. Y. Mizubuti*[1], [1]*Universidade Estadual de Londrina*, *Londrina, Paraná, Brazil*, [2]*Universidade Estadual do Oeste do Paraná*, *Marechal Cândido Rondon, Paraná, Brazil*.

Dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF) degradabilities of corn silage were evaluated in a 4x4 Latin square assay (four Holstein males and four incubation periods) in ruminal ambient adapted or not with different feed additives. The products containing additives were innoculated daily, directly in the rumen through ruminal cannula, as indicated by the manufacturers. The following treatments were used: corn silage without additive inoculation (CCS); corn silage inoculated with five grams of dehydrated and lyophilized ruminal and intestinal bacteria (SLB); corn silage inoculated with 15 g of cellulolytic enzymes (SCE); and corn silage inoculated with three mg of sodium monensin (SSM). The treatments SLB and SCE did not affect the potentially degradable fraction (b) of corn silage nutrients. The sodium monensin reduced the fraction b of DM and OM, with mean adjust values of DM fraction b of (%): 54.64, 55.92, 56.31 and 51.01 and OM fraction b of: 56.85, 57.81, 58.41 and 53.17 for CCS, SLB, SCE and SSM, respectively ($P<0.05$). The sodium monensin also reduced the DM and OM potential degradabilities, with mean adjust values of DM potential degradability of (%): 76.06, 76.87, 77.57 and 72.33 and OM potential degradability of: 76.89, 77.45, 78.27 and 73.13 for CCS, SLB, SCE and SSM, respectively ($P<0.05$). Among all the additives studied, the sodium monensin provided the largest NDF indigestible fraction, with respective treatments averaging (%): 36.16, 29.46, 33.17 and 45.57, and the largest ADF indigestible fraction, 38.29, 28.37, 34.74 and 47.88 ($P<0.05$), reducing the disappearance of these fractions after 48 h of intra-ruminal incubation. It was concluded that the different feed additives did not improve the DM, OM, CP, NDF and ADF effective degradabilities of corn silage.

Acknowledgements: The work was partially funded by CNPq.

Key Words: Cellulolytic Bacteria, Lyophilized Bacteria, Sodium Monensin

W188 Effects of adding polyethylene glycol 4000 or urea to high tannin high moisture sorghum grain on ruminal degradation in beef cattle. M. D. Montiel*[1,2], J. C. Elizalde[1,2], L. Giorda[3], and F. Santini[1,2], [1]*CONICET*, *Argentina*, [2]*Fac. Cs. Agrarias UNMdP-INTA Balcarce*, *Argentina*, [3]*EEA INTA Manfredi*, *Argentina*.

We studied the use of polyethylene glycol 4000 (PEG) or urea (U) to reduce the anti-nutritional effects of tannins in a high moisture sorghum grain. Ruminal dry matter (DM), crude protein (CP) and starch (ST) in situ degradability of high moisture sorghum grain treated with different doses of PEG or U, incubated during 0, 16 and 33 hours, were evaluated in three ruminally cannulated heifers. Sorghum grain, DA 49 hybrid with high tannin content, was harvested with 35 or 25% moisture content and treated with different levels of PEG (0, 0.1 and 1 g PEG/g CP) or U (0, 2 and 4% U based DM), and conserved under anaerobic conditions in PVC microsiles. In situ DM and ST degradability were higher ($P<0.05$) in sorghum treated with PEG than U (38.8 vs 32.3% and 40.4 vs 33.8% for DM and ST, respectively). However, U had higher ($P<0.05$) CP ruminal degradability than PEG (32.9 vs 28%, respectively). Interaction moisture*level(PEG or U) for DM, CP and ST degradability was significant ($P<0.05$). When grain was harvested with 25% moisture there were not responses ($P>0.05$) to treatment with either PEG or U on DM and ST degradability. However, CP ruminal degradability was higher ($P<0.05$) with 1 or 4%U (22.2 and

48.2%, respectively) than 0 g PEG or 0%U (14.1% and 15%, respectively). Sorghum harvested with 35% of moisture and treated with 1 g PEG-4000 showed highest ruminal DM, CP and ST degradability, and increased digestion 52, 61 and 27% higher respect to 0 g PEG for DM, CP and ST, respectively. Treatment with 2%U presented higher DM, CP and ST ruminal degradability respect to 0%U, and the improvements were 26, 31 and 20%, respectively. Treatments of high-moisture sorghum grain with PEG-4000 or U were effective to reduce the anti-nutritional effects of tannins, but the improvement was affected by moisture at harvest and PEG and U levels.

Key Words: High Moisture Sorghum, Tannin, Polyethylene Glycol and Urea

W189 Fermentation and fatty acid biohydrogenation in continuous cultures fed soybean meal with and without added lecithin. C. M. Thompson*[1], S. J. Freeman[1], P. W. Jardon[2], and T. C. Jenkins[1], [1]*Clemson University*, *Clemson, SC*, [2]*West Central Soy*, *Ralston, IA*.

Despite earlier findings that phospholipids are extensively degraded by ruminal microorganisms, some recent reports have indicated possible resistance of soybean phosphatides to microbial degradation. As a result, soybean lecithin might serve to enhance the flow of unsaturated fatty acids and choline to the intestines of dairy cattle. This study was designed to determine if outflow of unsaturated fatty acids from continuous cultures of mixed ruminal microorganisms increased following the addition of lecithin. Two blended diets of alfalfa pellets and concentrate (1:1) contained either soybean meal alone (control diet) or soybean meal with lecithin-containing gums (lecithin diet). Each diet was fed to four dual flow continuous fermenters maintained for 10 d at 0.10 h^{-1} liquid dilution rate and average pH 6.1. Culture samples from d 10 were analyzed for pH and volatile fatty acids. Samples of outflow were taken daily over d 8, 9, and 10 of each period, composited, freeze-dried and then analyzed for fatty acids and NDF. Fatty acid outflows for the control and lecithin diets did not differ and averaged 228 and 216 (SEM = 17) mg/d for oleic acid, 182 and 164 (SEM = 23) mg/d for linoleic acid, and 28 and 26 (SEM = 2) mg/d for linolenic acid, respectively. Biohydrogenation (fatty acid lost as a percentage of fatty acid intake) was not affected by diet for any unsaturated fatty acid. Total VFA concentration (148 and 127 mol/100 mol, SEM = 13), acetate to propionate ratio (1.68 and 1.66, SEM = 0.14), and digestibilities of NDF (34.9 and 37.7, SEM = 3.7) also were the same for the control and lecithin diets, respectively. The results of this continuous culture study suggest no advantage on either fermentation or on fatty acid biohydrogenation from adding lecithin-containing gums to soybean meal.

Key Words: Continuous Culture Fermentation, Biohydrogenation, Lecithin

W190 Effects of eugenol and thymol on rumen microbial fermentation in continuous culture. L. Castillejos, S. Calsamiglia*, and A. Ferret, *Universitat Autonoma de Barcelona*, *Bellaterra, Spain*.

Eight dual flow continuous culture fermenters (1320 mL) were used in 3 periods (6 d of adaptation and 3 d of sampling) to study the effects of thymol and eugenol on rumen microbial fermentation and nutrient flow. Fermenters were fed 95 g/d of DM of a 60:40 forage:concentrate diet (18% CP; 30% NDF). Treatments were: control (CTR), thymol at 5 mg/L (T5), 50 mg/L (T50) and 500 mg/L (T500), eugenol at 5 mg/L (E5), 50 mg/L (E50) and 500 mg/L (E500), and monensin at 10 mg/L (MON), and were randomly assigned to fermenters within periods. During the last 3 days of each period, samples were taken at 0, 2, 4 and 6 h after the morning feeding and analyzed for peptide, AA and ammonia N concentrations, and total and individual VFA concentrations. Differences were declared at $P < 0.05$. Monensin and T500 reduced DM, OM, NDF and ADF digestion. The T500 and E500 reduced total VFA concentration. Monensin, T500, and E500 reduced the proportion of acetate, branch-chained VFA concentration and acetate to propionate ratio, and increased the proportion of propionate, and T500 and E500 also increased the proportion of butyrate. However, T500 reduced the proportion of valerate and E500 increased it. The T5 tended to reduce the proportion of acetate and increased the proportion of butyrate without affecting total VFA concentration and nutrient fermentation. The concentration of peptide N was higher in T5, T500 and E500, suggesting that proteolysis was stimulated or peptidolysis was inhibited. The concentration of AA N was higher in T500. The accumulation of AA N suggests that proteolysis and peptidolysis were stimulated for T500. The concentration of ammonia N tended to be higher in MON. Eugenol and thymol demonstrated their antimicrobial activity decreasing total VFA concentration and modifying fermentation profile, MON modified fermentation profile but inhibited nutrient fermentation, and T5 modified the fermentation profile without decreasing total VFA concentration and nutrient fermentation.

Key Words: Thymol, Eugenol, Rumen Fermentation

W191 Effects of different dose levels of essential oils compounds on in vitro methane production by mixed ruminal bacteria. J. Chiquette* and C. Benchaar, *Dairy and Swine Res. & Dev. Centre*, *Lennoxville, Quebec, Canada*.

The objective of this study was to examine the effects of essential oils compounds on in vitro methane (CH_4) production by mixed ruminal bacteria isolated from a fistulated cow fed a diet consisting of 50% forage 50% concentrate. Mixed bacteria were incubated anaerobically in serum bottles (40 ml of incubation fluid) containing 0.4 g of ground (1mm) substrate (50% forage, 50% concentrate). Several dilutions of the following constituents of essential oils: thymol, carvacrol and eugenol were prepared as anaerobic solutions and added to the triplicate culture tubes. Monensin (5 ppm) was used as a positive control for the reduction of CH_4 concentration. The incubations were repeated on three consecutive weeks. Following 24 h incubation, total gas production was measured as well as methane and CO_2 concentration. The incubation milieu was sampled for VFA analysis and pH measurement. Data were analyzed using PROC MIXED of SAS. Significance was declared at $P \leq 0.05$. Compared to the control, monensin decreased CH_4 concentration (-37%), total gas production (-11%) and slightly increased pH (5.85 vs 5.71) and CO_2 concentration (18.95 vs 18.30 mM). Acetate was decreased (- 20%) and propionate was increased (+45%) with monensin compared to the control. Up to 260 ppm of thymol, 225 ppm of carvacrol and 500 ppm of eugenol, CH_4 concentration was not different from that of the control. At concentration ranging from 280 to 300 ppm of thymol, 500 to 600 ppm of eugenol and 225 to 250 ppm of carvacrol, CH_4 concentration was similar to that obtained with monensin. At those levels of essential oils, CH_4 was decreased by 46%, 42% and 23% and total gas production was decreased by 29%, 22% and 12%, with carvacrol, eugenol and thymol, respectively, compared to the control. Similarly to the effect of monensin, pH and CO_2 concentration were also increased with the addition of essential oils after 24 h incubation, compared to the control.

Acknowledgements: F. Markwell and C. Roy for technical assistance

Key Words: Essential Oils, Methane, In Vitro Incubations

W192 The effects of adverse environmental conditions on controlled-release property of Optigen® 1200. V. Akay*, *Alltech, Inc.*, *Nicholasville, KY.*

Optigen® 1200 (Alltech, Inc., Nicholasville, KY) is a polymer coated controlled-release non-protein nitrogen source for ruminants. Feedstuffs are exposed to adverse environmental conditions during the time between production and consumption. Therefore, a series of experiments were conducted to evaluate the effects of adverse environmental conditions on the controlled-release property of Optigen® 1200. The adverse environmental conditions were: 1) elevated temperature (room temperature vs. 50°C for 7 d); 2) exposure to sunlight (no sunlight vs. exposure to sunlight for 14 d from May 4 to 18, 2004; 3) freeze-thaw cycles (no freeze-thaw cycles vs. 3 times freeze-thaw cycles); and 4) mechanical degradation (tumbled 0, 5, 10, 15 and 20 min in a rock tumbler). After exposure of Optigen® 1200 to adverse environmental conditions, 20 g of Optigen® 1200 was placed into a 125 ml Erlenmeyer flask containing 100 ml distilled water at 39.4°C. The flask was then capped, swirled 3 times and placed into a 39.4°C water bath. The flask was swirled 3 times at the end of 3 h of incuba-

tion, and nitrogen content of the water was measured by Kjeldahl method. Treatments were run in triplicate and data were analyzed as a completely randomized design using GLM procedure of SAS. Exposure of Optigen® 1200 to elevated temperature, sunlight, freeze-thaw cycle, and mechanical degradation had no effect ($P > 0.05$) on the controlled-release property of Optigen® 1200. For elevated temperature, nitrogen content of water was 3.847 and 3.530 g/dl for control and treated Optigen® 1200, respectively. Nitrogen content of water was 3.264 and 3.511 g/dl for control and sunlight exposed Optigen® 1200, respectively. Exposure of Optigen® 1200 to freeze-thaw cycles resulted in 3.656 g/dl nitrogen in water compared to 3.660 g/dl nitrogen in water for control. Nitrogen content of water was 3.432, 3.749, 3.642, 3.796 and 3.908 g/dl for Optigen® 1200 tumbled 0, 5, 10, 15 and 20 min, respectively. These results indicate that polymer coating on Optigen® 1200 is strong and controlled-release property of Optigen® 1200 was not affected under present treatment conditions.

Key Words: Optigen® 1200, Controlled-Release Nitrogen, Kjeldahl

W193 The effect of a fibrolytic enzyme mixture on the performance of lactating dairy cows and digestibility of the total mixed ration. R. S. Teller*[1], R. J. Scmidt[1], C. N. Mulrooney[1], B. M. Moulder[1], J. St. Amand[1], L. Kung, Jr.[1], W. Steinberg[2], and I. Immig[2], [1]*University of Delaware*, *Newark*, [2]*DSM Nutritional Products Ltd.*, *Basel, Switzerland*.

We examined the effects of a mixture of fibrolytic enzymes (Roxazyme G2, DSM Nutritional Products, Ltd.), applied to a total mixed ration (TMR), on the performance of lactating dairy cows and the digestibility of the TMR. Sixteen multiparous and 10 primiparous Holstein cows averaging about 40 kg of milk/d and 93 ± 45 d in milk (DIM) were fed a TMR comprised of 50% concentrate, 30% corn silage, 10% alfalfa haylage, and 10% alfalfa hay on a DM basis. Cows were fed to obtain a 5% daily refusal and housed in a research barn with freestalls and Calan gates. After a 3-wk pretreatment period, cows were blocked by milk production, dry matter intake (DMI), DIM, parity, and body weight, before being randomly assigned to one of two treatments. The study was designed as a cross over experiment with two 7-wk periods. The TMR was treated while mixing with either 1) no enzyme or 2) Roxazyme G2 (hemicellulase, cellulose, and beta-glucanase) prepared fresh with water and sprayed daily onto the TMR at an enzyme inclusion rate of 4 ml/ kg DM. A similar amount of water was applied to the control TMR. Milk production, 3.5 % milk production, milk fat (% and yield), milk protein (% and yield), SCC and MUN were not affected by treatment. There was a trend ($P < 0.07$) for an increase in DMI for the cows fed the treated TMR. Body weight change was greater ($P < 0.05$) for cows fed the treated than untreated TMR (0.71 vs. 0.32 kg/d). After period 2, eight of the highest producing cows from each treatment remained on study for an additional 10 d to determine apparent nutrient digestibility via fecal collections and the use of indigestible NDF as a marker. There were no differences in digestibility of DM, OM, NDF, ADF, or starch between treatments. However, there was an increase ($P < 0.05$) in digestibility of CP for the TMR treated with enzymes (61.9 vs. 56.7 %). Treating a TMR with fibrolytic enzymes has the potential to improve animal performance.

Key Words: Fibrolytic Enzymes, Digestibility

W194 Identifying exogenous enzyme candidates that enhance degradation of alfalfa hay in vitro. J.-S. Eun*[1], K. A. Beauchemin[1], H.-E. Yang[2], and H. Schulze[3], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [2]*Korea University*, *Seoul, Korea*, [3]*Genencor International B. V.*, *Leiden, The Netherlands*.

Use of exogenous enzymes can significantly improve fiber digestibility of forages, but not all products are effective. The objective of this study was to identify enzyme candidates that improve fiber degradation. Commercial enzyme products (18) containing primarily endoglucanases and hemicellulases were investigated for their effects on in vitro gas production (GP) and degradability of alfalfa hay. Fresh, milled alfalfa hay (0. 5 g DM) was weighed into small bags. A low or high level of each enzyme product was added to the alfalfa hay (0.75 or 1.5 µL/g DM substrate, respectively). The bags were heat-sealed and placed in gas-tight serum culture vials. Strained ruminal fluid obtained from two cannulated lactating dairy cows was dispensed (5 mL per vial) into the vials. Headspace GP was measured during 18 h of incubation, whereas degradability of DM and fiber was sequentially measured after terminating the incubation at 18 h. At the high dose level, all except two products increased GP ($P < 0.05$) throughout fermentation, whereas four products improved DM degradability ($P < 0.05$). The highest response in DM degradability was an 11.3% improvement. In that case, the enzyme product also increased degradability of NDF ($P < 0.001$) by 20%, but ADF degradability was not affected, suggesting that this product mostly improved hemicellulose degradability. Meanwhile, at the low dose level, only two enzyme products increased GP ($P < 0.05$), but no products affected degradability of DM or fiber, suggesting that the low dose level was insufficient to improve in vitro degradation of alfalfa hay. This study indicates that some fibrolytic enzyme products effectively increase the degradation of alfalfa hay. The focus of our current research is to identify the key enzyme activities and doses needed to improve degradability of various forages in order to improve forage utilization by ruminants.

Key Words: Exogenous Enzymes, Alfalfa Hay, In Vitro Degradation

W195 Application of carbohydrase inhibitors to moderate rumen fermentation: In vitro evaluation. S. M. Speight* and D. L. Harmon, *University of Kentucky*, *Lexington*.

While carbohydrase inhibitors have been widely investigated for regulating human carbohydrate assimilation, their application to animal nutrition has been ignored. Four experiments were conducted to determine how commercially available α-amylase and α-glucosidase inhibitors affect rumen fermentation. *In vitro* incubations were conducted in 50-mL test tubes containing an inhibitor, 0.5 g ground corn, and 40-mL buffered rumen fluid inoculum. Rumen fluid donors were fed a 100% forage diet in Exp 1 and a 50:50 concentrate:forage diet in Exp 2-4. Incubations were conducted in duplicate at 37°C and replicated on consecutive days with pH and VFA concentrations measured at 1.5, 3, 4.5, 6, 9, 12, 18, and 24 h. Treatments for Exp 1 and 2 were: no additive (CON); 12.5-37.5 mg acarbose (ACB), miglitol (MIG), or glipizide (GLI); 12.5-75 mg trestatin (TRE); and 25-100 mg Alpha-Trim W® (ATW), CarboTame® (CT), starch blocker (SB), or wheat amylase inhibitor (RWI). ACB and TRE increased ($P = 0.02$) pH and decreased ($P \leq 0.06$) acetate, butyrate, propionate, and total VFA in Exp 1 and 2 in a non-dose-dependent manner. The remaining six treatments (MIG, GLI, CT, ATW, RWI, and SB) failed to affect pH and VFA concentrations. ACB and TRE doses were decreased to 1.2-9.5 mg and MIG and GLI doses were increased to 50-200 mg in Exp 3. ACB increased ($P = 0.01$) pH and decreased ($P \leq 0.04$) acetate, propionate, butyrate, and total VFA concentrations dose-dependently. GLI decreased ($P < 0.001$) pH and increased ($P \leq 0.03$) VFA concentrations beyond CON. MIG again failed to have any effect on pH or VFA. TRE increased ($P < 0.001$) pH and decreased ($P < 0.001$) VFA concentrations in a non-dose-dependent manner. Decreasing TRE doses to 0.1-1.1 mg in Exp 4 increased ($P < 0.001$) pH and decreased ($P < 0.001$) VFA concentrations in a dose-dependent manner. Although these data suggest that trestatin is ten times more potent than acarbose, both inhibitors have the potential to slow fermentation, and could help prevent rumen acidosis in addition to resulting in greater amounts of starch reaching the small intestine where its assimilation is more efficient.

Key Words: Carbohydrase Inhibitors, Rumen Fermentation Modulators, In Vitro

W196 Fibrolytic enzyme and diets for cattle and sheep I. *In virto* disappearance of dry matter and fiber. R. Moreno-Jaramillo[1], S. González*[2], J. Pinos-Rodríguez[3], G. Mendoza-Martínez[2], R. Bárcena-Gama[2], J. Herrera-Haro[2], and L. Miranda-Romero[4], [1]*Universidad Autónoma Gabriel René Moreno de Santa Cruz de la Sierra*, *Santa Cruz de la Sierra, Santa Cruz, Bolivia*, [2]*Colegio de Postgraduados*, *Montecillo, Estado de México, México*, [3]*Universidad Autónoma de San Luis Potosí*, *San Luis Potosí, México*, [4]*Universidad Autónoma Chapingo*, *Texcoco, Estado de México, México*.

To determine the effect of an exogenous fibrolytic enzyme (Fibrozyme; enzyme) on *in vitro* disappearance of dry matter (IVDMD) and neutral detergent fiber

(IVNDFD), diets (40, 50, 60% concentrate), each with or without enzyme, were incubated at 3, 6, 12, 24, 48 and 72 h (two runs; first phase of Tilley and Terry). A randomized block design with a factorial arrangement of treatments (3 x 2 x 6) was utilized; data was analyzed with SAS and means were compared with Tukey. The IVDMD in diets with 40 and 50% grain was not different ($P \geq 0.05$), but they were lower than that with 60% concentrate ($P \leq 0.05$). The IVNDFD was larger for the diet with 50% grain ($P \leq 0.05$), without differences between 40 and 60% concentrate diets ($P \geq 0.05$). The addition of the enzyme to the diets increased IVDMD and IVNDFD ($P \leq 0.05$). The IVDMD and IVNDFD were directly proportional to incubation time ($P \leq 0.05$). Within each diet (with or without enzyme) for equivalent times, the enzyme increased IVDMD and IVNDFD ($P \leq 0.05$), with a larger disappearance in the first 12 h. The interaction between diets x time, and enzyme x time affected IVDMD ($P \leq 0.01$). Besides, the interaction between diets x enzyme ($P \leq 0.05$) and between enzyme x time ($P \leq 0.01$) affected in vitro disappearance of NDF. It may be concluded that Fibrozyme increased *in vitro* NDF disappearance for diets with a higher fiber content.

Key Words: Fibrolytic Enzyme, *In vitro* Digestibility, Dry Matter and Fiber

W197 Fibrolytic enzyme and diets for cattle and sheep II. *In virto* disappearance of dry matter and neutral detergent fiber. R. Moreno-Jaramillo[1], S. González*[2], J. Pinos-Rodríguez[3], G. Mendoza-Martínez[2], R. Bárcena-Gama[2], J. Herrera-Haro[2], and L. Miranda-Romero[4], [1]*Universidad Autónoma Gabriel René Moreno de Santa Cruz de la Sierra*, *Santa Cruz de la Sierra, Santa Cruz, Bolivia*, [2]*Colegio de Postgraduados*, *Montecillo, Estado de Máxico, Máxico*, [3]*Universidad Autónoma de San Luis Potosí*, *San Luis Potosí, Máxico*, [4]*Universidad Autónoma Chapingo*, *Texcoco, Estado de Máxico, Máxico*.

With the objective of determining *in situ* dry matter (ISDMD) and neutral detergent fiber (ISNDFD) disappearance for diets with an exogenous fibrolytic enzyme (Fibrozyme; enzyme), six Rambouillet lambs (58 7.4 kg BW) with ruminal cannula were utilized. There were six treatments: three diets (40, 50, 60% concentrate), each with or without enzyme; diets were incubated at 3, 6, 12, 24, 48 and 72 h. A Cross-Over design with a factorial arrangement of treatments (3 x 2) was used; data analysis was done with PROC MIXED for repeated measurements, and means were compared using Tukey and Least Significant Difference. Concentrate level did not affect ISDMD ($P \geq 0.05$), but *in situ* disappearance of NDF decreased when grain was increased in the diet ($P \leq 0.05$). The enzyme increased ISDMD and ISNDFD ($P \leq 0.05$), and values for these variables were larger at 72 h. Within each diet (with or without enzyme), for equivalent times, the enzyme increased ISDMD and ISNDFD ($P \leq 0.05$), with a larger disappearance in the first 24 h. The interactions between diets x time (ISDMD), and enzyme x time (ISDMD; ISNDFD) were significant ($P \leq 0.05$). According to these results, Fibrozyme increased *in situ* disappearance of DM and NDF mainly in the first 24 h of incubation.

Key Words: Fibrolytic Enzyme, *In situ* Disappearance, Dry Matter and Fiber

W198 Effects of fibrolytic enzymes and soybean oil on dairy sheep performance and nutrient digestibility. M. A. Bouattour, R. Casals*, E. Albanell, E. Gonzáez, X. Such, and G. Caja, *Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*.

Two experiments were conducted with the aim of studying the effects of a fibrolytic enzyme complex (**E**) and soybean oil (**SBO**) on lactational performance and digestibility in dairy sheep. In Exp. 1, 24 Lacaune (**LC**) and 24 Manchega (**MN**) ewes (49 DIM) were blocked in 4 pens of 6 ewes per breed, and used in a replicated 4 × 4 Latin square for periods of 20 d. Dietary treatments were: 1) C (control); 2) SBO (2.8% of TMR on DM basis); 3) E (Promote, 2 ml/kg TMR on DM basis); and, 4) SBO plus E. Total mixed rations consisted of 60% forage (alfalfa and fescue dehydrated mixture, 1:1) and 40% concentrate. Diets were isonitrogenous (16.2% CP), but ether extract varied from 2.3 to 3.7% according to SBO addition. Breed responses to treatments were similar despite the differences between breeds (LC vs. MN; $P < 0.001$): DMI (3.06 vs. 2.43 kg/d), milk yield (2.07 vs. 1.08 L/d), and fat (5.60 vs. 6.63%) and casein (3.70 vs. 4.13%) milk contents. Feed intake (2.74 kg DM/d) did not vary between treatments. Addition of SBO increased milk and milk fat yields (6.2 and 5.3%, respectively; $P < 0.05$), and long chain fatty acids (38%; $P < 0.001$), but decreased ($P < 0.001$) milk protein, CN, and medium and short chain fatty acids. Increases in C18:1, C18:2 and CLA were 56, 22 and 300% ($P < 0.05$), respectively. Addition of enzymes increased milk and true protein yields (6.1 and 4.2%, respectively; $P < 0.05$), but decreased ($P < 0.05$) fat, total and true protein, and CN milk contents. In Exp. 2, the digestibility of the diets used in Exp. 1 was measured in 8 dry and open MN ewes in randomized block design (two periods of 20 d). When used alone, SBO increased ether extract digestibility ($P < 0.001$) but did not vary DM (64.4%), OM (67.9%) and NDF (53.6%) digestibilities. Moreover, the E treatment increased ($P < 0.05$) DM (8%), OM (7%) and NDF (12%) digestibilities. With regard to the SBO plus E treatment, SBO decreased ($P < 0.05$) DM (8%), OM (9%) and NDF (14%) digestibilities, and E complex was unable to recover the control values. Surface effects of soybean oil may have been responsible for the decrease of enzyme activity.

Acknowledgements: CICYT Spain (Project AGL2001-2617)

Key Words: Fibrolytic Enzymes, Soybean Oil, Dairy Sheep

W199 Effect of exogenous polysaccharide-degrading enzyme preparations on ruminal fermentation and total tract digestibility of nutrients in lactating dairy cows. A. N. Hristov*[1], C. E. Basel[1], A. Melgar[1], A. E. Foley[1], J. K. Ropp[1], C. W. Hunt[1], and J. M. Tricarico[2], [1]*University of Idaho*, *Moscow*, [2]*Alltech, Biotechnology Center*, *Nicholasville, Kentucky*.

The objective of this study was to evaluate the effect of three exogenous polysaccharide-degrading enzyme preparations (EPDE) on ruminal fermentation and total tract apparent digestion of nutrients in lactating dairy cows. Four late-lactation, ruminally cannulated Holstein cows were allocated to dietary treatments in a 4 × 4 Latin square design. The basal diet fed to the cows contained 40% alfalfa and grass hays, 44% corn and barley grains, 8% whole cottonseed, and 8% protein and mineral/vitamin supplements. The EPDE preparations, a blank, a predominantly amylase, a predominantly xylanase, and an amylase/xylanase combination were dosed into the rumen through the cannula daily, during the morning feeding (0600) at 10 g/cow. Treatments did not affect ruminal pH ($P = 0.97$), ammonia concentration ($P = 0.96$), protozoal counts ($P = 0.97$), total and individual VFA concentration ($P = 0.42$ to 0.99), acetate:propionate ratio ($P = 0.57$), and solid ruminal digesta passage rate ($P = 0.35$). Carboxymethylcellulase, xylanase, and amylase activities of whole ruminal contents at 2, 4, and 6 h following EPDE dosing were also not affected ($P = 0.20$ to 0.99) by the treatments. Intake of DM and nutrients and total tract apparent digestibility of starch, NDF, and ADF did not differ ($P = 0.24$ to 0.28) among treatments. Digestibilities of DM, OM, and N were reduced ($P = 0.06$ to 0.07) by the amylase/xylanase combination compared with the amylase or xylanase EPDE. Given the conditions of this experiment, EPDE dosed intraruminally at 10 g/head/d did not affect ruminal fermentation, did not increase the polysaccharide-degrading activities of ruminal contents, and did not affect total tract apparent digestion of nutrients compared to the control.

Key Words: Dairy Cow, Exogenous Enzyme, Digestion

W200 The effects of supplemental yeast culture fed during the periparturient period: Implications of milk production and feed intake of high producing dairy cows. R. Vogel*[1], J. N. Spain[1], and I. Yoon[2], [1]*University of Missouri*, *Columbia*, [2]*Diamond V Mills*, *Cedar Rapids, IA*.

Objective of this study was to determine the effect of yeast culture fed during late gestation and early lactation on dry matter intake and milk production of Holsteins. Mature cows (n = 36) and heifers (n = 33) were grouped by expected calving date, parity, milk production potential (mature cows only) and body weight. Animals were then randomly assigned within block to treatment. Dietary treatments were control (C), Diamond V yeast culture (XP), and Diamond V XP concentrate, designed to deliver the same effect of XP at 25% feeding rate

(XPC). Yeast cultures XP and XPC were fed at 56 g and 14 g/d, respectively, and added as part of the vitamin/mineral pre-mix. Cows were housed in a freestall barn except at calving when animals were housed in a calving pen. Cows were fed experimental diets twice daily for ad libitum consumption via electronic feeding gates (American Calan) with feed intake measured daily. Prepartum treatment diets began 21 d prior to expected day of calving. At calving, cows were fed standard lactation TMR which was formulated based on NRC 2001 recommendations for the first 10.5 wk of lactation. Cows were milked twice daily. Milk samples were collected at two consecutive milkings and analyzed for fat, true protein, MUN, and SCC. Blood samples were collected on day -10, -3, -1 and day of calving. Postpartum blood samples were collected on d 1, 3, 7, 10 and 14 of lactation then twice weekly until d 75. Blood samples were analyzed for plasma NEFA and glucose. Body weight and condition scores were collected twice weekly. Data were analyzed using mixed model ANOVA. DMI did not differ prepartum or after calving. Milk production was greater for cows fed XP and XPC compared to C (32.6, 32.3 vs. 28.2 kg FCM; P = 0.08). Inclusion of yeast culture increased milk yield without changing dry matter intake when fed to Holstein cows beginning 3 wk prior to calving through 75 d of lactation.

Key Words: Yeast Culture, Periparturient Cows, Milk Yield

W201 Effect of feeding a Saccharomyces Cerevisiae yeast culture on reproduction, body condition score (BCS) and lameness in dairy cows under heat stress. R. G. S. Bruno*, H. M. Rutigliano, R. L. A. Cerri, P. H. Robinson, and J. E. P. Santos, *University of California*, *Tulare*.

Multiparous Holstein cows, 723, from two dairy farms were blocked at calving by parity and previous lactation milk yield and, within each block, randomly assigned to one of two treatments: a diet containing no yeast (Control; n = 361) or 30g/d of Saccharomyces cerevisiae (Amax Extra, ViCor, IA: Yeast; n = 362) from 20 to 140 d in milk (DIM). The study was conducted from May to December of 2004 and cows calving during May to August were enrolled. Lameness score (1 to 5 scale) was evaluated at study enrollment and again at 100 d postpartum. The BCS (1 to 5 scale) was evaluated at calving, 28, 58 and 140 DIM. Cows received 2 injections of PGF2a at 37±3 and 51±3 DIM, and those observed in estrus were inseminated. Cows not in estrus were enrolled in a timed AI protocol at 65±3 DIM and inseminated at 75±3 DIM. Ovaries were examined by ultrasonography at 37±3 and 51±3 DIM to determine cyclicity by the presence of a CL in at least one of the two examinations. Pregnancy was diagnosed at 31, 38 and 66 d after the first AI and at 38 and 66 d after the second and third AI. Data were analyzed by the MIXED and LOGISTIC procedures of SAS (2001), and days open by survival analysis with censoring at 140 DIM. At 51 d postpartum, treatment did not affect (P=0.36) cyclicity and 8.2% of the cows were anovular. Detection of estrus in the 7 d after the second injection of PGF2a at 51 DIM was similar for Control and Yeast (52.9 vs 53.9%; P=0.75). For Control and Yeast, conception rates at first (35.5 vs 35.1%; P=0.75) and second (39.3 vs 34.2%; P=0.21) postpartum AI, and pregnancy loss from d 31 to 66 after first AI (17.4 vs 23.0%; P=0.28) did not differ. The median days open for Control and Yeast (96 vs 103 d) was similar did not differ (P=0.39). Treatment did not affect (P=0.77) BCS throughout the study and it averaged 2.89. For Control and Yeast, incidence of lameness (18.6 vs 14.9%; P=0.23) and the mean lameness score (2.3 vs 2.2: P=0.10) were similar. Feeding a yeast culture of S. cerevisiae had no impact on reproduction, lameness and BCS of multiparous cows under heat stress.

Acknowledgements: Vi-Cor and NRICGP USDA

Key Words: Dairy Cows, Reproduction, Yeast

W202 Effects of feeding yeast culture and propionibacteria on milk yield and milk components in Holstein cows. K. V. Lehloenya*[1], D. R. Stein[1], M. M. Aleman[1], T. G. Rehberger[2], D. T. Allen[1], D. A. Jones[1], and L. J. Spicer[1], [1]*Oklahoma State University*, *Stillwater*, [2]*Agtech Products,Inc.*, *Waukesha, WI*.

To determine the effect of supplemental feeding of Diamond V-XP Yeast Culture (XPY) alone or in combination with Propionibacteria strain P169 on milk production and milk components, 31 primiparous (PP) and multiparous (MP) Holstein cows were fed one of three dietary treatments between 2 wk prepartum to 30 wk postpartum: 1) Control (n = 10), fed a corn silage-based total mixed ration (TMR); 2) XPY (n=11), fed Control TMR plus XPY (at 56 g/head/d); and 3) XPY+P169 (n = 10), received Control TMR plus XPY plus P169 (at 6 x 10^{11}/head/d). After parturition, daily milk weights were recorded, and milk samples were collected twice weekly for milk component analyses. Daily uncorrected milk and solids-corrected milk (SCM) production tended (P < 0.09) to be affected by dietary treatment such that SCM for cows (averaged across PP and MP cows) fed P169+XPY (38±2 kg/d) was 8% and 5% greater than Control and XPY cows, respectively. Dietary treatment did not affect (P>0.20) 4% fat-corrected milk production (FCM) likely because percentage of milk fat was greater (P<0.02) in Control than XPY and P169+XPY groups. Milk lactose percentage was affected by diet x parity (P< 0.001) with XPY+P169 fed MP cows having greater lactose levels than Control and XPY MP cows; milk lactose in PP cows did not differ (P>0.20) among diet groups. Diet x parity tended (P<0.08) to affect milk protein percentage such that milk protein increased in MP cows fed XPY but decreased in PP cows fed XPY compared to the other groups. Percentage of SNF tended to be greater in XPY+P169 fed MP cows than Control and XPY MP cows (diet x parity, P<0.10). In conclusion, supplemental feeding of P169 in combination with XPY tended to increase uncorrected milk and SCM production in Holstein cows, and thus may hold potential as a natural direct-fed microbial to enhance lactational performance.

Key Words: Yeast Culture, Propionibacteria, Milk Production

W203 Production, intake, feed efficiency, and economic responses from feeding a concentrated yeast culture to lactating cows on commercial dairies. W. K. Sanchez*[1], I. Yoon[1], M. E. Engstrom[1], and N. R. St-Pierre[2], [1]*Diamond V Mills*, *Cedar Rapids, IA*, [2]*The Ohio State University*, *Columbus*.

Yeast Culture (XP) is fermented yeast and growth media fed to stimulate rumen fermentation. Improvements in adsorbent properties of the grain substrate have made it feasible to create an XP concentrate (XPC) that is equivalent to XP at 25% of the feeding rate. The objective of these trials was to evaluate the production, feed efficiency and economic responses from feeding XPC to lactating cows on commercial dairy farms. Two mixed model statistical designs were conducted. In trial one, six pens of cows were randomly assigned to two treatments in a double blind study. Dietary treatments consisted of a daily top dress of either 54g XP or 14g XPC for 60 d blended in a distillers dried grains carrier. Only cows that were in the pens for a preceding month and at least 1 of 2 monthly tests were included in the analysis. Cows fed XPC yielded more (P < 0.05) milk fat (1.54 vs. 1.34 kg/d) and 3.5% FCM (42.1 vs. 37.1 kg/d) than cows fed XP, respectively. Pen DMI were numerically lower and thus FCM/DMI efficiencies were higher for cows fed XPC. Cows appeared to respond quicker to XPC than XP but by 60 d differences were less evident. In trial two, pairs of herds within three regions (CA, OR, and WI) were randomly assigned to a double blind switch back arrangement of treatments. One herd in each pair was fed either 14g of XPC or placebo in the first 60 d period then switched to the other treatment during the next period. Only animals that were 80 DIM or greater and had at least one monthly milk test per period were included in the analysis. With herd as the experimental unit differences were non significant (P > 0.1) but feeding XPC resulted in 0.84 kg/d more FCM, 0.09 kg/d less DMI and thus greater FCM/DMI. With milk valued at $12/45 kg, TMR at $0.032/kg DM and XPC at $0.04/cow per d, XPC returned an additional $0.20/cow per d or 5:1 return on investment. Both trials together indicate that XPC is economically beneficial in-vivo.

Key Words: Yeast Culture, Lactation, Feed Efficiency

W204 Effects of live yeast supplementation on ruminal pH of loose-housed dairy cattle. A. Bach*[1,2], C. Iglesias[2], M. Devant[2], and N. Rafols[2], [1]*Institució Catalana de Recerca i Estudis Avançats (ICREA)*, *Barcelona, Spain*, [2]*Unitat de Remugants, Institut de recerca i Tecnologia Agroalimentàries (IRTA)*, *Barcelona, Spain*.

The aim of this study was to determine the effects on rumen pH of live yeast supplementation in loose-housed dairy cows. Three multiparous lactating ru-

men-cannulated cows receiving the same basal ration (50:50 forage:concentrate) were supplemented with 5 g/d (equivalent to 10^{10} CFU/d) of Saccharomyces cerevisiae strain CNCM 1077 (Levucell SC2, Lallemand, France) alternately for periods of 2 wk following a cross-over design. The three cows were maintained in loose-house conditions in a group of 70 cows in total, and thus they had to adjust their eating pattern to social interactions as it occurs in commercial herds. During the last 8 d of each period, rumen pH was monitored every 15 min. These pH measurements were recorded with an automatic pH meter that was placed inside a custom-made PVC pipe with about 300 g of lead to ensure that the device remained in the ventral part of the rumen throughout all readings. The rumen was only accessed once every 2 d during samplings. The data were analyzed using a mixed model with repeated measures accounting for the random effect of each cow, and the fixed effects of yeast, the day of sampling, the time since last TMR eating bout, the time since previous concentrate consumption, and the interaction of yeast with the remaining fixed effects. Average rumen pH was greater ($P < 0.01$) when yeast was supplemented compared with control (6.04 vs 5.46, respectively). Ruminal pH decreased ($P < 0.001$) as time since last TMR or concentrate bouts increased, but this decrease was independent of treatments. Also, the percentage of pH values below 5.6 was lower ($P < 0.001$) when yeast was supplemented compared with control (26 vs 67%, respectively). The results indicate that live yeasts have a beneficial effect on ruminal pH with cows kept in loose-house conditions receiving rations similar to the one of this study. Furthermore, the yeast effects may be evident starting 1 wk after their supplementation.

Key Words: Rumen, pH, Yeast

W205 Effect of feeding a Saccharomyces Cerevisiae yeast culture on lactation performance of dairy cows under heat stress. R. G. S. Bruno*, H. M. Rutigliano, R. L. A. Cerri, P. H. Robinson, and J. E. P. Santos, *University of California*, *Tulare*.

Multiparous Holstein cows, 723, from two dairy farms were blocked by parity and previous lactation milk yield and, within each block, randomly assigned to one of two treatments at calving: a diet containing no yeast (Control; n = 361) or 30g/d of Saccharomyces cerevisiae (Amax Extra, ViCor, IA: Yeast; n = 362) fed from 20 to 140 d in milk (DIM). The study was conducted from May to December of 2004 and cows calving during the hot months (May-August) were enrolled. Cows were milked twice daily and production of milk and milk components were measured every 2 weeks. Group DM intakes from 6 pens were measured daily and individual pen temperature and humidity was evaluated hourly with electronic data loggers (June to November). Rectal temperature was taken from 88 (22/trt/dairy) cows once weekly, during 4 weeks. Blood was sampled from a subset of 120 cows at 58±3 and 100±3 DIM for measurements of plasma glucose and nonesterified fatty acids. Data were analyzed by the MIXED procedure of the SAS (2001) program. For Yeast and Controls, respectively, average daily maximum temperature (30.7 vs 30.6 C; P=0.70) and humidity (86.5 vs 87.6%; P=0.56) in pens, and group DM intake (27.2 vs 27.4 kg/d; P=0.91) did not differ. Cows fed Yeast produced more milk (43.3 vs. 42.1 kg/d; P<0.05), milk protein (1.213 vs. 1.187 kg/d; P<0.05), solids nonfat (3.678 vs 3.583 kg/d; P<0.05) and lactose (2.074 vs. 2.016 kg/d; P<0.04) than Controls, but 3.5% fat-corrected milk was similar (43.1 vs. 42.4 kg/d; P=0.23) because of lower fat content in milk of cows fed Yeast than Controls (3.49 vs. 3.59%; P<0.001). However, concentrations of protein (2.82 vs. 2.84%; P=0.19), solids nonfat (8.58 vs. 8.50%; P=0.52), and lactose (4.83 vs. 4.83%; P=0.91) were similar between Yeast and Control cows. The linear somatic cell count score was not affected (P=0.85) by treatment and averaged 2.71. Rectal temperatures for Yeast and Control cows were similar (P=0.21) and averaged 38.52 and 38.47 °C, respectively. Feeding a yeast culture of S. cerevisiae improved yields of milk and milk components in heat-stressed multiparous Holstein cows.

Acknowledgements: Vi-Cor and NRICGP USDA

Key Words: Dairy Cows, Yeast, Heat Stress

W206 Effects of yeast culture and natural saponin sources on ruminal microbial populations and tropical forage digestion *in vitro*. H. R. Jiminez[1], O. Pacheco[1], H. Blanco[1], D. R. Chamorro[1], and J. M. Tricarico*[2], [1]*Corpoica, Cundinamarca, Colombia*, [2]*Alltech Inc., Nicholasville, KY*.

We conducted a series of experiments to examine the effects of yeast culture (Yea-Sacc®, Alltech Inc., Nicholasville, KY) and natural saponins from wingleaf soapberry (*Sapindus saponaria L.*, **SS**) and quinoa (*Chenopodium quinoa*, **CQ**) on ruminal protozoal and bacterial concentrations and *in vitro* degradation of kikuyugrass (*Pennisetum clandestinum*). We used batch cultures in a completely randomized-repeated measures design. Triplicate cultures were established with 100 mg of substrate and received one of the following six treatments: 1) no supplement, 2) 0.5 mg Yea-Sacc® (**YS**), 3) 1.5 mg CQ, 4) 6.0 mg SS, 5) 0.5 mg YS + 1.5 mg CQ, or 6) 0.5 mg YS + 6.0 mg SS. Microbial enumerations were performed on all cultures after 8, 12, 24 and 48h incubations. Degradation of kikuyugrass DM, NDF and ethanol insoluble residue (**EIR**) was determined by measuring *in vitro* gas production. Cumulative gas data from each fraction were fitted with the Gompertz equation to estimate maximum gas volume, specific rate of gas production and lag time. Supplementation with SS reduced (P<0.01) total protozoa and entodiniomorphs after 24h and reduced isotrichs and dasytrichs below detectable limits after 48 h. The defaunation activity of SS was further enhanced by YS addition. Supplementation with CQ increased (P<0.05) total protozoa after 24h but the CQ-YS combination reduced (P<0.05) total protozoa after 48h. After 12 h, cellulolytic bacteria concentrations were greater (P<0.05) in cultures receiving YS, CQ, or SS and tended (P<0.10) to be greater in cultures receiving the saponin-YS combinations. Supplementation with SS reduced (P<0.05) the maximum gas volume from DM, the lag time from NDF and the specific rate and lag time from EIR. The CQ-YS combination reduced (P<0.05) the maximum gas volumes from DM and EIR and increased (P<0.05) the lag time from DM. Although saponins and the saponin-YS combinations reduced protozoa and increased cellulolytic bacteria concentrations they also reduced the rate and extent of DM, NDF and EIR degradation.

Key Words: Saponin, Yeast, Fermentation

W207 Lactation response of dairy goats fed sugar cane silage treated with *Lactobacillus buchneri*. C. Q. Mendes, I. Susin*, A. V. Pires, L. G. Nussio, I. U. Packer, and R. C. Araujo, *ESALQ/University of São Paulo*, *Piracicaba, SP, Brazil.*

Sugar cane silage is an alternative feed for ruminants. Studies have shown that sugar cane ensiled without additive results in low quality roughage. A high concentration of ethanol, present in sugar cane silage, may reduce voluntary feed intake affecting animal performance. Our objective was to evaluate the effects of feeding sugar cane silage treated with *Lactobacillus buchneri* on milk yield and milk composition. Thirty-nine Saanen goats (83 ± 5 DIM) were assigned to a complete randomized block design according to milk production, DIM and number of lactation. Goats were housed individually in a tie stall for a period of 10 weeks. Does were fed a 50:50 (concentrate:roughage ratio) TMR. Experimental treatments were: fresh sugar cane (FSC), sugarcane silage without additive (SCS) and sugar cane silage treated with Lactobacillus buchneri (SCS+Lb, $5x10^4$ cfu/g wet basis). DMI was higher (P<0.01) for goats fed FSC diet (2.82 kg/d) when compared to SCS (2.22 kg/d) and SCS+Lb (2.42 kg/d). Milk production (MP) and fat corrected milk yield (FCM 3.5%) were similar among diets (MP 1.65, 1.42, 1.48 kg/d and FCM 1.48, 1.56, 1.41 kg/d for FSC, SCS and SCS+Lb, respectively). However, feed efficiency was greater for goats fed the silage diets (0.52, 0.64 and 0.64 kg FCM 3.5% / kg DMI for FSC, SCS and SCS+Lb, respectively). Milk fat and total solids were higher for diets containing silages. SCS+Lb diet had higher (P<0.01) milk fat content (3.8%) than SCS (3.46). Sugar cane silages reduced DMI, however, had no detrimental effects on lactation performance of Saanen does.

Key Words: Silage Additive, Milk Production, Saanen

W208 Withdrawn.

W209 Influence of dietary silymarin on hematic parameters and oxidative stress in periparturient dairy goats. D. Tedesco*[1], S. Galletti[2], S. Spaguolo[1], P. Abrescia[3], and L. Ferrara[2], [1]*University of Milan, Milan, Italy*, [2]*ISPAAM-CNR, Naples, Italy*, [3]*Università di Napoli Federico II, Naples, Italy*.

Silymarin, a hepatoprotective and antioxidant extract from seeds of Silybum marianum L. (Gaertn) (milk thistle), has shown to prevent fat accumulation in liver in periparturient dairy goats and to have positive effects on milk production in cows and goats. Aim of the present study was to determine the effects of silymarin extract fed in the peripartum period on hematic parameters and antioxidant status in dairy goats. A total of 24 dairy goats in their second pregnancy were divided into two groups according to body condition score (BCS), health condition and previous milk production. From 5 d prior to the expected kidding date to 15 d postpartum, the treated goats received 10 mL/d of silymarin (Silyvet®, Indena S.p.A., Milan, Italy) as a water suspension, administered as oral drenches. Plasma samples were collected weekly from 5 d prior to kidding date to 21 d after kidding, and analysed for NEFA, BHBA, triglyceride, cholesterol, glucose, retinol, α-tocopherol, and nitrotyrosine, a biomarker of in vivo oxidative damage. Data were analysed as repeated measures using PROC MIXED of SAS. Silymarin treatment did not influence levels of NEFA, BHBA, triglyceride, cholesterol, and glucose in the peripartum period. Liposoluble antioxidants levels were not influenced by treatment; in both groups retinol and α±-tocopherol were lower at kidding day and increased at 7 and 14 d after kidding. Nitrotyrosine plasma level significantly increased in control goats on 7, 14, and 21 d after parturition, indicating an oxidative stress. In silymarin treated goats nitrotyrosine level at kidding was lower with respect to the observed prepartum value and the nitrotyrosine concentration at 0, 7, 14 and 21 d after kidding was significantly lower with respect to control (P<0.001). From these results we can affirm that oxidative stress occur in periparturient dairy goats, and the antioxidant effect of silymarin can contribute to prevent oxidative damage.

Key Words: Silymarin, Dairy Goat, Oxidative Stress

W210 Sorghum grain physical, chemical and genotype characteristics influence ruminal degradation in cattle. M. D. Montiel*[1,2], J. Elizalde[1,2], L. Giorda[3], and F. Santini[1,2], [1]*CONICET, Argentina*, [2]*Fac. Cs. Agrarias UNMdP-INTA Balcarce, Argentina*, [3]*EEA INTA Manfredi, Argentina*.

We studied the influence of genotype, physical and chemical characteristics of sorghum grain hybrids on ruminal in situ degradation using flint and dent corn hybrids as controls. Two digestion trials were conducted with three ruminally cannulated heifers. Ruminal dry matter (DM), crude protein (CP) and starch degradability of 14 sorghum hybrids, with different tannin content and endosperm structure, and 4 corn hybrids, incubated during 16 and 33 hours, were evaluated in the fist trial. Physical (test weight, milling ratio, percentage of floating grain, apparent density) and chemical (tannins, CP, starch and kafirins) characteristics were evaluated. Ruminal degradability of sorghum grain related with physical and chemical characteristics were used in order to predict digestion. In situ DM, CP and starch degradability were different between corn and sorghum genotypes (P<0.05), however two sorghum hybrids were not different from three corn hybrids. Physical characteristics were not related to ruminal degradability. Tannins content affected in situ DM, CP and starch degradability and was the best predictor of DM, CP, and starch degradability (R^2= 0.5, 0.45 and 0.73, respectively). The kinetics of ruminal digestion of six sorghum hybrids with different tannin content (high-HT-, medium-MT-, and low tannin-LT-) and two corn grains (flint and dent) were evaluated in the second experiment. Degradability of LT sorghum was higher (P<0.05) than HT (49.5 vs. 43.9%, 47.1 vs. 34.2%, 51.6 vs. 39%, for DM, CP and starch, respectively). The LT sorghum had higher (P<0.05) degradability than the HT hybrids, although LT were less digestible (P<0.05) than corns. Ruminal degradability of sorghum grain was highly dependent on the genotypes, and can not be predicted from physical characteristics. However, tannin content was most reliable predictor of DM, CP and starch degradability.

Key Words: Sorghum Grain, Genotype, Physical and Chemical Characteristics

W211 Nitrogen fractions and fibers of commercial nonforage fiber sources for ruminants in central Iran. G. R. Ghorbani*[1] and A. Nikkhah[2], [1]*Isfahan University of Technology, Isfahan, Iran*, [2]*University of Manitoba, Winnipeg, Manitoba, Canada*.

A thorough knowledge of the variability in chemical composition of the commercial by-products fed to ruminants is imperative for high predictability of animal response on-farm. The objective of this study was to analyze the fibers and nitrogen (N) fractions of wheat bran (WB) and beet pulp (BP), as the common nonforage fiber sources used in ruminant rations in Iran. Feed samples were collected from 14 dairy farms across Isfahan province. Cell wall fibers (NDF and ADF) were determined and crude protein (CP) was fractioned into nonprotein nitrogen (NPN) or A, quickly degradable true CP (B1), moderately degradable true CP (B2), slowly degradable true CP (B3), and unavailable N (C) based on the Cornel Net Carbohydrate and Protein System (CNCPS). Descriptive statistics for all fiber and N fractions, and correlation coefficients between fibers and N fractions were obtained. Data were analyzed in a completely randomized design using the General Linear Model Procedure of SAS. The fiber and all N fractions of WB except for fraction C differed significantly ($P < 0.001$) across farms. The unavailable N (31.4 vs. 22.6 g/kg), B3 (31.5 vs. 26.5 g/kg) and NPN (31.4 vs. 22.6 g/kg) were greater ($P < 0.01$), but CP (161.9 vs. 171 g/kg), B2 (64.2 vs. 83.4 g/kg), and NDF (424 vs. 510 g/kg) were lower ($P < 0.01$) in WB of this study as compared to that reported in recent CNCPS feed library. The higher CP (108.6 vs. 98.0 g/kg, $P < 0.01$) and lower NDF (420 vs. 446 g/kg, $P < 0.01$) content of BP in this study compared to the CNCPS feed library were translated into more soluble fiber and thus more ruminally available energy in the samples of this study. The N fractions of A (38.7 vs. 25.4 g/kg) and C (17.6 vs. 10.8 g/kg) in BP were greater ($P < 0.01$) than those in CNCPS library. Results uncovered the regional variability in the fiber and N fractions of the commercial by-products fed to ruminants in central Iran, emphasizing the necessity of further investigations on other nutrients.

Acknowledgements: This study was supported by Isfahan University of Technology. The farmers who participated in the study are gratefully thanked.

Key Words: Nitrogen Factions, Beet Pulp, Wheat Bran

W212 Intake and apparent digestibility in Holstein Steers fed diets containing Tifton 85 hay with different particle sizes. E. S.s Pereira*[1], A. M. V.a Arruda[1], and I. Y. Mizubuti[2], [1]*Universidade Estadual do Oeste do Paraná, Marechal Cândido Rondon, Paraná, Brasil*, [2]*Universidade Estadual de Londrina, Londrina, Paraná, Brasil*.

This work had the objective of evaluating the effect of different particle sizes of Tifton 85 hay (5, 7, 10 millimeters and whole) in the diet of Holstein steers, with the average weight of 300 kg and 20 months of age, on the intake of dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), total carbohydrates (TC), non structural carbohydrates (NSC), neutral detergent fiber (NDF), acid detergent fiber (ADF) and total digestible nutrients (TDN), and the apparent digestibilities of DM, OM, CP, EE, TC NDF, ADF and NSC. It was used a 4 × 4 Latin square experimental design, with four steers and four periods of sixteen days for each one. Intakes of DM, NDF, OM, CP, EE, TC and NSC, expressed in different ways, were not influenced by the different granulometric profiles of the experimental diets. DM coefficients of digestibility were significant for five percent and influenced by the granulometric profile; values ranged from 54.95 to 67.3% for the diets constituted by 10 and 7 millimeters of particle sizes, respectively. There were no differences significant in the CP coefficients of digestibility for the diets constituted by 5 and 7 millimeters and whole particle sizes; average value was 69.39%. Digestibility coefficients for EE, TC, NDF and ADF did not differ among experimentals diets. NSC digestibilities were different for five percent for the diets constituted by 10 millimeters and whole hay (76.64 and 87.19%, respectively). However, these values were similar to the ones from diets with 5 and 7 millimeters particles, which presented an average value of 83.33%. It can be concluded that diets with Tifton 85 hay with particles sizes of 5 and 7 millimeters resulted in similar nutrients intake and digestibilities.

Key Words: Food Intake, Nutrient Digestibility, Particle Size

W213 The determination of fermentation characteristics of Iranian beet pulp, sunflower head and forages using gas production technique. M. Ziabakhsh, A. Taghizadeh*, H. Abdoli, G. A. Moghaddam, A. Tahmasbi, and P. Yasan, *Tabriz University*, *Tabriz, East Azarbayjan, Iran*.

In vitro gas production technique was used to measure the gas production from Iranian beet pulp (BP), sunflower head (SFH), alfalfa hay (AH) and barley straw (BS) as test feeds. Two sheep (38±4 kg) were used. The sheep were fed a diet consisting of 600 g kg^{-1} concentrate and 400 g kg^{-1} forage containing DE (3.35 Mcal/kg DM) and CP (160 g/kg DM) and used as ruminal fluid donors for the preparation of inoculums. The production of gas was measured in each vial after 2, 4, 8, 12, 15, 24, 48, 72 and 96 h of incubation. The results were analyzed using completely randomized design (CRD) in each incubation time with Duncan` s multiple range test used for the comparison of means. Feeds were the only sources of variation considered. Gas production data were in triplicate fitted to a equation of $p=a+b\ (1-e^{-ct})$; where (p) is the gas production at time, t, (a) is intercept and ideally reflects the fermentation of soluble and readily available, (b) is fermentation of the insoluble (but with time fermentable) fraction, (c) is the fractional rate at which b is fermented per hour. The soluble fraction (a) for SFH, BP, AH and BS was (ml/g) 61.83, 91.63, 42.28 and 25.51, respectively. The insoluble (but with time fermentable) fraction (b) was (ml/g) 164.02, 237.05, 281.46 and 180, respectively. The fractional rate (c) was (%/h) 0.036, 0.029, 0.01 and 0.018, respectively. The results showed the soluble fraction (a) of BP was higher than the other feedstuffs, while the insoluble (but with time fermentable) fraction (b) of AH was significantly ($P<0.05$) higher than the other test feeds. The fractional rate (c) of SFH was significantly ($P<0.05$) higher than the other feedstuffs. The results showed that the differences between chemical composition of feedstuffs caused to change fermentation parameters determined by in vitro gas production technique.

Acknowledgements: The authors thank Tabriz University, Iran for funding of this research.

Key Words: Gas Production, Beet Pulp, Sunflower Head

W214 Relationship between in vitro dry matter disappearance and gas production of some feedstuffs. H. Abdoli, A. Taghizadeh*, and A. Tahmasbi, *Tabriz University*, *Tabriz, East Azarbayjan, Iran*.

Test feeds including barley grain (BG), soybean meal (SBM) and wheat bran (WB) were evaluated using in vitro techniques. Two sheep (38±4 kg) were used and fed a diet consisting of 600 g kg^{-1} concentrate and 400 g kg^{-1} forage containing DE (3.35 Mcal/kg DM) and CP (160 g/kg DM) and used as ruminal fluid donors for the preparation of inoculums. The production of gas and in vitro DM disappearances of test feeds were measured in each vial after 0, 2, 12, 24 and 48 h of incubation. The results were analyzed using completely randomized design (CRD) in each incubation time with Duncan's multiple range test used for the comparison of means. The in vitro DM disappearances and gas production data in triplicate were fitted to a equation of $p=a+b\ (1-e^{-ct})$; where (p) is the gas production and DM disappearance at time, t, (a) is the fermentation of soluble fraction, (b) is fermentation of the insoluble (but with time fermentable) fraction, (c) is the fractional rate at which b is fermented per hour. The gas production of soluble fraction (a) for BG, SBM and WB was (ml/g) 99.1, 56.7 and 79.2, respectively. The gas production of insoluble fraction (b) was (ml/g) 191.6, 170.2 and 165.3, respectively. The gas production rate of fermentation (c) was (%/h) 0.12, 0.04 and 0.06, respectively. The DM soluble fraction (a) for BG, SBM and WB was (%) 29.7, 39.6 and 29.6, respectively. The insoluble (but with time fermentable) fraction (b) was (%) 57.9, 50.2 and 47.3, respectively. The fractional rate of fermentation (c) was (%/h) 0.13, 0.05 and 0.05, respectively. There was a close relationship between in vitro disappearance results and the gas production in incubation times, especially at 24 h of incubation was indicated more relationship ($P<0.01$). The relationship of DM disappearance and gas production results in BG, SBM and WB were obtained ($P<0.05$): 90.3, 91.7 and 84.6, respectively. The high relationship of ruminal DM disappearance and gas production data showed that in vitro disappearance technique can be proper replacement assay for gas production technique.

Acknowledgements: The authors thank Tabriz University, Iran for funding of this research.

Key Words: Gas Production, Dry Matter, Disappearance

W215 Nutritive value of pistachio hulls and effect on feed intake, milk production and composition in lactating dairy cows. P. Vahmani*, A. A. Naserian, J. Arshami, and M. Ghafurian, *Ferdowsi University of Mashhad*, *Khorasan, Iran*.

Pistachio hulls (Pericarp) are a by-product of de-hulling of pistachio nuts soon after harvest. This experiment was carried out to evaluate the effect of dried pistachio hulls (DPH) as a feed ingredient for lactating dairy cows. Eight multiparous Holstein dairy cows (606±24kg BW and 160±18 DIM) were used in a replicated 4×4 latin square design. Cows were housed in a tie-stall barn, fed a TMR ration ad libitum. Control diet contained (DM basis) 22% corn silage, 18% alfalfa hay, 23% barley, 10% cottonseed meal, 8% beet pulp, 7% corn grain, 5.50% wheat bran, 5% soybean meal, 0.6%limestone, 0.3%vitamin premix and 0.3% salt . The treatments were 0 (control diet), 2, 4 or 6% DPH in dietary dry matter. The DPH substituted for beet pulp in the control diet. Each experimental period was for 21 days, which included 14 days of adaptation followed by 7 days sampling period. Dry matter intake (DMI), ruminal pH, blood urea nitrogen (BUN), milk production and composition were determined in sampling period. Chemical analysis indicated that DPH contained 12% CP, 5% ether extract, 45% NDF, 34% ADF, 5.20% ash and 8% tannin (DM basis). Increasing levels of DPH in diets had no significant effect on DMI, ruminal pH, BUN, milk yield, milk fat, milk protein, lactose and SNF ($P>0.05$), but there was a trend for decreased DMI (23.24, 23.19, 23.01 and 22.70 kg/day, respectively) as dietary DPH content increased. The decline of the DMI may be attributed to reduced palatability, because of increasing tannin content with increasing DPH in diets. Results from the chemical composition and production responses indicate that the use of low levels of DPH did not adversely affect animal performance. However additional research projects are needed to determine the effect of higher levels of DPH on dairy cows or other ruminants.

Key Words: Pistachio Hulls, Tannin, Dairy Cows

W216 The influence of urea treatment on in vitro gas production of pomegranate peel. R. Feizi*[1], A. Ghodratnama[1], M. Zahedifar[2], M. Danesh Mesgaran[3], and M. Raisianzadeh[1], [1]*Agricultural and Natural Resources Research Center of Khorasan*, *Mashhad, Khorasan, Iran*, [2]*Animal Science Research Institute Iran*, *Karaj, Tehran, Iran*, [3]*Ferdowsi University of Mashhad*, *Mashhad, Khorasan, Iran*.

Pomegranate peel (the rind of the fruit) is poor in protein and rich in tannins. Tannins components of Pomegranate peel (PP) prevents its optimal use. The objective of this experiment was to evaluate the effect of different levels of urea on in vitro gas production (GP) without and with the phenol binding agent polyvinylpolypyrrolidone (PVP) to ensiled pomegranate peel (EPP). In this experiment 4 levels of urea (0, 2.5, 5 and 7.5% of dry matter) were added to PP (6 replicates per treatment) and ensiled for two periods of 30 and 60 days. In vitro GP from the samples were measured during 96 h incubation without PVP or with 300 mg dry weight of PVP. GP data were analysed in a randomized complete block design using the GLM procedure of SAS. The results indicate that addition of urea and then storage decreased ($P<0.05$) total extractable tannins (TET) content (206, 177, 169 and 170 mg/g respectively). In vitro GP after 24 and 48 h was higher for EPP treated with 0% urea (40.37 and 45.20 ml without PVP; 43.23 and 50.29 ml with PVP respectively) and lower for EPP treated with 7.5% urea (30.21 and 34.91 ml without PVP; 31.95 and 39.24 ml with PVP respectively) ($P<0.05$). There was a negative correlation between the CP content of EPP and in vitro GP. Also non-fiber carbohydrate (NFC) level was positively correlated with GP potential. Against the previous studies, in this study, the relationship between the TET content and volume of GP was not

negative which may be relates to the fact that different sources of tannins have different natures and different biological responses. This study shows that tannins have negative effect on in vitro rumen fermentation and increase the volume of gas produced with PVP, revealed the inhibitory effects of tannins on fermentation.

Key Words: Pomegranate, In Vitro Gas Production, Urea

W217 Carbohydrate and protein fractions and ruminal kinetics of Tifton 85 grass (Cynodon Spp.) silages. E. S. Pereira*[1], A. M. V. Arruda[1], and I. Y. Mizubuti[2], [1]*Universidade Estadual do Oeste do Paraná*, *Marechal Cândido Rondon, Paraná, Brasil*, [2]*Universidade Estadual de Londrina*, *Londrina, Paraná, Brasil*.

The objective of this work was evaluate the fractionation and the degradation kinetics of the nitrogenous compounds and of the carbohydrates in five silages prepared with Tifton 85 grass forage. Silages were: 1-exclusive Tifton 85, 2-Tifton 85 silage with 16.5% of corn industrial residue added, 3-Tifton 85 silage with 16.5% corn meal added, 4-Tifton 85 silage inoculated with lactobacillus (1 g for each 3 liters of water for ton of fresh material) and 5-beforehand dry Tifton 85 silage, with the drying time of 90 minutes. The non-protein nitrogenous compounds, soluble and insoluble nitrogen in borate-phosphate buffer, neutral and acid detergent insoluble nitrogen were analyzed for protein composed fractions. The degradation rates of the protein fractions were obtained by in vitro incubation of the foods with proteases isolated from ruminal ambient. The total carbohydrates (TC), C and B2 fractions and neutral detergent soluble components were determined by Cornell System. The values of 73.86; 2.97; 13.71; 8.91 and 0.55 percentage of the fraction B2 of the nitrogenous compounds were observed for exclusive Tifton 85, Tifton 85 silage added of corn industrial residue, Tifton 85 silage with corn meal added, Tifton 85 silage inoculated with lactobacillus and beforehand dry Tifton 85 silage, respectively. The values of TC varied from 63.21 to 73.12, the B2 fraction varied from 52.27 to 35.09 percentage; and non structural carbohydrate fraction varied from 8.61 to 38.03 percentage. Tifton 85 silage with corn residue added and Tifton 85 silage with corn meal added, showed higher soluble component fraction, and higher potentially degradable fiber and repletion effect (4.6 hour). The corn residue and corn meal used for silage production favored the effective degradation of B2 fraction, and offered small effect in ruminal fill or repletion, and consequent higher availability of energy in the gastrointestinal tract.

Acknowledgements: Fundação Aráucaria- Paraná- Brasil

Key Words: Feed, Fiber, Nutrition

W218 Ensiling legume and grass pastures: Effects of wilting time and bacterial inoculation on silage fermentation, quality and degradability. L. O. Abdelhadi[1] and J. M. Tricarico*[2], [1]*Est. El Encuentro, Reserach and Extension in Ruminant Nutrition*, *Coronel Brandsen, Buenos Aires, Argentina*, [2]*Alltech Inc.*, *Nicholasville, KY*.

A completely randomized design with a 3x3 factorial arrangement of treatments was used to evaluate the effects of wilting time (**WT**) and microbial inoculation during ensiling of red clover (63.2% red clover, 22.2% perennial ryegrass and 14.5% tall fescue; DM basis) and tall fescue (54% tall fescue, 34.1% alfalfa and 11.9% white clover; DM basis) based pastures. Pastures were cut and allowed to wilt for 0, 6 or 10h before ensiling for 120 d in triplicate mini silos constructed from PVC pipe. Pastures received no inoculant (control) or were inoculated with Sil-All® or Sil-All4x4® (Alltech Inc. Nicholasville, KY) at a rate of 10 g/tonne of fresh forage. Samples collected before and after ensiling were analyzed for DM, OM, NDF, CP, true protein (**TP**), NH_3-N, pH, and OM degradability (**OMD**) after incubation with ruminal fluid from 3 to 72h. Forage DM increased (P<0.05) with increasing WT in both pastures. Wilting also reduced (P<0.05) CP and increased (P<0.05) NDF and TP content of the tall fescue-based pasture and increased (P<0.05) OMD of the red clover-based pasture. When ensiling tall fescue-based pasture, WT reduced (P<0.05) pH, NH_3-N content and DM recovery (**DMR**) and increased (P<0.05) OMD, DM and CP content of silage. Microbial inoculation did not affect fermentation but reduced (P<0.05) DM content of tall fescue-based silage. When ensiling red clover-based pasture, WT increased (P<0.05) DMR and TP and reduced (P<0.05) NDF content of silage. Inoculation increased (P<0.05) CP content of red clover silage across WT. Inoculation x WT interactions were significant for NH_3-N, pH, DM, OM and OMD in ensiled red clover. Microbial inoculation reduced (P<0.05) NH_3-N and pH and increased (P<0.05) OM content and OMD in non-wilted silage, and reduced (P<0.05) DM content at 6 and 10h WT. We conclude that microbial inoculation is valuable when ensiling legume-based pastures but WT is more important when grass is the main component of the silage.

Key Words: Silage, Inoculation, Wilting

W219 Effects of bacterial inoculation on fermentation, chemical composition and degradability of sorghum by-product and whole-plant soybean silages. L. O. Abdelhadi[1] and J. M. Tricarico*[2], [1]*Est. El Encuentro, Research and Extension in Ruminant Nutrition*, *Coronel Brandsen, Buenos Aires, Argentina*, [2]*Alltech Inc.*, *Nicholasville, KY*.

Ensiling whole-plant soybean and sorghum by-product represents an attractive alternative for on-farm preservation of high quality feedstuffs for Argentine farmers. We conducted two experiments to evaluate the effects of microbial inoculation on fermentation, chemical composition, DM recovery (**DMR**) and OM degradability (**OMD**) of sorghum by-product and whole-plant soybean silages. We used triplicate mini silos constructed from PVC pipe and a completely randomized design in both experiments. In experiment 1, wet sorghum by-product received no inoculant (control) or 10 g/tonne Sil-All® (Alltech Inc., Nicholasville, KY) and was ensiled for 4 months. In experiment 2, whole-plant soybean, harvested at the R6 stage of maturity, received no inoculant (control) or was inoculated with Sil-All® or Sil-All4x4® (Alltech Inc., Nicholasville, KY) at 10 g/tonne of forage and was ensiled for 3 months. Samples collected before and after ensiling were analyzed for DM, CP, true protein (**TP**), NDF, pH, NH_3-N and OMD after incubation in ruminal fluid for 72h. Microbial inoculation had no effects on fermentation, chemical composition or OMD of sorghum by-product. Ensiling whole-plant soybean increased DM (31.7 vs. 35.8 g/kg, P=0.03) and decreased CP (144.7 vs. 124.3 g/kg DM, P=0.08), TP (616 vs. 471 g/kg CP, P=0.02) and NDF (480 vs. 407 g/kg DM, P=0.02) content of silage without affecting OMD. Microbial inoculation increased the CP content (P=0.07) and reduced the pH (P<0.01) of whole-plant soybean silage without affecting DMR or OMD. We conclude that microbial inoculation provides no additional benefits when ensiling sorghum by-product but is valuable for improving the nutrient preservation of whole-plant soybean silage.

Key Words: Silage, Soybean, Sorghum By-Product

W220 Ensiling corn and sorghum: Effects of bacterial inoculation on fermentation, quality and degradability of eight different silage hybrids. L. O. Abdelhadi[1] and J. M. Tricarico*[2], [1]*Est. El Encuentro, Research and Extension in Ruminant Nutrition*, *Coronel Brandsen, Buenos Aires, Argentina*, [2]*Alltech Inc.*, *Nicholasville, KY*.

We conducted two experiments to evaluate the effects of two bacterial inoculants (Sil-All® and Sil-All4x4®; Alltech Inc., Nicholasville, KY) on fermentation, chemical composition, DM recovery (**DMR**) and OM degradability (**OMD**) of corn and sorghum silages (Dekalb, Colon, Argentina). We ensiled four corn hybrids (DK780S, DK790S, M369 and SIL-3) in experiment 1 and four sorghum hybrids (DK39T, DK61T, DK68T and SX-121) in experiment 2. We used a randomized complete block design with three blocks (plots) in both experiments. Each corn and sorghum hybrid received no inoculant (control) or were inoculated with Sil-All® (**SA**) or Sil-All4x4^® (**4x4**) at 5 g/tonne of fresh forage before ensiling for 120 d in mini silos constructed from PVC pipe. Samples collected before and after ensiling were analyzed for DM, NDF, starch, CP, true protein (**TP**), total N, NH_3-N, pH, and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h. Before ensiling, corn hybrid SIL-3 had a greater (P=0.03) TP content than DK780S, DK790S, M369 and sorghum hybrid SX-

121 had greater NDF (P=0.07) and lower starch (P=0.01) and TP (P=0.01) contents than DK39T, DK61T and DK68T. In addition, OMD was similar across corn and sorghum hybrids before ensiling. In experiment 1, inoculation did not affect fermentation, chemical composition, DMR or OMD of M369 silage. Reductions in silage DM contents were observed with 4x4 inoculation of DK780S silage (P=0.06) and SA inoculation of DK790S silage (P=0.07). Both inoculants increased 6h OMD in DK780S silage (P=0.02) and NDF (P=0.08) content and 72h OMD (P=0.07) in SIL-3 silage. In experiment 2, microbial inoculation did not affect fermentation, chemical composition, DMR or OMD of DK39T and DK61T silages. Inoculation with 4x4 increased total N (P=0.06) and CP (P=0.06) content in DK68T silage. Inoculation with SA increased TP (P=0.02) content in DK68T silage and reduced NDF (P=0.09) content in SX-121 silage. We conclude that the beneficial effects of microbial inoculation of corn and sorghum silages depend on the particular hybrid and inoculant used.

Key Words: Silage, Corn, Sorghum

W221 Fermentation characteristics and microbial succession of silage from organic residues of orange (*Citrus sinensis*) and pineapple (*Ananas comosus*) processing plants. S. Pagán*, A. Rodríguez, and E. Valencia, *University of Puerto Rico*, *Mayagüez, Puerto Rico*.

Two experiments were conducted to evaluate the microbial succession and fermentation end-products of organic residues from orange (*Citrus sinensis*, **CS**) and pineapple (*Ananas comosus*, **PS**) fruit processing plants. Residues composed of pulp, skins and seeds were fermented in PVC micro-silos for 0, 4, 7, 11, 29 and 65 days. Triplicate samples from each residue and fermentation period (d) were analyzed for pH, microbial succession (coliforms, **C**; lactic acid-producing bacteria, **LAPB**; molds and yeast, **MY**), and fermentation end-products (organic acids). Data within each fermented residue were analyzed as a completely randomized design using the General Linear Model. Bonferroni test was used for means separations. Final pH was 3.32 and 3.21 for **CS** and **PS**, respectively. During the whole fermentation and, for both silages, **C** populations were not detected, while **LAPB** and **MY** had a typical microbial growth. After 65 d of fermentation lactic acid was the main end product associated with the fermentation process, (0.90 and 1.02% for **CS** and **PS** respectively), low percentages of acetic acid were also detected (0.19% **CS** and 0.98% **PS)**. Butyric acid was not detected on both fruit residues silages. These results indicate that silage production is an alternative for the disposal of organic residues from orange and pineapple fruit processing plants. Inclusion of these fruit silages on farm animal's diets must be evaluated.

Key Words: Organic Residues, Silage, Fermentation

W222 Silages carbohydrate fractions and degradation rates estimated by gas production technique. E. S. Pereira*[1], A. M. V. Arruda[1], and I. Y. Mizubuti[2], [1]*Universidade Estadual do Oeste do Paraná*, *Marechal Cândido Rondon, Paraná, Brasil*, [2]*Universidade Estadual de Londrina*, *Londrina, Paraná, Brasil*.

The objective of this work was to determine the total carbohydrates composed fractions, and to estimate the digestion rate of the non fiber carbohydrate (NFC) and neutral detergent insoluble fractions of five silages prepared with Tifton 85 grass forage using the gas production technique. Silages were: 1-exclusive Tifton 85, 2-Tifton 85 silage with 16.5% of corn industrial residue added, 3-Tifton 85 silage with 16.5% corn meal added, 4-Tifton 85 silage inoculated with lactobacillus (1 g for each 3 liters of water for ton of fresh material) and 5-beforehand dry Tifton 85 silage, with the drying time of 90 minutes. The total carbohydrate fraction and C, B2 and NFC fractions were determined by laboratory methods (Cornell system). The statistical analyses performed including general variation analyses and comparative means by tukey test in five percent probability. The in vitro gas production from dry matter (DM), neutral detergent fiber (NDF) and NFC in the silages were determined by laboratory anaerobic incubations. The Tifton 85 silage with corn industrial residue and Tifton 85 silage with corn meal additive, showed highest potential digestible content of NFC and B2 carbohydrate fractions. The Tifton 85 silage dry presented lower gas production. The beforehand dry Tifton 85 silage with corn industrial residue and Tifton 85 silage with corn meal additive showed highest gas production from NFC carbohydrate fraction. The rate of digestion to the NFC and NDF carbohydrate fraction in the Tifton 85 silages in this work showed a range of 0.0652 to 0.2273%/hour and a range of 0.0315 to 0.0552%/hour, respectively. More studies with the by-products used in this work as additives for silage were necessary for knowing your influence on the nutritional quality and future recommendations.

Acknowledgements: Fundação Araucária, Paraná - Brasil

Key Words: Carbohydrate Fractions, Gas Production Technique, Silages

Ruminant Nutrition: Protein and Amino Acids

W223 Use of Synchrotron FTIR microspectroscopy to determine the effect of heat treatment on protein secondary structures of brown and golden flaxseeds at a cellular level in relation to nutritive value of protein: A novel approach. P. Yu*[1], J. J. McKinnon[1], H. W. Soita[1], C. R. Christensen[2], and D. A. Christensen[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Canadian Light Source*, *Saskatoon, SK, Canada*.

An understanding of the structure of the whole protein is often vital to understanding its digestive behavior and nutritive value in animals. Protein secondary structures include α-helix and β-sheet. The percentage of these two structures influences protein nutritive value and quality. High percentage of β-sheet structure may cause low access to gastrointestinal digestive enzymes, which results in a low protein value. The objective was to use the synchrotron FTIR microspectroscopy (S-FTIR) to reveal chemical features of protein secondary structures of flaxseed tissues affected by varieties and heating in relation to protein nutritive value. The results showed that with the S-FTIR, the structural-chemical makeup and nutritive characteristics of the flaxseed tissues could be revealed. The protein secondary structure differed between the golden and the brown seed coat types. The golden contained higher percentage of α-helix (47.1±3.2 vs. 36.9±4.7%, n=20), lower percentage of β-sheet (37.2±3.4 vs. 46.3±4.0%, n=20) and higher ratio of α-helix to β-sheet (1.3 vs. 0.8) ($P < 0.05$), indicating higher protein nutritive value and availability in the golden. The effects of roasting on protein secondary structures depended on the variety. The roasting reduced percentage of α-helix (47.1 to 36.1%), increased percentage of β-sheet (37.2 to 49.8%) and reduced α-helix to β-sheet ratio (1.3 to 0.7) of the golden variety ($P < 0.05$). However, roasting did not affect protein secondary structures of the brown. These results indicated that: 1) different sensitivities of protein secondary structure to the heat processing between the varieties; 2) roasting affected protein value and availability in the golden but not in the brown. The results demonstrate the potential of highly spatially resolved S-FTIR to reveal protein secondary structures. Further study is needed to quantify the relationship between protein secondary structures and protein nutrient availability in animal models.

Key Words: Synchrotron FTIR, Protein Secondary Structures, Nutritive Value

W224 The role of protein matrix in the digestion of corn grain: Assessment by scanning electron microscopy. Y. Wang*[1], D. Sapienza[2], V. J. H. Sewalt[3], Z. Xu[1], and T.A. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Sapienza Analytica, LLC*, *Johnston, IA*, [3]*Kemin AgriFoods North America*, *Des Moines, IA*.

Corn grains (Pioneer Hi-Bred International, Inc.) harvested at maturities for silage (SIL) and for grain (black layer, GRN) were halved longitudinally and ruminally incubated for up to 48 h in nylon bags in a non-lactating cow fed a corn grain/corn silage diet, and then for 8 h in artificial post-ruminal digestion solution (ANKOM Daisy II). Grains retrieved after 4, 24, and 48 h in the rumen (4R, 24R, 48R), and after 24 h in the rumen plus 8 h post-ruminal incubation (24R8P), were processed for viewing on a Hitachi S-570 scanning electron microsope (accelerating voltage 7-10 kV). The grains were examined extensively in the vitreous (V), horny starch (H) and floury starch (F) areas of the endosperm. Disappearance of starch granules was consistently more rapid (4R to 48R) or extensive (24R8P) than that of protein matrix, in both SIL and GRN. In all regions of the endosperm, bacterial colonization of starch granules was the first microbial activity observed upon exposure of sectioned grains to the ruminal environment. Extensive bacterial colonization and digestion of protein matrix was evident at 48R but not at 4R. Compared with 24R, the primary effect of 24R8P was an increased disappearance of starch granules from exposed areas. The proportion of protein matrix was highest, and its association with starch granules was tightest, in area V, followed by H and then F, but the order of bacterial colonization and disappearance of protein matrix was reversed (F>H>V). Trends in bacterial colonization and digestion of protein matrix, as compared with starch granules, were similar between SIL and GRN, although overall disappearance of endosperm was greater with SIL than with GRN, suggesting greater vulnerability of protein matrix in SIL as compared with GRN. In corn cut for silage and for corn, the protein matrix regulates the rate and extent of digestion of exposed endosperm.

Key Words: Corn Grain, Maturity, SEM

W225 Development of an *in vitro* technique to monitor the fate of true proteins of feedstuffs in the rumen. A. A. Sadeghi*[1] and P. Shawrang[2], [1]*Islamic Azad University*, *Tehran, Iran*, [2]*Tehran University*, *Karaj, Iran*.

An integrated artificial rumen (AR) and electrophoretic technique were used to develop an *in vitro* technique to monitor the fate of true proteins of feedstuffs in the rumen. The objective was to adapt an *in vitro* procedure to obtain simulated rumen fluid and many residue at different incubation times that could be analyzed for true protein patterns by using SDS-PAGE technique. Duplicate nylon bags containing two grams of soybean meal and canola meal were suspended into the rumen (R) of three 450 kg Holstein steers and artificial rumen from 0 to 24 h. A 50 µl aliqout of rumen and artificial rumen fluid samples, also twelve mg of well-ground feed sample and bag residues from *in situ* and artificial rumen incubation were placed into 750 µl SDS-PAGE sample buffer. After 30 min of thorough mixing, samples were immersed at 90°C for 3 min, and then centrifuged at 10000 × g for 1 min. A 30 µl aliqout of each protein sample was then loaded into the sample well. Samples were fractionated by a SDS-PAGE discontinuous system. The sub-units of the gel were monitored by densitometric scanning at 580 nm. In soybean meal two major proteins (glycinin with acidic and basic subunits, and β-conglycinin with α', α and β subunits) and in canola meal (napin with two subunits and cruciferin with four subunits) were observed. In rumen fluid collected from steers consuming two test feeds, no protein bands were found after 5-h incubation, but in artificial rumen fluid, there were some small bands after 6-h incubation. In AR, there were some bands between original protein bands of two test feeds at shorter incubation times. These bands were related to small polypeptides produced from larger ones. Densitometrical scanning data for R and AR fluid samples were not correlated (P>0.10). SDS-PAGE patterns of bag residues of R and AR were similar. Densitometrical scanning data for bag residues of R and AR were highly correlated (r = 0.92; P<0.05). These results indicate that the integrated artificial rumen and electrophoretic technique could be used to monitor the fate of true proteins of feedstuffs in the rumen.

Key Words: Artificial Rumen, Electrophoresis, True Protein

W226 Degradability characteristics of crude protein of some feedstuffs in ruminants using in vitro technique. A. Taghizadeh*[1], H. Abdoli[1], A. Tahmasbi[1], and R. Noori[2], [1]*Tabriz University*, *Tabriz, East Azarbayjan, Iran*, [2]*Ekrami Highschool, Training and Education Ministry*, *Tabriz, East Azarbayjan, Iran*.

The degradability characteristics containing fractional rates of digestion, soluble fraction and degradable fraction were determined using in vitro technique. The feeds were barley grain (BG), soybean meal (SBM), and wheat bran (WB). The in vitro studies were conducted consecutively over a period of two weeks using rumen fluid obtained pre-feeding from two sheep (38±4kg, fed a diet containing (as fed) 600 g kg^{-1} concentrate and 400 g kg^{-1} forage containing DE (3.35 Mcal/kg DM) and CP (160 g/kg DM) and used as ruminal fluid donors for the preparation of inoculums. Crude protein degradation (CPD) was estimated 0, 2, 12, 24 and 48 h of incubation. The results were analyzed using completely randomized design (CRD) in each incubation time with Duncan's multiple range test used for the comparison of means. Feeds were the only sources of variation considered. Degradabilities data in triplicate were fitted to an equation of p=a+b ($1-e^{-ct}$); where (p) is CP degradability at time, t, (a) is intercept and ideally reflects the soluble fraction, (b) is the degradable of insoluble (but with time fermentable) fraction, (c) is the fractional rate at which b is fermented per hour. The CP soluble fraction (a) for BG, SBM and WB was (%) 31.7, 36.7 and 50.0, respectively. The insoluble (but with time fermentable) fraction (b) was (%) 66.0, 62.0 and 37.0, respectively. The fractional rate of fermentation (c) was (%/h) 0.04, 0.02 and 0.06, respectively. The results showed that the soluble fraction (a) and fractional rate (c) in WB were more than the other feedstuffs (P<0.05), while CP insoluble fraction in BG was more than the other test feeds (P<0.05). This variability in CP fermentation parameters can be resulted from the differences among CP fractions and type of CP in feeds.

Acknowledgements: The authors thank Tabriz University,Iran for funding of this research.

Key Words: Degradability, In Vitro, Crude Protein

W227 Effects of adaptation time of a specific blend of essential oils on rumen nitrogen metabolism and fermentation profile in sheep. L. Castillejos[1], S. Calsamiglia*[1], A. Ferret[1], and R. Losa[2], [1]*Universitat Autonoma de Barcelona*, *Bellaterra, Spain*, [2]*AKZO NOBEL/CRINA SA*, *Gland, Switzerland*.

Eight sheep (average body weight of 57 kg) were used to study the effects of long term adaptation of rumen fluid to a specific blend of essential oils (BEO, Crina® for ruminants) on rumen fermentation. Animals received 1.3 kg of a 50:50 forage:concentrate diet (16% CP and 38% NDF). Four sheep were assigned at random to the control (CTR, without BEO) and four sheep were adapted to BEO (110 mg/d) for four weeks (ADBEO). After four weeks samples of ruminal fluid were obtained at 0 and 3 h after the morning feeding and in two consecutive days using an oro-ruminal probe. Samples were analyzed for peptide, amino acid and ammonia N concentrations, total and individual VFA, and pH. Differences between means were declared at P < 0.05. Total VFA and ammonia N concentrate were higher, and the acetate:propionate ratio was lower at 3 than at 0 h. Treatment ADBEO tended (P < 0.10) to increase the proportion of acetate and decrease the proportion of valerate compared with CTR. Treatment ADBEO had no effect on N metabolism and pH, but ADBEO sheep had a 16% numerical decrease in ammonia N concentration. Ruminal fluid collected from each of CTR and ADBEO sheep was used to study in vitro fermentation profile of soybean meal, corn meal, alfalfa hay and ryegrass hay. Treatments were: control fluid (CTR, without BEO), CTR fluid plus a single dose of BEO (11 mg/l; CTR+BEO) and ADBEO fluid plus a single dose of BEO (11 mg/l; ADBEO+BEO). The proportion of acetate and acetate to propionate ratio was higher, and the proportion of propionate and isovalerate, and branch-chained VFA and ammonia N (-14%) concentration were lower in ADBEO+BEO fluid compared with CTR fluid. However, treatment CTR+BEO had no effect on ammonia N concentration and VFA profile compared with CTR. A four weeks adaptation period of rumen microorganisms appear necessary to observe the effects of BEO on VFA and ammonia N concentration.

Key Words: Essential Oil, Nitrogen Metabolism, Rumen Fermentation

W228 Exogenous proteolytic enzymes improve in vitro degradation of alfalfa hay but not alfalfa silage. J.-S. Eun* and K. A. Beauchemin, *Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*.

An enzyme product containing only protease activity was shown previously to increase in vitro and in vivo fiber digestibility of alfalfa hay and TMR. An in vitro experiment was therefore conducted to evaluate the efficacy of this exogenous proteolytic enzyme (EPE) product (Protex 6L®, Genencor Int., Rochester, NY) using a 2 × 2 factorial design for improving the degradation of alfalfa silage. Fresh, milled alfalfa silage or alfalfa hay (0.5 g DM) was weighed into fermentation bottles. The amount of enzyme added to substrate was the same as in previous experiments (1.25 μL/g DM). Anaerobic buffer medium (20 mL) adjusted to pH 6.5 and strained ruminal fluid (5 mL) were inoculated into culture bottles and incubated for 24 h. Headspace gas production (GP) was measured at 2, 6, 12, and 24 h of inoculation. At the end of the 24 h-incubation, contents of the incubation bottles were centrifuged, and 5 mL of the supernatant was added to 1 mL of 25% meta-phosphoric acid for VFA determination. After discarding the supernatant, the bottle and its contents were dried at 55°C for 48 h. Degradation of DM, NDF, and ADF was sequentially determined. Data were analyzed using the Proc Mixed procedure of SAS. Adding EPE increased ($P < 0.01$) GP from only alfalfa hay throughout the fermentation, resulting in an interaction between substrate and EPE starting at 6 h of incubation. In addition, adding EPE increased degradability of DM ($P = 0.04$), NDF ($P = 0.05$), and ADF ($P = 0.05$) for alfalfa hay. Total VFA production was not affected by EPE. However, EPE addition decreased molar proportion of acetate (A) for alfalfa hay and increased molar proportion of propionate (P) for both alfalfa silage and alfalfa hay, resulting in decreased A:P ratio for only alfalfa hay ($P < 0.01$). Adding EPE to alfalfa silage had minimal effects on ruminal fermentation, and it had no effect on in vitro GP or degradability. In summary, adding EPE improved in vitro degradation of alfalfa hay, but not alfalfa silage, highlighting the importance of enzyme and substrate specificity.

Key Words: Exogenous Proteolytic Enzyme, Alfalfa Silage, Alfalfa Hay

W229 Amino acid content of residues from *in vitro* and *S. griseus* incubations. D. A. Ross* and M. E. Van Amburgh, *Cornell University*, *Ithaca, NY*.

The degradability of ruminant feed proteins has been measured using *in vitro* (IV) and protease procedures but without comparative amino acid (AA) contents of the residues. The objective of this study was to evaluate the AA contents of the residues following a 24-hr IV fermentation and a comparative *S. griseus* (SG) incubation (1 EU/ml; Licitra et. al., 1998) at time points designed to correspond to the protein degradation observed in the IV fermentation for twelve feeds (four alfalfa forages, four corn silages and four soy products). The incubation times for the protease were predetermined to be 0.5 and 1 hr for the forages and 9 and 10 hr for the soy products. Only the time point that represents the value closest to the 24-hr IV nitrogen (N) degradation is presented. Parallel IV and SG incubations without feed were run and analyzed for AA content which were subtracted from the respective incubations in an attempt to correct for the microbial and protease contributions, respectively. The N content (g/g DM; mean ± SD) of the feeds were: alfalfa, 0.036 ± 0.003; corn silages, 0.013 ± 0.001; soy products, 0.080 ± 0.004. Residues from these incubations were analyzed for AA content using HPLC after acid hydrolysis or preoxidation followed by acid hydrolysis for sulfur AA. Significant differences were obtained when IV and SG incubations were performed on the same samples, even with the variation within feeds (Table 1). Apparently protease cleaves the N specifically without degrading the cell wall and was most prominent in the corn silages in which the protease degraded 58.7 % of the N but only 17.7 % of the DM while the IV significantly degraded more DM than N.

Table 1. The mean values for degraded DM, N and selected AA contents following IV and SG incubations (n= 4 samples per type).

Feed	trt	Degraded—>		Met	Lys	Leu	His
		% DM	% N	—mg	AA per	100 g	CP—-
Alfalfa	IV	53.6[a]	48.5[a]	9.2[a]	11.2[a]	15.0[a]	2.9[a]
	SG	37.1[b]	54.5[b]	4.9[b]	6.7[b]	10.9[b]	2.3[b]
Corn	IV	59.1[a]	14.1[a]	14.0[a]	19.1[a]	27.1[a]	5.8[a]
	SG	17.7[b]	58.6[b]	3.1[b]	5.6[b]	9.0[b]	2.5[a]
Soy	IV	68.9[a]	68.3[a]	11.7[a]	14.5[a]	20.2[a]	3.3[a]
	SG	56.1[b]	64.9[b]	5.8[b]	2.6[b]	10.7[b]	1.2[b]

[ab]Means within feed in same column with different letters are significant ($P < 0.05$).

Key Words: Amino Acids, *In Vitro*, *S. Griseus*

W230 Estimation of duodenal microbial N flow: Level of agreement between two methods of analysis. R. Martineau*[1], H. Lapierre[2], D. R. Ouellet[2], D. Pellerin[1], and R. Berthiaume[2], [1]*Université Laval*, *Québec, Canada*, [2]*Dairy and Swine R&D Centre, AAFC*, *Lennoxville, Québec, Canada*.

The concordance correlation coefficient (**CCC**) and the error of prediction (in central tendency, **ECT**; due to regression, **ER**; or due to disturbances, **ED**) were used to compare the level of agreement between 2 methods of estimation of duodenal microbial N flow. Either urinary purine derivatives (method 1) or duodenal purine flow and purine:N ratio from duodenal bacteria as microbial markers (method 2) were used. Duodenal DM flow was estimated using chromium oxide as an indigestible marker. Samples were collected during an experiment (replicated 3 x 3 Latin square design) evaluating the effects of three modes of conservation of timothy: 1) hay (**H**), 2) restrictively- (**F**; formic acid), or 3) extensively-fermented silage (**I**; inoculant). Diets were tested in 6 duodenally-cannulated Holstein cows (DIM = 162 ± 135 at start of experiment) fed 12 equal daily meals. Each period had a 14-d adaptation to the diet, followed by a 6-d total collection of feces and urine (method 1) and by a 2-d collection of digesta 14 d later (method 2). Duodenal digesta samples were collected at 0900, 1100, 1300 and 1500 on day 34, and at 0800, 1000, 1200 and 1400 on day 35. The DMI averaged 15.3 kg/d (SEM = 1.15; $P = 0.79$) during sampling in method 1, and 14.7 kg/d (SEM = 1.14; $P = 0.86$) during sampling in method 2. Three cow-period data were missing (2 for **H** and 1 for **F**). Duodenal microbial N flows were 195, 235 and 224 g/d (SEM = 31.4; $P = 0.18$) for method 1, and 248, 239 and 246 g/d (SEM = 24.5; $P = 0.83$) for method 2 in **H**, **F**, and **I**, respectively. The **CCC** over all treatments was 0.38, and was 0.44, 0.63 and 0.22 for **H**, **F**, and **I**, respectively. The **ECT** over all treatments was 11%, and was 81, <1 and 7% for **H**, **F**, and **I**, respectively. The **ER** over all treatments was 60%, and was 6, 60 and 72% for **H**, **F**, and **I**, respectively. The **ED** over all treatments was 29%, and was 13, 40 and 21% for **H**, **F**, and **I**, respectively. Present findings show a poor level of agreement between the 2 methods even though the correlation was high for **H** and average values were similar for **F** and **I**.

Key Words: Urinary PD, Purine, Microbial N

W231 Efficiency of microbial N supply (EMNS) and digestibility of N in dairy cows fed timothy conserved as restrictively- or extensively-fermented silage or as hay. R. Martineau*[1], H. Lapierre[2], D. R. Ouellet[2], D. Pellerin[1], and R. Berthiaume[2], [1]*Université Laval*, *Québec, Canada*, [2]*Dairy and Swine R&D Centre, AAFC*, *Lennoxville, Québec, Canada*.

The effects of three modes of conservation of timothy (*Phleum pratense L.*) on EMNS and N digestibility were investigated in a replicated 3 x 3 Latin square design with 35-d periods. Timothy was conserved as: 1) hay (**H**), 2) restrictively- (**F**; formic acid), or 3) extensively-fermented silage (**I**; inoculant). Diets (forage-to-concentrate ratio of 60:40) were tested in 6 ruminally- and intesti-

nally-cannulated Holstein cows (DIM = 162 ± 135) fed 12 equal daily meals. On days 34 and 35, 8 digesta samples (duodenal, ileal and fecal) were collected (ileal sampling on 3 cows only). Chromium oxide was used as an indigestible marker. Microbial N flow was estimated from the purine flow and the purine:N ratio of duodenal bacteria. The DMI averaged 14.7 kg/d (SEM = 1.14; P = 0.86). The EMNS was not affected by treatments. Duodenal N flux averaged 385 g/d and was similar (SEM = 31.0; P = 0.96) among treatments despite a lower N intake for cows on the hay diet. Cows receiving the hay diet had a higher preduodenal N recycling than cows receiving the silage diets. Total tract digestibility of N was not affected by treatments (P = 0.55) but intestinal digestibility of N was 3% higher (P = 0.01) in cows receiving the hay diet. Intestinal digestibility of non-microbial N was not affected by treatments (P = 0.43) whereas that of microbial N was 4% higher (P = 0.04) in cows receiving the hay diet compared to cows receiving the silage diets. Digestibility of microbial N in the small intestine was 10% greater (P = 0.06) for cows receiving the hay compared to the silage diets. Extent of silage fermentation did not affect any of the measured parameters. In conclusion, expected benefits on EMNS associated with feeding a forage with a low protein solubility and a high water soluble carbohydrate content were not observed in this experiment.

	Treatments				Contrasts (P)	
	H	**F**	**I**	SEM	**H** vs **F+I**	**F** vs **I**
EMNS[a]						
- g MN/kg OMADR	49.2	46.2	50.1	9.70	0.83	0.42
- g MN/kg OMTDR	29.5	28.3	29.3	3.35	0.71	0.61
N intake, g/d	275	310	317	24.7	< 0.01	0.43
Preduodenal N recycling, g/d	109	73	66	26.5	0.03	0.65
Non-microbial N, g/d						
- duodenal	135	146	137	16.7	0.37	0.22
- ileal	57	60	67	12.4	0.60	0.53
- fecal	63	64	65	13.0	0.75	0.93
Microbial N, g/d						
- duodenal	248	239	246	24.5	0.71	0.62
- ileal	50	78	71	7.4	0.15	0.41
- fecal	37	45	46	8.1	0.07	0.71

[a]OMADR and OMTDR: OM apparently and truly digested in the rumen

Key Words: Microbial Synthesis, Restrictively-Fermented Silage, Extensively-Fermented Silage

W232 Endogenous nitrogen (EN) flows: Effects of methods of conservation of timothy in lactating dairy cows. D. R. Ouellet*[1], R. Berthiaume[1], G. Holtrop[2], G. E. Lobley[3], R. Martineau[4], and H. Lapierre[1], [1]*Agriculture and Agri-Food Canada*, *Lennoxville, Canada*, [2]*BIOSS, Aberdeen, UK*, [3]*Rowett Research Institute*, *Aberdeen, UK*, [4]*Department of Animal Science, U. Laval*, *Quebec, Canada*.

The current NRC model (2001) estimates EN at the duodenum as 1.9 g per d per kg DMI, with no allowance for differences in diet quality. The current study used 4 lactating cows in a replicated incomplete 4x3 Latin square to study the effect of 3 methods of conservation of timothy (*Phleum pratense* L.) on EN flows. Treatments were: 1) sun-cured hay (**H**), 2) formic acid-treated silage (**F**) or 3) inoculated silage with *L. plantarum* and *P. cerevisiae* (**I**). Diets (60% forage) were fed every 2h. From d 27 to 35, cows were infused into a jugular vein with ^{15}N-leucine (0.45 mmol/h). On d 34 and 35, intestinal wall, duodenal digesta and feces were sampled (4 samples/day) to determine enrichment of ^{15}N. Contributions of EN flows were calculated as described (Ouellet et al., 2002; JDS 85:3013). Nitrogen intake and total N flow at the duodenum were similar between treatments but the contribution of free EN was greater for cows when fed H, both in absolute terms (P=0.06) or related to DMI (P=0.04; 3.0, 1.8, and 1.8 ± 0.36% of DMI for H, F and I). Total EN at the duodenum, however, was not affected by diets (84, 72, 75 ± 6.1 g/d for H, F and I). The EN loss in feces did not vary with treatments but real intestinal N digestibility was higher (P=0.06) for cows when fed H compared with F or I (77.5, 74.3, and 73.7 ± 0.75%). Overall, total EN represented 20% of total N at the duodenum and tended to vary (P=0.09) with diets (5.9, 4.5, 4.6 ± 0.54% of DMI for H, F and I), with a greater contribution than adopted by NRC (2001).

	Treatment				P	
Parameter (g N/d)	H	F	I	SEM	H vs. F, I	F vs. I
Intake	263	302	302	19.4	0.14	0.99
Duodenal digesta	399	398	381	23.1	0.74	0.54
-Undigested feed	126	130	114	12.5	0.79	0.32
-Free EN	43	29	30	4.5	0.06	0.91
-Bacterial	231	239	237	9.4	0.52	0.86
— From feed	155	158	156	8.8	0.90	0.86
— From EN	42	43	45	2.1	0.46	0.48
— From urea-N	34	39	37	2.0	0.13	0.42
Feces	97	111	111	5.2	0.07	0.91
-EN from duodenal EN	19	18	20	1.3	0.96	0.47
-EN from SI[a] secretions	8	9	10	3.4	0.60	0.83

[a]SI: small intestine

Key Words: Endogenous, Gastrointestinal Tract, Forage Conservation

W233 Effects of glutamate on microbial efficiency and metabolism in continuous culture of ruminal contents and on performance of mid-lactation dairy cows. H. M. Dann*[1], C. S. Ballard[1], R. J. Grant[1], K. W. Cotanch[1], M. P. Carter[1], and M. Suekawa[2], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Zen-Noh National Federation of Agricultural Co-operative Associations*, *Tokyo, Japan*.

Three experiments were conducted to determine 1) the dose of glutamate (Glu) needed to alter fermentation and N partitioning in a continuous culture system, 2) the effect of supplemental Glu in diets varying in rumen-undegradable protein (RUP) on fermentation and N partitioning in a continuous culture system, and 3) the effect of dietary supplemental Glu on the performance of lactating Holstein cows, total tract nutrient digestibility, and microbial N synthesis. All experiments added Glu in the form of monosodium L-glutamate. In Experiment 1, 0, 40, or 80 g Glu·cow^{-1}·d^{-1} was added to a basal diet and evaluated in a continuous culture system using a completely randomized design. Glu linearly decreased crude protein (CP) digestion (72, 67, 62%; P=0.03) and microbial N (2.1, 1.9, 1.7 g/d; P=0.02) and linearly increased non-ammonia, non-microbial N (NANMN; 0.8, 1.0, 1.2 g/d; P=0.03). Glu did not affect (P>0.05) carbohydrate digestion, volatile fatty acid (VFA) production, or fermenter pH. In Experiment 2, diets were formulated to have high RUP [HRUP; 6.8% of dry matter (DM)], low RUP (LRUP; 6.2% of DM), and low RUP plus 80 g Glu·cow^{-1}·d^{-1} (LRUP+G). Diets were evaluated in a continuous culture system using a completely randomized design. Digestion of CP and carbohydrate, microbial N, and NANMN were similar (P>0.05) among diets. LRUP+G had lower VFA production (376 vs 412 mmoles/d; P=0.04) and higher fermenter pH (6.3 vs 6.1; P=0.04) than LRUP. In Experiment 3, 40 lactating cows were utilized in a crossover study to test the effect of 2 dietary treatments: 0 or 80 g of supplemental Glu·cow^{-1}·d^{-1}. Glu did not affect (P>0.05) milk yield (0 vs 80 g Glu; 34.8 vs 34.2 kg/d), microbial N (254 vs 257 g/d), or total tract nutrient digestion. Based on the results from these in vitro and in vivo experiments, the addition of Glu to lactating cow diets is not recommended.

Key Words: Glutamate, Dairy Cow, Rumen

W234 Metabolic and production responses of dairy cows to glutamine (Gln) supplementation. L. Doepel*[1], J. F. Bernier[2], G. E. Lobley[3], P. Dubreuil[4], M. Lessard[5], and H. Lapierre[5], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Universite Laval*, *QC, Canada*, [3]*Rowett Research Institute*, *Aberdeen, UK*, [4]*Coll. Vet. Med., U. Montreal*, *St. Hyacinthe, QC, Canada*, [5]*Agriculture & Agri-Food Canada*, *Lennoxville, QC, Canada*.

This study examined the effect of supplemental Gln on the plasma metabolic profile and milk production of lactating dairy cows. Seven multiparous Holstein cows received abomasal infusions immediately after calving of either 300 g/d Gln (85 mmol/h) delivered in 10 L of water, or water alone in a crossover design with 21 d periods. Cows were fed a TMR twice daily except during d18-21 when they were fed 12x daily. Jugular blood samples were obtained on d4, 11, and 18 of each period. Dry matter intake was higher for the control cows than the Gln treated cows (18.9 vs. 18.0 ± 0.24 kg/d, P = 0.04) during d12-17. Both milk (39.4 vs. 41.2 ± 0.72 kg/d, P = 0.14) and milk protein (1197 vs. 1291 ± 57.0 g/d, P = 0.30) yields were unaffected by Gln treatment. Gln supplementation increased plasma Gln concentrations by 45% (225 vs. 326 ± 10.7 µM, P = 0.001). Total essential AA concentrations tended to be lower in Gln cows (900 vs. 756 ± 50.1 µM, P = 0.10). Glucose, lactate, NEFA, and BHBA concentrations were not affected by treatment, while urea-N increased with Gln supplementation (Table). These data suggest that decreased concentrations of Gln observed in early lactation do not limit milk protein secretion although an effect on AA metabolism cannot be excluded.

Plasma metabolite concentrations

	Ctrl	Gln	SEM	P
BHBA, mM	1.6	0.9	0.25	0.12
Glucose, mM	3.2	3.3	0.09	0.20
Lactate, mM	0.6	0.8	0.17	0.43
NEFA, mM	932	913	62.9	0.84
Urea, mM	8.3	11.2	0.19	0.01
Ala, mM	182	181	13.0	0.96
Glu, mM	41	42	1.2	0.36
Gly, mM	440	385	18.1	0.08
His, mM	48	51	2.0	0.35
Leu, mM	179	147	10.5	0.08
Lys, mM	75	63	5.1	0.14
Met, mM	29	23	1.4	0.04
Tyr, mM	42	36	2.0	0.08
Val, mM	267	213	15.9	0.06

Acknowledgements: Thanks to Ajinomoto for supplying the glutamine.

Key Words: Glutamine, Metabolic Response, Dairy

W235 Effect of glutamine (Gln) supplementation on splanchnic flux in lactating dairy cows. L. Doepel*[1], J. F. Bernier[2], G. E. Lobley[3], P. Dubreuil[4], M. Lessard[5], and H. Lapierre[5], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Universite Laval*, *Quebec, Canada*, [3]*Rowett Research Institute*, *Aberdeen, UK*, [4]*Coll. Vet. Med., U. Montreal*, *St. Hyacinthe, QC, Canada*, [5]*Agriculture & Agri-Food Canada*, *Lennoxville, QC, Canada*.

Seven multicatheterized Holstein cows were used to determine if Gln affected net splanchnic flux of N and energy metabolites. Cows received abomasal infusions of water (10L) or 300 g/d Gln (85 mmol/h) in a cross-over with 21-d periods starting 1 d after calving. Cows were fed a TMR every 2 h during the last 4 d of each period. On d 21, six blood samples were collected simultaneously from arterial, portal and hepatic vessels at 45 min intervals. Para-amino hippurate was infused to determine blood flows. Together, the increment in Gln plus Glu portal absorption accounted for 77% of the Gln infused. Despite increased Gln absorption, the increment in hepatic removal resulted in no effect on splanchnic net release of Gln (13 vs 2 ± 5.4 mmol/h: P = 0.22). Although there was no effect on individual amino acids (AA), Gln tended to decrease absorption of the total AA-N measured (sum of Ala, Glu, Gly, His, Ile, Leu, Lys, Met, Phe, Ser, Thr, Tyr & Val; excludes Gln). Splanchnic net flux of total AA-N also decreased with Gln (362 vs 253 ± 34.0 mmol/h; P = 0.08). Increased hepatic removal of total AA and Gln was accompanied by elevated ureagenesis. Net portal flux of glucose was unaffected by Gln, indicating no sparing of glucose utilization by the gut. Despite reports that Gln impacts on intestinal metabolism *in-vitro*, supplementation to cause a major increase in Gln net absorption does not appear to improve either energy (glucose and lactate) or protein (AA) metabolism across the gut of lactating dairy cows.

Effect of Gln infusion on net splanchnic flux of N and energy metabolites (mmol/h)

	portal Ctrl	portal Gln	SEM	P	liver Ctrl	liver Gln	SEM	P
Gln	8	69	5.7	0.01	6	-67	7.0	0.01
Glu	10	13	0.9	0.03	31	28	1.5	0.22
Ala	84	88	5.1	0.62	-63	-77	8.7	0.30
Total AA-N[1]	502	461	19.7	0.19	-140	-208	47.5	0.34
Urea-N	-478	-469	55.0	0.91	1120	1378	109.6	0.16
Ammonia	446	480	32.3	0.49	-428	-470	30.0	0.37
Glucose	33	23	17.9	0.71	692	666	57.9	0.76
Lactate	164	176	6.3	0.22	-291	-293	23.4	0.94

[1]Excludes Gln

Acknowledgements: Thanks to Ajinomoto for supplying the glutamine

Key Words: Glutamine, Splanchnic, Dairy

W236 Determination of the first-limiting amino acid for milk production in dairy cows consuming a high concentrate diet containing corn and soybean meal. H. S. Kim[1], J. M. Yeo*[1], K. S. Ki[1], and C. -H. Kim[2], [1]*Dairy Science Division, National Livestock Research Institute, Rural Development Administration*, *South Korea*, [2]*Department of Animal Life and Resources, Hankyong National University*, *South Korea*.

Four lactating Holstein cows consuming a high concentrate diet were used in a 4 x 4 Latin square with 10-d periods to determine the first-limiting amino acid (AA) for milk production. The four intravenous infusion treatments were no infusion (control); a mixture of 6 g/d methionine, 19.1 g/d lysine, 13.8 g/d isoleucine and 15.4 g/d valine (4AA); the mixture without methionine (-Met); and the mixture without lysine (-Lys). Cows were given a basal diet of alfalfa hay (1 kg/d), corn silage (10 kg/d) and a concentrate mixture (14 kg/d; 63.0 % dry ground corn, 20.0 % soybean meal, 9.4 % cotton seed meal, 6.0 % sugar beet pulp and 1.6 % mineral and vitamin mixture on a fresh weight basis) and *ad libitum* access to timothy hay. The four AA were expected as limiting AA, which would be deficient for milk production from the basal diet according to NRC (2001). Alfalfa hay, corn silage and the concentrate mixture were completely consumed on all treatments. Relative to control, the 4AA treatment significantly (P < 0.05) increased the yield (913 vs. 997 g/d) and concentration (2.93 vs. 3.08 %) of milk protein and this response was not diminished by omission of lysine. However, excluding of methionine showed no response over control, suggesting that methionine was the first limiting AA. No significant differences were found in timothy hay DM intake and milk yield between treatments. The 4AA treatment numerically increased the concentrations of the infused AA in plasma compared with control. The results of the present experiment indicate that secretion of milk protein was limited only by methionine deficiency in cows fed a high concentrate diet containing primarily corn and soybean meal although it was calculated that lysine, isoleucine and valine would seem to be also deficient.

Key Words: Amino Acids, Milk Protein, Dairy Cow

W237 Effect of supplementing rumen-protected methionine at two levels of dietary crude protein in lactating dairy cows. G. A. Broderick*[1], M. J. Stevenson[2], R. A. Patton[3], N. E. Lobos[4], and J. J. Olmos Colmenero[4], [1]*U.S. Dairy Forage Research Center*, *Madison, WI.*, [2]*Degussa Corp.*, *Kennesaw, GA*, [3]*Nittany Dairy Nutrition, Inc.*, *Mifflinburg, PA*, [4]*University of Wisconsin*, *Madison*.

Leonardi et al. (J. Dairy Sci. 86:4033, 2003) reported that supplementing rumen-protected Met (RPM) increased milk protein concentration at both 16.1 and 18.8% crude protein (CP), with no interaction. This would be unexpected if Met were the first-limiting metabolizable AA. Cows in their study were calculated to be in positive energy balance. A 4x4 Latin square lactation trial was conducted with a 2x2 arrangement of diets: 17.3 or 16.1% CP, with or without supplementation of about 15 g/d of RPM (as Mepron®). Diets were fed as TMR and contained (DM basis) 21% alfalfa silage, 28% corn silage, 4.5% roasted soybeans, 5.8% soyhulls, 0.6% sodium bicarbonate, 0.5% vitamins and minerals, and 27% NDF. Dietary CP was lowered by replacing solvent soybean meal with high moisture shelled corn. Thirty-two multiparous Holstein cows averaging 604 kg BW were blocked by DIM into 8 groups and randomly assigned to the 4x4 Latin square sequences. Periods were 4-wk long and production data were collected from the last 2-wk. The statistical model included square, period, cow(square), CP, RPM, and CP*RPM; least square means are reported. All treatments were calculated to be in negative energy balance due to lower than expected DMI. There were no effects of RPM supplementation on any production trait. However, higher CP increased ($P \leq 0.03$) yield of milk, protein, and SNF by 1.0, 0.04, and 0.11 kg/d; there were trends ($P \leq 0.09$) for increased DM intake and lactose yield at higher CP. A trend ($P = 0.08$) for an interaction suggested that protein yield increased when RPM was fed at higher CP but decreased when RPM was fed at lower CP. However, apparent N efficiency (milk N/N-intake) was greater ($P < 0.01$), and MUN lower ($P < 0.01$), on lower CP diets and both were unaffected by RPM feeding. Under the conditions of this trial, reducing dietary CP from 17.3 to 16.1% reduced yield of milk, protein and SNF and this reduction was not reversed by supplementing with RPM.

Item	CP, %	17.3	17.3	16.1	16.1	Contrasts (P > F)		
RPM g/d		0	15.4	0	14.6	SE	CP	RPM	CP*RPM
DMI, kg/d		21.6	21.8	21.6	20.9	0.3	0.09	0.44	0.14
Milk, kg/d		39.8	40.1	39.2	38.7	0.4	0.01	0.87	0.34
Fat, %		3.57	3.59	3.65	3.62	0.09	0.55	0.94	0.81
Fat, kg/d		1.40	1.43	1.42	1.38	0.04	0.71	0.94	0.81
Protein, %		3.08	3.09	3.07	3.06	0.02	0.37	0.98	0.67
Protein, kg/d		1.21	1.23	1.19	1.17	0.01	0.01	0.94	0.08
SNF, %		8.85	8.85	8.83	8.83	0.02	0.24	0.79	0.99
SNF, kg/d		3.47	3.57	3.44	3.38	0.05	0.03	0.67	0.10
MUN, mg/dl		12.4	12.1	10.2	10.2	0.2	< 0.01	0.38	0.45
Milk N/N-intake		0.32	0.32	0.34	0.35	0.01	< 0.01	0.37	0.91

Key Words: Mepron, Rumen-Protected Methionine, Milk Yield

W238 Effects of supplemental DL-methionine and L-lysine-HCl on ruminal fermentation and ruminal and total tract digestibility in non-lactating Holstein cows. H. G. Bateman, II*, T. W. Braud, C. C. Williams, D. T. Gantt, C. F. Hutchison, J. D. Ward, P. G. Hoyt, and G. A. Sod, *Louisiana State University*, *Baton Rouge*.

Four non-lactating Holstein cows (average 642 kg body weight) were used in a replicated switchback design experiment to evaluate the use of supplemental DL-methionine and L-Lysine-HCl on ruminal fermentation and apparent ruminal and total tract digestibility. The base diet consisted of (DM basis) 45% corn silage, 20% cottonseed hulls, 15% ground corn, 15% soybean meal, and 5% vitamin and mineral premix. Treatments were either the base diet or the base diet top dressed with 190 g L-lysine-HCl and 20g DL-methionine. To insure that cows would consume all feed, as offered feed intake was restricted to approximately 12 kg/d prior to the addition of the amino acids. Periods were 7 d in length with an abrupt switch of treatments at the beginning of each period. Flow of digesta was estimated using Cr_2O_3 (10 g/d) as an external marker. Samples were collected every 4 h over the last 3 d of each period moving the collection time forward 2 h each day. Addition of amino acids tended ($P < 0.1$) to increase DMI but had no effect of apparent ruminal or total tract dry matter digestibility. Apparent total tract N digestibility was not affected by treatment. Ruminal pH averaged 6.4 and was not affected by addition of amino acids. Addition of amino acids did not alter the proportions of VFA or total VFA concentrations in ruminal fluid. Ruminal ammonia N averaged 2.9 mg/dl but was not affected by treatment. Results indicate that supplemental methionine and lysine were not effective in stimulating ruminal fermentation and altering ruminal or total tract digestibility in non-lactating cows.

Key Words: Rumen, Methionine, Lysine

W239 The effects of Alimet feed supplement and Sequent feed supplement on rumen digestibility, protein synthesis and ruminal disappearance. M. Vazquez-Anon*, *Novus International, Inc*, *St. Louis, MO*.

A dual effluent continuous culture system was used to investigate the effect of inclusion of Alimet (2 hydroxy 4 [methylthio] butanoic acid (HMTBA),source Novus International, Inc.) and Sequent (2-propyl ester of HMBTA (HMTBi), source Novus International, Inc) in the diet on nutrient digestibility, bacterial protein synthesis and ruminal disappearance. Twelve fermenters were fed a basal diet two times a day that consisted of 52% grain mixture and 48% forage for 9 days. In experiment one, 0, 0.1% of HMTBA, and 0.1% HMTBi were added to the diet and fed to the fermenters. In experiment two, 0.1% HMTBA was added to the diet in the presence and absence of active yeast (10^{12} cfu/kg diet), and in experiment three, 0.1% HMTBA + 65 ppm Agrado® feed supplement were added to a diet that contained 1.9% rumen protected fat or 1.9% of a blend of corn, linseed, and menhaden fish oils. In experiment one, HMTBA significantly improved and HMTBi significantly ($P < 0.05$) reduced microbial protein synthesis and efficiency. The by-pass of HMTBA and HMTBi were 63% and 75%, respectively. In experiment two, HMTBA improved CP digestibility, microbial protein synthesis and efficiency, and yeast improved CP and ADF digestibility. In experiment three, addition of HMTBA + Agrado restored the microbial protein synthesis depression observed in diets with unprotected fat. It can be concluded that a fraction of HMTBA survived rumen degradation and therefore provides a rumen protected form of methionine at the same time as it improves bacterial protein synthesis and efficiency in the presence and absence of yeast and unprotected fat. It is also concluded that a fraction of HMTBi escapes rumen degradation but has limited ruminal effect.

Acknowledgements: ALIMET and AGRADO are trademarks of Novus International, Inc. and are registered in the United States and other countries SEQUENT is a trademark of Novus International, Inc.

Key Words: HMTBA, Yeast, Fat

W240 Effects of corn source with or without supplementation of lysine and methionine on milk production in dairy cows. C.-H. Kim*[1], H. S. Kim[2], and J. M. Yeo[2], [1]*Hankyong National University*, *Ansung, Gyeonggi, Korea*, [2]*Dairy Science Division, National Livestock Research Institute, Rural Development Administration*, *Cheonan, Chungbuk, Korean*.

Four lactating Holstein cows were used in a 4 x 4 Latin square with four 10-day periods and a 2 x 2 factorial arrangement of treatments to examine the effect of intravenous infusions of lysine (19.1 g/d) and methionine (6 g/d) (IVLM) in diets containing dry ground (GC) or steam flaked corn (SFC) on milk production. The treatments were as follows: GC diet, GC diet plus IVLM, SFC diet and SFC diet plus IVLM. Cows were given a fixed amount of alfalfa hay (1 kg/d), corn silage (10 kg/d) and a concentrate mixture (14 kg/d) containing primarily GC or SFC (410 g/l) and *ad libitum* access to timothy hay. There were no interactions between the amino acids infusion and corn source. Alfalfa hay and corn silage and the concentrate mixture were completely consumed on all treat-

ments. Timothy hay DM intake (10.4, 10.1, 8.7 and 8.5 kg/d, respectively) was significantly lower for the SFC diet than for the GC diet ($P < 0.01$) but the amino acids infusion did not affect it. No significant differences were found in milk yield (36.3, 35.8, 36.8 and 36.6 kg/d) between treatments. Therefore, the SFC diet significantly increased feed efficiency (4 % fat corrected milk/DM intake) compared with the GC diet (1.38, 1.33, 1.53 and 1.54; $P < 0.001$). There were no significant differences in the concentrations and the yields of milk composition between treatments with the exception that the SFC diet significantly increased milk protein yield (1087, 1103, 1143 and 1135 g/d; $P < 0.01$) compared with the GC diet. Allantoin/creatinine ratio in spot urine and the concentrations of glucose and urea-N in plasma were not affected by treatments. The results of the present experiment show that the diet itself was sufficient to meet the requirement of methionine and lysine for milk production and that the yield of milk protein could be modulated by changes in corn source.

Key Words: Corn Source, Amino Acids, Dairy Cow

W241 Effect on milk protein of reducing crude protein intake while maintaining methionine and lysine: A field study. L. E. Armentano[1], R. A. Patton*[2], and M. J. Christians[3], [1]*University of Wisconsin*, *Madison*, [2]*Nittany Dairy Nutrition*, *Mifflinburg, PA*, [3]*Degussa Corporation*, *Kennesaw, GA*.

The objective of the study was to increase the ratio of methionine and lysine as % of metabolizable protein by maintaining the supply of methionine and lysine as predicted by the Mepron 2.6 program, while reducing the amount of CP in the diets of dairy cows. Treatments consisted of a Control which was the normal herd ration and an AA Balanced ration which was balanced for the same g of MET and LYS but lower in CP. Predicted LYS g were maintained with soybean products and blood meal and MET g with corn gluten meal, fishmeal or Mepron®. The experiment was conducted over 6 wk, consisting of 2 periods of 3 wk. Nineteen herds in central Wisconsin participated with half the herds starting the experiment on the control diet and half on the AA Bal diet. At the end of 3 wk diets were abruptly switched. Once each period milk was weighed and sampled for milk components. Statistical analysis was by Proc Mixed of SAS and included terms for diet, sequence, period and herd, where herd was the observational unit. Data from pre-peak cows or cows that left the herd prior to period 2 sampling were excluded. The AA bal diets were only slightly lower in CP (17.2%) compared to the control (17.9%). This resulted in slight, but significant differences in AA % MP (2.10 vs 2.18 for MET and 7.11 vs 7.17 for LYS, both P<.01) and LYS:MET (3.39 vs 3.29) for control relative to AA Bal rations. Production variables were unaffected by diet. We conclude there is potential to reduce the amount of CP in dairy diets. If MET and LYS as MP affect milk protein percent, differences would need to be larger than those in this study.

Item	Control Mean	AA Bal Mean	SEM	Diet P Values	Sequence P Values	Period P Values
Milk kg/d	34.6	34.5	0.53	0.89	0.55	0.01
Protein %	3.19	3.23	0.03	0.18	0.10	0.44
Protein kg/d	1.10	1.11	0.08	0.71	0.85	0.02
Fat %	3.69	3.63	0.08	0.45	0.73	0.50
Fat kg/d	1.27	1.25	0.12	0.42	0.33	0.04

Key Words: Methionine, Lysine, Metabolizable Protein

W242 Postruminal protein infusion increases leucine use by the gastrointestinal tract of sheep while glucose utilization remains unchanged. S. El-Kadi*[1], R. Baldwin, VI[2], N. Sunny[1], S. Owens[1], and B. Bequette[1], [1]*University of Maryland*, *College Park*, [2]*USDA-ARS*, *Beltsville, MD*.

To date, the metabolism of amino acids (AA) and glucose by the gastrointestinal tract (GIT) of ruminants in response to increments of postruminal protein supply has not been studied. Our aim was to determine if leucine and glucose metabolism by the mesenteric (MDV; small intestine) and portal (PDV; whole gut) drained viscera represents a fixed amount or a fixed fraction of intestinal supplies in sheep fed a low protein diet with duodenal casein infusion. Wethers (n=4, 33 ± 2.0 kg) were fitted with catheters for casein infusion and for measurements of PDV and MDV leucine and glucose metabolism. Animals were fed a forage-based diet (9.5 % CP) to 1.4 × maintenance and given 5-d duodenal casein (0, 35, 70 and 105 g/d) infusions in a 4 × 4 Latin square design. On day 5 of each period, jugular [1-^{13}C]leucine and [6-$^{2}H_2$]glucose and duodenal [$^{2}H_3$]leucine tracers and a blood flow marker were infused for 8 h. Blood was continuously withdrawn over 1-h intervals during the last 4-h period of tracers infusion. Postruminal protein supplementation increased whole body leucine irreversible loss ($P < 0.05$). Leucine arterial sequestration by the MDV was not affected, however, arterial sequestration by the PDV increased linearly ($P < 0.05$) in response to casein infusion. Leucine removal by the GIT represented a fixed proportion of leucine irreversible loss (MDV = .16; PDV = .33) for all levels of casein. Despite the increase in glucose entry rate with casein infusion ($P < 0.05$) and the significant increase in blood glucose concentration, GIT arterial removal did not change. Our data show that casein infusion could have stimulated hepatic gluconeogenesis possibly from AA. It also appears that the GIT is opportunistic in its use of AA from arterial and/or luminal sources, whereas the fixed glucose utilization could reflect an obligatory GIT requirement.

Key Words: Leucine, Glucose, Gastrointestinal Tract

W243 Appearance of free and peptide-bound AA in blood from the rumen, abomasum, and intestines and in lymph from the intestine of sheep. L. A. Sullivan and K. E. Webb, Jr.*, *Virginia Tech*, *Blacksburg*.

Appearances of free (FAA) and peptide-bound AA (PBAA) in blood from the rumen, abomasum, and intestines and in lymph from the intestine were quantified. Six ewe lambs (avg. wt. = 28.2 kg) were anesthetized with pentobarbital 2 hr postprandial, the abdominal cavity was opened and a catheter was placed in a mesenteric lymph duct and lymph was collected on ice for 30 min. Blood was collected via syringe and needle from a mesenteric artery and from ruminal, abomasal, and mesenteric veins midway through lymph collection and plasma was separated immediately by centrifugation. Lymph and plasma were combined with two volumes of methanol and allowed to stand at 2°C overnight and then were centrifuged (27,000 x g, 2°C, 30 min) and the supernatants were filtered using Centricon-3-microconcentrator 3,000 MW cut-off filters. Individual AA concentrations were determined on the filtrate for FAA and the filtrate following hydrolysis (vaporized HCl at 112°C for 24 h) for total AA. Concentrations of PBAA were calculated as the difference between total and FAA. There was a net appearance of total FAA and PBAA in blood draining the intestines and rumen as indicated by positive veno-arterial differences. There was a net appearance of total PBAA in and a net disappearance of total FAA from blood draining the abomasum as indicated by positive and negative, respectively, veno-arterial differences. Concentrations of individual FAA were greater ($P < 0.04$ to 0.001) than PBAA in lymph from the intestine and were reflected in a greater ($P < 0.001$) total FAA than PBAA concentration (274.6 and 122.2 mg/L, respectively). As observed previously, the results of the present study confirm that both FAA and PBAA enter the blood from the rumen and the intestine. The novel observations from the present study are that peptides may be absorbed from the abomasum and that both FAA and PBAA leave the intestine via the lymph. Accounting for the contributions of all of these pools will result in the most accurate estimate of absorbed AA.

Key Words: Amino Acid, Peptides

W244 Digestibility and N flux in steers fed diets with differing sources of supplemental protein. J. Eisemann*, G. Huntington, and M. Poore, *North Carolina State University*, *Raleigh*.

The objective was to determine the nutritional value of duckweed (DW, *Lemma gibba*, 391g CP/kg DM) in diets of cattle. The DW used was harvested locally and dried until DM reached 90%. The experimental design was a 4 X 4 Latin square with four Holstein steers (326 kg BW). Steers were fed diets containing no supplemental protein (Basal), a positive control with supplemental protein from soybean meal (SBM), a diet with 2/3 of the supplemental protein from corn gluten meal (CGM) and a diet with 2/3 of the supplemental protein from

DW. The basal diet included (g/kg DM) wheat hay (440), soybean hulls (255), ground corn grain (250), minerals (12.5) and molasses (42.5). Diets were fed at 2.8 kg/d per 100 kg BW. Each period was 2 wk of dietary adaptation followed by a 5-d total urine and feces collection. Beginning 4 d before and during the balance trial steers were fed equal-weight meals every 6 h. A 60 min infusion (i.v.) of ^{15}N-glycine (2.6 mg/kg BW) was begun on d2 of the balance trial. Total urine was collected at 5, 11, 17, 23, 35, 47 and 71 h following glycine infusion. Concentration and ^{15}N-enrichment of urinary urea were determined for calculation of N flux. N excreted was subtracted from N flux to estimate N used to synthesize protein (PS). Individual treatment values were compared where protein sources differed (P<0.10). Data are listed for Basal, SBM, CGM and DW treatments, respectively. N digestibility was greater (P<0.01) for supplemented diets and greater (P=0.06) for DW than SBM. Values (%) were 46.2, 55.0, 58.3 and 60.4. N intake, N retained, and N retained/N digested values were greater (P<0.01) for supplemented diets. N retained/digested was greater (P<0.05) for CGM than DW. Values for N intake (g/d) were 135.1, 172.2, 173.1, and 176.5; for N retained (g/d) were 35.2, 52.2, 62.5, and 56.2; and for N retained as % of digested were 56.4, 54.9, 63.1 and 51.9. N flux toward PS was greater (P<0.01) for supplemented diets and greater (P<0.05) for SBM than DW. Values (g/d) were 249, 335, 314, and 290. Steers readily consumed the DW. Post-absorptive use of N from DW was less efficient than from CGM.

Key Words: Steers, Protein Supplements, Protein Turnover

W245 Effect of RDP source on production and ruminal metabolism of lactating dairy cows. S. M. Reynal*[1] and G. A. Broderick[2], [1]*University of Wisconsin*, *Madison*, [2]*US Dairy Forage Research Center*, *Madison, WI.*

Twenty-eight lactating dairy cows (8 with ruminal cannulas) averaging 137 DIM were used in a 4 x 4 Latin square design with 28-d periods to study the effect of dietary RDP source on production and ruminal metabolism. Diets contained (DM basis) 15% alfalfa silage, 40% corn silage, 29 to 27% high-moisture corn, and 16 to 18% concentrate mix. Proportions of ingredients (DM basis) in the four concentrate mixes in diets A to D were changed in equal increments to replace RDP from solvent soybean meal (SSBM) with RDP from urea as follows: ground shelled corn, from 0 to 6.3%; SSBM, from 13.7 to 2.7%; lignosulfonate-treated SBM, from 0 to 6.0%, and urea, from 0 to 1.0%. Diets contained on a DM basis 16.3% CP, 26% NDF, and 14% ADF. Estimated (NRC, 2001) dietary concentrations of NEl, NFC, RDP, and RUP were constant across diets and were, respectively, 1.60 Mcal/kg and 50, 10.6, and 5.7% of diet DM. Data were analyzed as a Latin square design using the Proc Mixed procedure of SAS. Linear effects (tested using contrasts) of replacing SSBM with urea from diets A to D were negative for DMI (23.6 to 22.3 kg/d; P < 0.01), body weight gain (BWG; 0.57 to 0.34 kg/d; P = 0.04), and yields of milk (39.3 to 36.0 kg/d; P < 0.01), 3.5% FCM (36.7 to 34.2; P < 0.01), milk protein (1.27 to 1.17 kg/d; P < 0.01), milk fat (1.20 to 1.11 kg/d; P = 0.02), and SNF (3.59 to 3.32 kg/d; P < 0.01). Concentrations of fat, protein, and SNF in milk and ruminal pH were not significantly affected by RDP source and averaged, respectively, 3.05, 3.19, and 9.04%, and 6.53 across diets. Replacing non-urea N with urea N in the RDP resulted in linear increases in the concentrations of urea-N in milk (from 6.8 to 9.1 mg/dl; P < 0.01) and blood (from 8.9 to 12.8 mg/dl; P < 0.01) and of ammonia-N in the rumen (from 8.4 to 10.8 mg/dl; P < 0.01). Replacing SSBM with urea in the RDP negatively affected milk production and BWG (mainly through an effect on DMI) and N utilization in lactating dairy cows.

Key Words: RDP Source, Performance, Dairy Cows

W246 Effects of protein source on ruminal and total tract nutrient digestibility in non-lactating Holstein cows. T. W. Braud*, H. G. Bateman, II, C. C. Williams, C. C. Stanley, D. T. Gantt, C. F. Hutchison, J. D. Ward, P. G. Hoyt, and G. A. Sod, *Louisiana State University*, *Baton Rouge*.

Six non-lactating Holstein cows with ruminal and duodenal cannulas were used in a replicated 3x3 Latin square design experiment to investigate the effects of supplemental protein source on ruminal and total tract digestibilities. Supplemental protein was provided from soybean meal (SBM), expeller processed soybean meal (EXP), or menhaden fish meal (FISH). Basal diets consisted of (DM basis) 33% corn silage, 20% bermudagrass hay, 27% ground corn, and 2% minerals and vitamins. Supplemental protein was provided as (DM % of total diet) 18% soybean meal (SOY), 17% soybean meal and 1% fish meal (FISH), or 12% soybean meal and 6% expeller processed soybean meal (EXP). Period length was 14 d. Flow of digesta was estimated using Cr_2O_3 (20g/d) as an external marker. Dry matter intake averaged 9.5 kg/d and was not affected by treatment. Apparent ruminal dry matter digestibility was not affected by source of supplemental protein. Source of supplemental protein did not affect apparent total tract dry matter digestibility. Feeding low ruminal degradable protein to non-lactating cows resulted in no appreciable impact on feed intake or apparent diet digestibility.

Key Words: Rumen, Protein, Degradability

W247 Influence of slow-release urea on N balance and nutrient absorption of steers. C. C. Taylor*[1], N. A. Elam[1], S. E. Kitts[1], K. R. McLeod[1], D. E. Axe[2], and D. L. Harmon[1], [1]*University of Kentucky*, *Lexington*, [2]*Mosaic*, *Riverview, FL*.

Effects of urea or slow-release urea (SRU) on N balance and nutrient absorption were investigated. Four Holstein steers (236 ± 43 kg BW) and six Angus steers (367 ± 46 kg BW) were surgically prepared with hepatic portal, hepatic venous, mesenteric venous, and mesenteric arterial catheters. Catheterized steers were utilized in a crossover design with 21 d periods. Treatments were either urea or SRU at 1.6% of diet DM combined as a total mixed ration with 88.4% corn silage and 10% ground corn-based supplement on a DM basis. Diets were offered twice daily (12 h apart) at 2.0% of BW. Total fecal and urine output were measured on d 15 to 19. Nutrient absorption across the portal drained viscera (PDV) was determined on d 21 of each period by continuous infusion of p-aminohippuric acid into the mesenteric venous catheter. Simultaneous arterial, portal and hepatic blood samples were obtained 0, 2, 4, 6, 8, and 10 h relative to feeding. Mean DMI was 6.25 kg/d and did not differ among treatments. Mean N intake (124.9 g/d), urinary N excretion (total and as a percent of N intake) did not differ among treatments. SRU increased fecal N as a percent of intake N (34.4 vs. 38.5%; P < 0.05) by numerically increasing fecal N (43.7 vs. 47.4 g/d; P < 0.11). N balance was 41.0 g/d and 47.4 g/d for animals fed SRU and urea, respectively (P < 0.16), but did not differ as a percent of N intake (P < 0.30). Both treatments increased arterial urea concentrations from 2 to 6 h after feeding but SRU consistently reduced mean arterial urea N concentration (trt×time P < 0.01). SRU increased mean portal plasma flow (P < 0.05). Portal venous-arterial urea N difference did not differ but mean net portal urea flux was -52 and -64 mmol/h for urea and SRU, respectively (P < 0.06), indicating SRU increases net transfer of urea to the PDV. These results show SRU reduces plasma urea concentrations but increases net recycling of urea to the PDV; however, greater fecal N may suggest limited availability or timing of urea availability for utilization.

Key Words: Urea, N Balance, N Recycling

W248 Encapsulated slow release urea in lactating dairy cow diets impacts microbial efficiency and metabolism in continuous culture. J. Garrett*[1], T. Miller-Webster[2], W. Hoover[2], C. Sniffen[3], and D. Putnam[1], [1]*Balchem Encapsulates*, *New Hampton, NY*, [2]*West Virginia University*, *Morgantown*, [3]*Fencrest, LLC*, *Holderness, NH*.

The objectives were to compare the effectiveness of encapsulated, slow release urea (SRU), containing 89% urea, (Nitroshure™; Balchem, New Hampton, NY) relative to urea (U) or soybean meal 48 (SBM) in lactating dairy cow diets. Diets were formulated for a cow producing 45 kg/d, eating 24.5 kg of DM/d, and tested in a continuous culture fermentation system (Rumen Profiling Lab., West Virginia University, Morgantown, WV). The six diets tested were: T0, (0 SRU, 0.16 kg U), T1 (0.11 kg SRU, 0.05 kg U, T2 (0.16 kg SRU, 0 U,) T3 (0.07 kg SRU, replaced 0.36 kg SBM), T4 (0.17 kg SRU, replaced 0.9 kg SBM), T5 (0.27 kg SRU, replaced 1.46 kg SBM). For diets T0, T1 and T2, SBM was held constant at 12.3% of DM. For T3, T4, and T5, a mix of 18.9% SRU, 12.1% molasses, and 69% corn replaced SBM on an equal DM basis, while U was held

at 0.14 kg/d. Culture conditions were: liquid dilution rate, 13.0 %/h, solids dilution rate 4.5%/h, solids retention time 22.0 h, feeding frequency, 25 g DM, every 6 h. Each diet was tested in triplicate 9 d fermentations with effluent samples composited for analysis from the last 3 d of each fermentation. Data were analyzed using the GLM procedure of SAS®, with Duncan's Multiple Range Test used to compare individual treatment means. Results are shown in Table 1 below. The response to SRU appeared to be optimized at 0.16 kg per day and, for most parameters, T4 was the optimum treatment.

Table 1. Changes in rumen metabolism.

Item	T0	T1	T2	T3	T4	T4
DMD[1],%	60.0[a,b,c]	58.6[b,c]	56.6[c]	57.7[b,c]	65.6[a]	63.1[a,b]
NAN, g/d	2.88[a,b]	2.94[a]	2.93[a]	2.91[a,b]	2.87[a,b]	2.82[b]
NANMN[1], g/d	0.69[a,b]	0.86[a]	0.60[a,b]	0.67[a,b]	0.48[b]	0.44[b]
MN[1], g/d	2.18	2.08	2.33	2.23	2.39	2.37
MN g/kg DMD	36.3[b]	35.5[b]	41.3[a]	38.8[a,b]	36.5[b]	37.5[b]
TVFA[1] mol/kg MN	189[a,b]	194[a]	172[a,b]	174[a,b]	169[a,b]	162[b]

[a,b,c] Means differ, P<.05. [1] DMD = DM digested, NDFD = NDF digested, NANMN = non-ammonia non-microbial N, MN = microbial N, TVFA = total VFA

Key Words: Slow Release Urea, Encapsulated, Ruminal

W249 Ruminal degradation of crude protein of cull chickpeas using nylon bag technique in bovines. R. Barajas*, L. R. Flores, and J. J. Lomeli, *FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

The nylon bag technique was used to determine the ruminal degradation of crude protein of cull chickpeas in bovines. Four bovines (Simbrah; female, BW = 280 kg) were fitted with T cannulas in rumen. The animals were fed a diet containing sudan grass hay 30%, corn grain 33.5%, cull chickpeas 20%, soybean meal 3.5%, sugar cane molasses 10%, urea 0.4%, and mineral premix 2.6% (13% CP and 2.78 Mcal ME/kg). Pairs of nylon bags (12 X 18 cm) containing five grams of ground chickpeas (CHP) or soybean meal (SBM) were placed in rumen, and incubated for 3, 6, 9, 12, 15, 18, 21, and 24 h. After removal from the rumen, residual CP content were determined. Solubility was obtained placing the bags in a 0.15 N NaCl solution. Kinetic parameters A, B, and C were calculated for CHP and SBM. Rate of passage of small protein particles (K) was estimated as 0.02 to calculate the effective degradability of CP in rumen. Residual CP values of CHP at 0, 12 and 24 h incubation were used to obtain the rumen undegradable crude protein (UCP), taking as reference the value of 20% for SBM. Chickpeas CP was 80% more soluble (P < 0.05) than SBM-CP (46.51 vs 25.77%). The CP disapearance from nylon bags was higher (P < 0.05) for CHP than SBM during the 3, 6, 12, 15, and 21 hours of incubation. CP degradability at 24 hours was similar (P > 0.10) for CHP and SBM (98.98 vs 98.19%). The degradation rate of CHP-CP was 0.194 %/h (r = 0.95). The effective CP degradation in rumen for CHP was estimated to be 93.9%. The calculated rumen UCP content of chickpeas was 5.16%. It is concluded, that CP of chickpeas is extensively degraded in rumen of bovine.

Key Words: Chickpeas, Degradabilty, Bovine

W250 Utilization of different protein sources as supplements to whey treated straw silage. F. T. Sleiman*, M. N. Afram, M. G. Uwayjan, M. T. Farran, S. K. Hamadeh, and M. R. Darwish, *American University of Beirut*, *Beirut, Lebanon*.

Feed consumption, apparent digestibility and fermentation characteristics of whey treated barley straw silage (WBSS) supplemented with urea (U), cottonseed meal (CSM), soybean meal (SBM) and safflower seed meal (SFM) were studied using 12 Awassi ram lambs averaging 42 kg BW. The study consisted of a 5-wk trial and a 1-wk collection period using the following treatments: I) 49% straw (S) + 50% liquid whey (W)+1% U, II) 41% S + 50% W + 9% CSM, III) 44% S + 50%W + 6% SBM and IV) 36% S +50% W + 14% SFM. Each lamb received 1 kg/d concentrate (14% CP on DM basis), in addition to ad libitum feeding of the experimental silages. Changes in fermentation parameters, temperature and pH, recorded at 3d interval for 21d were not significantly different (P>0.05) among the treatments. The temperature averages were 29.8, 29.2, 29.4 and 29.8 C and the pH averages were 4.8, 4.6, 4.7 and 4.4 for the respective treatments. All lambs had positive but non significant (P>0.05) body weight gains (BWG) at the end of the trial with the highest BWG recorded for treatment III compared to I, II and IV (178 vs 170, 114 and 159g/d, respectively). Silage DMI was not significantly different (P>0.05) among treatments and averaged 451, 411, 373 and 368g/d for treatments I, II, III and IV, respectively. Digestibility of DM, CP, NFE, NDF and ADF was not significantly different (P>0.05) among treatments. Treatment II had significantly higher (P<0.05) EE digestibility than treatments III and IV (85.9 vs 81.5 and 79.1%, respectively) and also had significantly higher (P<0.05) CF digestibility than treatment IV (53.4 vs 43.1%). Results of this study indicate that the protein sources as used resulted in positive response on animal performance, apparent digestibility and fermentation characteristics of the WBSS.

Key Words: Liquid Whey, Protein Supplements, Barley Straw

W251 Effects of dietary crude protein level on growth performance and blood parameters of Holstein heifers and steers. M. A. Bal*, H. Yarar, and M. Sahin, *Kahramanmaras Sutcu Imam University, Department of Animal Science*, *Kahramanmaras, Turkey*.

The objectives of this study were to compare two different levels of dietary CP on growth performance, feed efficiency and blood parameters of Holstein heifers and steers. Experimental diets consisted of 16 (HIGH) and 12% (LOW) CP with 2.7 Mcal/kg of ME (DM basis). Ratios of CP:ME were 61, 60, 46, and 45 gr/Mcal for high heifer (HIH), steer (HIS), low heifer (LOH) and steer (LOS) diets, respectively. Eight animals were assigned to each experimental diet in a 2x2 factorial arrangement of Randomized Block Design for 8 wk period. Diets containing 50% forage (corn silage and alfalfa hay) and 50% shelled corn:barley:cotton seed meal based concentrate (DM basis) were fed twice daily in a TMR. There was no significant difference (p> 0.1) for DMI (9.05 vs 9.64 kg/d) and protein intake (1.27 vs 1.35) between heifers and steers. However DMI was higher (P< 0.05) for 12% CP diet (10.97 kg/d) compared to 16% CP diet (7.71 kg/d) across the groups. As a percent of body weight, DMI was higher (p= 0.07) for LOS (3.62%) and LOH (2.81%) compared to HIH (2.39%) and HIS (2.04%). No significant difference was observed for ADG between heifers (1.18 kg/d) and steers (1.28 kg/d) as well as CP levels (1.21 kg/d for LO and 1.25 kg/d for HI). Feed efficiency was higher (p< 0.05) for HI diet (0.17 and 0.16 for HIS and HIH, respectively) compared to LO diet (0.11 for both LOS and LOH, respectively). There was no significant blood urea N (averaging 8.58 mg/dL)and creatinine (averaging 1.1 mg/dL) difference between treatment groups. Data indicates that heifers responded to 12% dietary CP level better than 16% based on desirable ADG (1.12 kg/d) and low serum urea N concentration (8.3 mg/dL) at 16 mo age. Although DMI was higher for LOH compared to HIH group, these animals performed a compensatory growth pattern for an optimum body weight (366 kg) for breeding. Growth pattern of steers was more efficient in 16% ditary CP level compared to 12%. Similar ADG and lower DMI but higher finishing body weight resulted a higher feed efficiency in this experimental group.

Key Words: Crude Protein, Growth, Urea N

W252 Feed conversion and efficiency of NPK utilization in lactating dairy cows. A. R. Castillo*[1], J. E. P. Santos[2], and J. H. Kirk[2], [1]*University of California*, *Merced*, [2]*University of California*, *Tulare*.

A survey on 51 totally random selected dairy farms was carried out in the Central Valley of California. The aim of this study was to estimate the efficiency of NPK utilization in lactating dairy cows on commercial dairy farms. NRC (2001)

was used for nutrient balances. Silages and hays were based on NRC nutrient composition. Concentrate feeds and mineral mixes samples were taken in each farm and analyzed for DM, N, P and K. A multiple regression analysis was carried out to study the main dietary variables related to N metabolism that can explain efficiency of N utilization (ENU). The model included ENU=Feed Conversion (FC), CP%, and required, supplied and balance (supplied - required) of CP, RDP, RUP, and MP. Dietary contents (averages±SD) of CP (N*6.25), P and K were: 17.0%±1.19; 0.44%±0.07, and 1.53%±0.25, respectively. Results are presented in Table 1. ENU was significantly correlated (P<0.001) with CP balance (R2=0.649) and FC (R2=0.645). Compared to RDP, RUP and MP variables, CP explained better ENU variations

Table 1

		Average/farm	SD	Min	Max
FCM3.5%†	kg/cow/d	30.9	5.31	18.9	45.1
FC	kgFCM3.5%/kgDMI‡	1.41	0.17	1.10	1.88
ENU	kgNmilk/kgDMI	0.26	0.03	0.20	0.34
N excretion d	g/cow/d	447	71.9	261	600
P excretion g	g/cow/d	46	15.8	15	89
K excretion g	g/cow/d	136	52.0	-63	334

(†)Fat Corrected Milk 3.5%; (‡)DMI=Dry Matter Intake; (d)N Excretion=090*N intake-89; (g)Excretion=Total Dietary Supply-Total Absorbed Required

Key Words: Dairy Cows, Nutrient Balances, Feed Conversion

W253 Manure production of heifers fed diets varying in forage, grain, and byproduct content. S. R. Hill*, K. F. Knowlton, R. E. James, R. E. Pearson, G. Bethard, K. P. Pence, and S. W. Wilson, *Virginia Polytechnic Institute and State Univeristy*, *Blacksburg*.

The objectives of this study were to evaluate the effect of varying feed intake and proportions of forage, grain, and byproducts on growth and excretion of urine, feces, and nitrogen in growing heifers. Holstein heifers (n=18) confirmed pregnant were grouped by due date and fed one of three diets for the last 16 weeks of pregnancy. Diets were high forage, fed ad libitum (HF); byproduct-based, fed ad libitum (BP); or low forage, fed at 75% of ad libitum (LF). Diets were designed to supply the same quantities of phosphorus, nitrogen, and metabolizable energy. Total collection of feces and urine was conducted in weeks 4, 8, 12 and 16. The HF ration was 85% forage, 13.7% CP, and contained orchardgrass hay, corn silage, corn grain, soybean meal, and a vitamin-mineral pre-mix. The BP diet was 60% forage and 14.0% CP, with 50% of the grain mix replaced with soybean hulls and cottonseed hulls. The LF ration was 60% forage, 17.8% CP, and fed at 75% of ad libitum. All data was analyzed using the PROC MIXED procedure of SAS with repeated measures (collection week). As intended, heifers fed HF and BP had greater DMI than the heifers limit-fed LF and there was no effect of diet on average daily gain or BW. Intake and digestibility of N was lower in heifers fed HF and BP than heifers fed LF. Fecal N excretion was higher in heifers fed HF and BP compared to those fed LF. Mean feces excretion on both wet and dry basis were highest in heifers fed HF, but heifers fed LF excreted more urine than those fed HF or BP. Despite differences in urine output, diet had no effect on urea N excretion. Heifers fed the LF ration excreted more total manure and urine per kg of BW compared to heifers fed BP and HF. Observed manure and urine excretion from heifers fed LF was greater than current ASAE values, while heifers fed HF excreted less manure and urine than predicted. Heifers achieving similar rates of gain from diets differing in forage, grain and byproduct content excreted widely varying quantities of manure.

Key Words: Manure Excretion

Women & Minority Issues in Animal Agriculture

W254 Heritability and permanent environmental effect for fleece quality assessed by an ancient Tzotzil indigenous evaluation system. H. Castro-Gámez[1], G. Campos[1], R. López[1], R. Perezgrovas[2], and H. Castillo-Juárez*[3], [1]*Universidad Nacional Autónoma de México*, *Ciudad Universitaria, México*, [2]*Universidad Autónoma de Chiapas*, *Chiapas, México*, [3]*Universidad Autónoma Metropolitana-Xochimilco*, *Calzada del Hueso, México D.F.*

The Tzotzil indigenous population living in the mountains of Chiapas (Mexico) obtains up to 36 % of its income from sheep-derived activities. In 1991 a breeding program, where the selection of sheep includes an ancient indigenous criteria for fleece quality, was introduced. This breeding program is supervised by the Teopisca Sheep Center from the Autonomous University of Chiapas. It uses empirical criteria from Tzotzil shepherdesses and formal quantitative fleece-quality and -production traits. The aim of this study was to estimate the heritability (h^2) and the permanent environmental effect (c^2) of fleece quality based on the indigenous grading system (FQ) where FQ depends on the visual and tactile evaluation of fleece volume, staple length, and the amount of coarse-long fibers within the double-coated fleece. This evaluation results in a quantitative discrete measure for FQ ranging from 1 to 4. The percentage of inbred animals within the flock, and the mean inbreeding coefficient of inbred sheep were established. We used 2255 FQ records from 886 animals from the three color varieties of the wool sheep locally named Chiapas Blanco, Raza Café, and Chamula Negro. Feeding of the animals is based on an extensive grazing system in the highlands covered by native vegetation, and a supplement of corn fodder during the winter. Shearing is made twice a year. Fleece gradings were made from February of 1998 to February 2004. Heritability and c^2 were estimated using an animal model that included shearing number, year-season of shearing, sex, and fleece color as fixed effects. The pedigree file included 935 sheep. Heritability (s.e.) for FQ was 0.31 (0.05) and c^2 (s.e) was 0.11 (0.04). A likelihood ratio test showed that the permanent environmental effect was statistically significant ($P < 0.05$). The breeding values for FQ ranged from -0.79 to 0.61. The percentage of inbred animals was 1.82, these with an inbreeding mean of 13.97 %. It is concluded that the empirical fleece-quality grading system shows a moderate genetic variation and hence it may be successfully included in the breeding programs.

Key Words: Fleece Quality, Genetic Parameters, Indigenous Women

Wednesday, July 27, 2005

SYMPOSIA AND ORAL SESSIONS

Animal Behavior and Well-being: Swine Transportation Handling & Feed Restriction

449 Effects of albuterol on behavioral and heart rate responses of finishing pigs to handling. J. Marchant-Forde*[1], K. McMunn[1], B. Richert[2], D. Lay Jr.[1], and R. Marchant-Forde[1], [1]USDA-ARS, Livestock Behavior Research Unit, W. Lafayette, IN, [2]Purdue University, W. Lafayette, IN.

It has been proposed that a pure form of albuterol will deliver similar positive production effects without negative effects on well-being seen with other β-agonists. This experiment examined the effects of albuterol on behavior and heart rate (HR) during handling. The study used 192 pigs (88.8±0.9 kg BW) housed in groups of six in 32 pens (1.4m x 4.1m) and assigned to one of four treatments: 1) Control - standard finishing ration, 2) ALB-R2 - diet with 2 ppm of the pure R-enantiomer of albuterol, 3) ALB-R4 - diet with 4 ppm of pure R-albuterol, or 4) ALB-RS8 - diet with 8 ppm of a racemic mixture of R- and S-enantiomers. All diets supplied 18.3% CP, 1.1% lysine and 3534 kcal ME/kg and were offered ad libitum for a 4-wk . Behavioral responses to handling during weighing were recorded immediately before assignment to the treatments (wk 0) and at weekly intervals over the subsequent 4-wk period (wk1-wk4). Behavioral and HR responses to a 10-min human presence test in the home pen were measured during wk 0, wk1 and wk3. Finally, HR responses to 5-min loading, 26-min transport and 5-min unloading periods were recorded. Data were analyzed using Proc GLM of SAS, with pen as the experimental unit. Treatment had no effect on overall handling measures (P>0.05), including the number of pigs exiting the pen voluntarily, the time taken to weigh or the number of physical interactions needed by the handler to complete the task. Treatment also had no effect on behavioral responses to human presence (P>0.05), with all treatments willing to spend similar amounts of time close to, and interacting with the human. However, during the human presence test in wk1 and wk3, treated pigs had heart rates around 10 bpm higher (P<0.05) than control pigs, thought to be due to systemic vasodilation rather than direct β1-receptor stimulation. During all phases of transport, heart rates were similar across treatments (P>0.05). The results indicate that albuterol-treated pigs do not differ markedly from control pigs in behavioral and heart rate responses to handling and transportation.

Key Words: Albuterol, Pigs, Behavior

450 Characterizing hunger in swine utilizing metabolic parameters during 36 h of imposed feed deprivation. M. Toscano*[1], D. Lay, Jr.[1], B. Craig[2], and E. Pajor[2], [1]USDA-ARS-LBRU, West Lafayette, IN, [2]Purdue University, West Lafayette, IN.

Manipulations of diets in modern swine operations is a common technique to reduce costs and improve productivity, although a variety of behavioral and physiological measures suggest swine suffer from hunger. Due to hunger's subjective nature and the ambiguity of the parameters measured, evaluating the impact of specific diets on hunger is problematic. To develop a uniform index of hunger that diets could be compared against, individually penned barrows (90.05 ± 0.73 kg BW) were acclimatized over 5 d to an ad-libitum, 3-h feeding routine beginning at 0800. On d 6, pigs began 36 h of feed deprivation (DEP, n=17) or continued their normal feeding routine (CON, n=18). Animals were catheterized and blood was collected from all pigs at 0, 6, 12, 24, and 36 h during the deprivation period and assayed for non-esterified fatty acids (NEFA), insulin, glucose, and glucagon. Differenced between time points, treatment, and their interaction were assessed using mixed model analysis. Pigs of the CON treatment had greater glucose (87.2 ± 1.0 mg/dL vs. 80.1 ± 1.1 mg/dL), insulin (8.4 ± 0.7 μIU/ml vs. 3.6 ± 1.1 μIU/ml) and glucagon concentrations (55.1 ± 2.6 pg/ml vs. 37.4 ± 1.8 pg/ml) than DEP pigs ($p < 0.004$, for all comparisons), although the NEFA concentrations were greater in DEP pigs (0.29 ± 0.01 mEq/L vs. 0.55 ± 0.02 mEq/L, $p < 0.001$,). A time by treatment interaction ($p < 0.002$) was found for all metabolites with the exception of glucose ($p > 0.1$). In contrast to CON pigs, glucagon concentrations of DEP pigs remained unchanged while insulin concentrations fell from a 0 h initial baseline and remained at a reduced concentration. Future efforts should seek to combine physiologic data such as presented here with behavioral and other measurs to indicate the severity of specific dietary manipulations on hunger in livestock.

Key Words: Swine, Hunger, Feed Restriction

451 A model for the study of dead and down pigs associated with transport: effects of maternal pheromone on pigs in transit. C. Lewis*[1,2], N. Krebs[1,2], L. Hulbert[1,2], and J. McGlone[1,2], [1]Pork Industry Institute, Lubbock, TX, [2]Texas Tech University, Lubbock.

The objectives of this study were: (1) to establish a model for the study of dead and down (DD) pigs associated with transport and (2) to evaluate the effects of the maternal pheromone (MP) Suilence (Ceva, France) on DD rates. Human-pig interactions were observed during handling audits at the farm during truck loading and at the packing plant during unloading and movement to stun and kill. 30 trucks were observed which contained a total of 5,169 pigs (~164 pigs per truck). The pigs traveled ~45 min during transport, in the summertime. The truck was the experimental unit. At the farm, observers were blind to treatment and randomly selected trucks to receive MP or a control (CO) containing the solvent used to deliver MP. MP or CO was evenly sprayed on each truck (500 ml). They recorded the number of pigs that slipped/fell (S), vocalized (V), reared (R) and the number of pigs touched with an electric prod (E) (at the farm only; prods were not used at truck unloading) by using live continuous observation methods. The numbers of pigs that were DD at truck unloading, in rest pens or pre-stun were recorded. The completely random design was analyzed as a simple ANOVA with two treatments. The rate of pig death was low (0 on the trucks, and 0.0008±0.0007 & 0.0007±0.0007 respectively in the pre stun area). At truck loading the rate of pig S, V, R, and E for CO and MP were not different (S: 0.014±0.007 & 0.032±0.007, V: 0.87±0.08 & 0.72±0.08, R: 0.048±0.08 & 0.03±0.08, E: 1.15±0.15 & 1.04±0.15, respectively). V were higher (P=0.03) among CO than MP at the pre-stun area (0.14±0.015 & 0.09±0.015 for CO and MP respectively). A power analysis determined that the number of trucks needed to detect a 50% difference for S, V, R, E (at the farm) and NANI (at the plant) were 144, 16, 66, 29, 249, trucks, respectively. While mean improvements in the rate of down pigs and associated pig handling measures are suggested, studies of this type require over 200 trucks to detect meaningful differences.

Key Words: Swine Transportation, Swine Handling, Swine Stress

452 Relationships between residual feed intake, ultrasound, and temperament traits in Brangus heifers. P. A. Lancaster*[1], G. E. Carstens[1], E. G. Brown[1], R. D. Randel[2], T. H. Welsh, Jr.[1], T. D. A. Forbes[3], D. T. Dean[1], and A. D. Herring[1], [1]Texas Agricultural Experiment Station, College Station, [2]Texas Agricultural Experiment Station, Overton, [3]Texas Agricultural Experiment Station, Uvalde.

Residual feed intake (RFI) is a moderately heritable feed efficiency trait that is independent of changes in ADG and BW. Objectives of this study were to measure RFI in growing heifers and examine phenotypic correlations between RFI and performance, body composition, and escape velocity (indicator of temperament). Purebred embryo-transfer Brangus heifers (Camp Cooley Ranch; n = 114) were individually fed a roughage-based diet (ME = 2.2 Mcal/kg) using Calan-gate feeders. Weekly BW and DMI were measured for 70 d, and RFI calculated as the residual value from linear regression of DMI on mid-test $BW^{0.75}$ and ADG. Ultrasound measures of 12th rib fat thickness (BF), longissimus muscle area (REA), and percent intramuscular fat (IM), and escape velocity were measured on d 0 and 70. Overall, ADG, DMI, and RFI were 0.90 (SD = .15), 9.10 (SD = 1.11), and 0.0 (SD = .75) kg/d, respectively. Escape velocity on d 70 was correlated with ADG (r = -0.28; P < 0.01) and DMI (r = -0.22; P < 0.05), but not with RFI. Escape velocity on d 70 was also correlated with BF on d 70 (r = -0.25; P < 0.01) and gain in BF (r = -0.21; P < 0.05). Results suggest that heifers with calmer temperaments had improved DMI and ADG but not RFI. RFI was correlated (P < 0.01) with DMI (r = 0.68) and feed conversion ratio (FCR; r = 0.56), but not with ADG, initial or final BW. FCR was correlated with ADG (r = -0.69; P < 0.01) and DMI (r = 0.18; P = 0.05). Average RFI for heifers with low (< 0.5 SD below the mean; n = 36) and high (> 0.5 SD above the mean; n = 31) RFI was -0.79 and 0.97 ± .06 kg/d, respectively. Heifers with low RFI consumed 18% less (P < 0.01) DMI and had 16% lower (P < 0.01) FCR than high RFI heifers, even though final BW and ADG were similar for both groups. RFI was not correlated with REA, BF, or IM measured on d 70, but tended to be correlated with gain in BF (r = 0.17; P = 0.08) and gain in IM (r = -0.17; P = 0.07) from d 0 to 70 of the trial. Increased leanness may have contributed to the enhanced feed utilization of low RFI heifers, but the magnitude of this contribution was small.

Key Words: Net Feed Efficiency, Escape Velocity, Carcass Traits

453 Relationships between feed efficiency and real-time ultrasound traits in growing and finishing steers. E. G. Brown*[1], G. E. Carstens[1], J. T. Fox[1], S. A. Woods[1], D. T. Dean[1], A. D. Herring[1], S. Moore[2], and P. C. Genho[2], [1]Texas Agricultural Experiment Station, College Station, [2]King Ranch, Kingsville, TX.

The objective of this study was to examine phenotypic correlations between three feed efficiency traits and ultrasound measurements of 12th rib fat thickness (BF), longissimus muscle area (REA), and percent intramuscular fat (IM) in growing and finishing steers. Individual DMI were measured in Santa Gertrudis steers (n = 116) fed a roughage-based diet (ME = 2.1 Mcal/kg) for 77 d during the growing (G) phase and a grain-based diet (ME = 3.0 Mcal/kg) for 80 d during the finishing (F) phase using Calan gate feeders. Residual feed intake (RFI), residual gain efficiency (RGE) and feed:gain ratio (FCR) were calculated for G and F phases. RFI was calculated as the residual value from linear regression of DMI on mid-test metabolic BW (MBW) and ADG; RGE as the residual value from linear regression of ADG on MBW and DMI. Ultrasound measures of BF, REA and IM were obtained on d 70 of the G and F phases. RFI was positively correlated (P < 0.001) with DMI during the G (r = 0.68) and F (r = 0.61) phases, but not MBW or ADG. RFI ranged from -2.1 (efficient) to 2.3 (SD = 0.89) kg/d and -1.9 and 2.5 (SD = 0.98) kg/d during the G and F phases, respectively. RGE was positively correlated (P < 0.001) with ADG during the G (r = 0.81) and F (r = 0.73) phases, but not MBW or DMI. RGE ranged from 0.58 (efficient) to -0.41 (SD = 0.16) kg/d and 0.39 and -0.46 (SD = 0.17) kg/d during the G and F phases, respectively. FCR was negatively correlated (P < 0.001) with ADG during the G (r = -0.66) and F (r = -0.63) phases. Ultrasound traits were not correlated with feed efficiency traits during the G phase. During the F phase, BF was positively correlated with RFI (r = 0.30; P < 0.001), but not RGE or FCR. Feed efficiency traits were not correlated with REA and IM during the F phase. Correlations between G and F phase feed efficiency traits were higher for RFI (r = 0.48; P < 0.001) than for FCR (r = 0.22; P < 0.05) or RGE (r = 0.27; P < 0.01), suggesting that RFI may be a more appropriate trait to assess feed efficiency across various production phases. More research is warranted to examine effects of diet and physiological status on RFI.

Key Words: Residual Feed Intake, Carcass Composition, Residual Gain

454 Optimizing use of distiller's grains in finishing cattle diets. B. E. Depenbusch*, J. S. Drouillard, E. R. Loe, and M. E. Corrigan, Kansas State University, Manhattan.

Two hundred ninety-nine crossbred-yearling steers (363 ± 15 kg initial BW) were fed for 114 days in a finishing study comparing 7 diets in which steam-flaked corn was used as the principal energy source. A control diet (CONTROL) with no distiller's grains was compared to six diets in which a portion of the flaked corn was replaced with distiller's grains with solubles (approximately 15% of DM). These diets contained wet sorghum distiller's grains with 0 or 6% alfalfa hay (WSDG0H, WSDG6H); dry sorghum distiller's grains with 0 or 6% alfalfa hay (DSDG0H, DSDG6H); and wet or dry corn distiller's grains with alfalfa hay (WCDG6H and DCDG6H, respectively). Average daily gains were 1.44, 1.35, 1.37, 1.22, 1.41, 1.41, 1.45 kg/d; DMI were 9.34, 8.71, 9.39, 8.66, 9.57, 9.21, 9.48 kg/d; and feed efficiencies were 0.154, 0.155, 0.147, 0.142, 0.148, 0.153, 0.153 for steers fed CONTROL, WSDG0H, WSDG6H, DSDG0H, DSDG6H, WCDG6H and DCDG6H, respectively. Steers fed sorghum-based distiller's diets with hay consumed more feed (P < 0.01) and gained more weight (P < 0.01) than steers fed diets without hay, but gain efficiencies were not different (P > 0.78). Dry matter intake and ADG were similar for steers fed wet and dry sorghum-based distiller's grains (P > 0.30), but steers fed wet sorghum distiller's grains tended (P = 0.08) to be more efficient than those fed dry sorghum distiller's grains. Steers fed corn- and sorghum-based distiller's grains had similar (P > 0.12) DMI, ADG, and efficiencies. Carcass attributes were largely uninfluenced by diet. These data suggest that distiller's grains with solubles derived from sorghum and corn are comparable when added to feedlot diets. Furthermore, complete removal of hay from the diet is not advised on the basis of these data.

Key Words: Distiller's Grains with Solubles, Roughage, Steam-Flaked Corn

455 Effects of vegetable and animal lipid sources on meat sensory attributes and longissimus muscle fatty acid profile from yearling beef steers. E. R. Loe*[1], J. S. Drouillard[1], K. A. Hachmeister[1], and F. N. Owens[2], [1]Kansas State University, Manhattan, [2]Pioneer Hi-Bred International, Des Moines, IA.

From 363 harvested steers, 108 carcasses were selected based on visual appraisal of phenotype and fat thickness for analysis of meat sensory attributes and fatty acid profiling of fat from the longissimus muscle. Finishing diets had been fed for 132 d: 1) control - no added lipid, 2) tallow, 3) dry-rolled soybeans, 4) high-linoleic sunflowers, 5) mid-oleic sunflowers, and 6) high-oleic sunflowers. Rib sections were removed from one side of each carcass (2 carcasses/pen; 9 pens/treatment) approximately 24 h postmortem. Ribs were de-boned, packaged in impermeable vacuum bags, and stored at 0°C. After 14 d of storage, rib sections were removed from the vacuum packages and cut into steaks 2.5 cm thick for sensory analysis by trained panelists. Pen was the experimental unit and data were analyzed using SAS Proc Mixed, testing for linear and quadratic effects of oleic acid within sunflower treatments. Intensity of beef flavor was greater for cattle fed no added lipid than for cattle fed added lipid (P < 0.01). Off-flavor intensity was greater for steers receiving supplemental lipid (P < 0.05). Myofibrillar and steak tenderness were greater for steaks from cattle

fed mid-oleic vs high-linoleic or high-oleic sunflowers (quadratic; P < 0.05). Intensity of beef flavor and off-flavor intensity responded quadratically (P < 0.001) to dietary oleic acid; steaks from cattle fed mid-oleic sunflowers had greater intensity of beef flavor and lower intensity of off-flavor than steaks from cattle fed high-linoleic or high-oleic sunflowers. Steaks from cattle fed soybeans had more C18:2 fatty acids than steaks from steers fed sunflowers. Oleic acid content of steaks increased and linoleic acid decreased (linear; P < 0.001) as oleic acid content of sunflowers was increased. Dietary lipid source and fatty acid profile of lipid sources can influence flavor intensity and fatty acid profile of beef.

Key Words: Vegetable Oil, Tallow, Fatty Acid

456 Effects of source of lipid on finishing cattle performance and carcass characteristics. E. R. Loe*[1], J. S. Drouillard[1], and F. N. Owens[2], [1]Kansas State University, Manhattan, [2]Pioneer Hi-Bred International, Inc., Des Moines, IA.

Crossbred steers (n = 376; 340 ± 21 kg) were fed for 132 d to evaluate effects of lipid source on feedlot performance and carcass merit. Steers were blocked by BW and allotted randomly to diet (9 pens/diet). Diets included 1) control - no added fat; 2) tallow; 3) dry-rolled soybean; 4) whole high-linoleic sunflower seed; 5) whole mid-oleic (66.7% of oil) sunflower seed; 6) whole high-oleic (86.8% of oil) sunflower seed; dietary fat concentrations were 3.2, 6.6, 6.5, 6.8, 7.1, and 6.0% (DM basis), respectively. Diets contained steam-flaked corn (mean = 72%) and 6.3% ground alfalfa hay (DM basis), and were formulated to contain 14% CP, 0.8% Ca, 0.75% K, and to provide 300 mg monensin and 90 mg tylosin daily. For the randomized complete block design, pen was the experimental unit; data were analyzed with PROC MIXED of SAS. Compared to steers fed rolled soybeans, steers fed sunflowers consumed 6% more feed (P = 0.007, DM basis), 7% more lipid (P < 0.001), and gained 7% faster (P = 0.02); steers fed tallow were intermediate; as oleic acid content of the sunflowers increased, DMI increased linearly (P = 0.001) but lipid intake decreased linearly (P = 0.02) and quadratically (P < 0.001). Steers receiving lipid were 9% more efficient (P < 0.001) and had more KPH fat (P = 0.01) than steers not receiving lipid. Steers fed tallow had fewer USDA Standard carcasses (P = 0.03) and tended (P = 0.06) to produce more USDA Choice carcasses than steers fed vegetable oils. Compared with those receiving mid-oleic sunflowers, steers fed high-oleic or high-linoleic sunflowers had greater 12th rib fat thickness, more KPH fat, higher USDA Yield Grades, and fewer USDA Yield Grade 1 carcasses (quadratic response; P < 0.02). Marbling linearly increased with oleic acid content of sunflowers (P = 0.03; marbling scores of Slight 53, Slight 47, and Slight 74 ± 12). Lipid source and fatty acid profile can influence feedlot performance and carcass characteristics of yearling steers.

Key Words: Vegetable Oil, Tallow, Fatty Acid

457 Effects of ractopamine-HCl (Optaflexx) and protein source on performance and carcass characteristics of feedlot heifers. B. E. Depenbusch*, D. K. Walker, E. C. Titgemeyer, E. R. Loe, M. E. Corrigan, M. J. Quinn, A. S. Webb, and J. S. Drouillard, Kansas State University, Manhattan.

Crossbred heifers (n=72; 475 ± 6 kg initial BW) were used in a 28-d finishing study with a 2 × 3 factorial arrangement of treatments. Factors consisted of protein source (with increasing UIP concentrations) and level of ractopamine-HCl (0 or 200 mg/heifer daily). Heifers were implanted with Revalor-H 60 d prior to starting the study. After allotment to treatments (12 heifers/treatment), heifers were placed into individual feeding pens (10 m^2). Flaked corn finishing diets were formulated to 14% CP (dry basis) using 1.5% urea (UREA); 0.5% urea + 6.6% solvent extracted soybean meal (SBM); or 0.5% urea + 7.9% expeller process soybean meal (EXSBM), and provided 300 mg monensin, 90 mg tylosin, and 0.5 mg melengestrol acetate per heifer daily. DMI were not different among treatments (P > 0.21). There was an interaction between ractopamine and protein source for live weight gain and gain efficiency (P < 0.05). Gains and efficiencies for heifers fed no ractopamine increased as dietary UIP increased (1.37, 1.53, 1.81 kg/d and 0.156, 0.179, 0.198 gain/DMI for UREA, SBM, and EXSBM, respectively). Conversely, gains and efficiencies for cattle fed 200 mg/d ractopamine increased in response to higher DIP concentrations (1.71, 1.80, 2.06 kg/d and 0.205, 0.202, 0.223 gain/DMI for EXSBM, SBM, and UREA, respectively). No interactions existed for carcass-adjusted ADG or carcass-adjusted efficiencies (P > 0.61). Heifers fed ractopamine gained more weight and were more efficient than controls (P < 0.01). Heifers fed ractopamine tended (P < 0.10) to have greater carcass weights compared to controls (318, 316, and 319 kg for UREA, SBM, and EXSBM in cattle fed no ractopamine; and 328, 324, and 323 kg for UREA, SBM, and EXSBM in cattle fed 200 mg/d ractopamine). Marbling score and fat thickness were not different among treatments (P > 0.30). These data suggest that additional UIP supplementation is not required to optimize response to ractopamine in heifers.

Key Words: Ractopamine, Heifers, Protein

458 Effects of ractopamine and days on feed on performance and carcass traits of yearling steers. J. P. Hutcheson*[1], W. T. Nichols[1], C. D. Reinhardt[1], R. S. Swingle[2], and K. J. Karr[2], [1]Intervet, Inc., Millsboro, DE, [2]Cactus Research, Ltd., Amarillo, TX.

Two-thousand two hundred fifty English × Continental cross yearling steers (avg. 313 kg) were used in a randomized complete block study to evaluate the effects of ractopamine and days on feed on performance and carcass traits. Steers were blocked by arrival time at the research facility. On each arrival day cattle were processed and randomly allotted to 6 pens of 91 to 97 head each. Within each block, three pens were randomly selected to receive ractopamine (RAC) and the remaining three were controls (CON). Within each block and within each treatment, pens were randomly assigned to be fed for either 150, 171, or 192 days. RAC was fed at 200 mg/hd/d for the final 28 days on feed. When measured over the entire feeding period, feeding RAC increased ADG 4.6%, increased final weight 11 kg, improved G:F 3.4%, and increased HCW 8.2 kg (P<.01), and tended (P=.12) to reduce percent YG 4+5. All other carcass measurements were similar. Additional days on feed had a significant (P<.10) effect on final wt, ADG, DMI, G:F, dressing percentage, HCW, Yield Grade distribution, and Quality grade. There was an interaction between treatment and days on feed for G:F (P=.09) and carcasses weighing >431 kg (P<.01) with greater differences between RAC and CON at 192 than at 150 or 171 days on feed. Feeding RAC improved performance regardless of days on feed. Increasing days on feed decreased performance but increased dressing percentage and carcass weight.

Key Words: Ractopamine, Feedlot, Steers

Breeding and Genetics: Beef Cattle Breeding and Genetics

459 Educating beef cattle breeders on the use of genomic technology for quantitative traits. W. Shafer*, American Simmental Association, Bozeman, MT.

Individuals with little or no technical expertise make the majority of beef cattle breeding decisions. Even so, due to an extensive educational effort and the technology's effectiveness, the decidedly technical EPD has become common currency in beef cattle breeding—evolving into the primary tool for affecting additive change in a population. Traditional EPDs have shortcomings, however. Specifically, Mendelian sampling relegates non-parents to low-accuracy evaluation and some economically important traits are not suited to the large-

scale data collection required to achieve high-accuracy prediction. Though genomic research has the potential to help us prevail over these shortcomings, the industry is in a precarious position in regards to the application of DNA information to selection decisions. Given their widespread acceptance, EPDs provide the most rational format to deliver DNA test results to breeders. Before melding marker genotypes into the industry's existing genetic evaluation infrastructure, however, mechanisms to fully account for pleiotropy and interaction among alleles should be developed. Unfortunately, for the foreseeable future, the expansion of commercially available DNA tests will likely outstrip the development of analytical approaches and infrastructure capable of handling the burgeoning database. Understandably, with developmental costs to underwrite and a profit objective to achieve, companies offering DNA tests are not waiting until the infrastructure is in place to merchandise their products. Though the resultant database is certain to be integral to infrastructure development, the incessant exposure of cattle breeders to the promise of DNA technologies, combined with a lack of understanding makes them prone to placing undue emphasis on raw test results at the expense of EPDs—ultimately undermining genetic improvement. Consequently, educational efforts should emphasize the importance of breeder contribution in developing a DNA database, while discouraging the use of test results until integrated into an adequate infrastructure.

Key Words: Beef Cattle, Education, Genomics

460 Using appropriate genetic evaluations to make better selection decisions. D. Garrick*, Colorado State University, Fort Collins.

Genetic change is easy to achieve by selection. Selection on EPDs provides a predictable response in the characteristics described by the EPDs. Genetic improvement is more difficult to achieve than genetic change as selection typically results in simultaneous change in a number of characteristics. Some of the characteristics for which EPDs are available (marbling score, calving ease) are economically relevant traits (ERTs) that directly influence income or expenses. Other EPDs are available for traits that are not directly economically relevant (ultrasound intramuscular fat %, birth weight) but are correlated with ERTs. These are known as indicator traits and are useful when the corresponding ERT does not have an EPD. Phenotypic measures on indicator traits are best used in multi-trait prediction of EPDs for ERTs. When this occurs, selection considering the ERT and indicator trait will be less effective than selection on the ERT EPD alone. For example, suppose selection was practiced using the EPDs of sires with 50 offspring with observed birth weight and calving ease scores. After a generation of selection on calving ease the proportion of difficult calvings among bull calves born to 1st calvers could be reduced from 20 to 12%. The correlated reduction in birth weight would be about 1 kg. In contrast, if selection had been on (reduced) birth weight EPD, it would take twice as many years for the same reduction in calving difficulty and the birth weight would have been reduced by 4 kg. Simultaneous selection for birth weight and calving ease can only produce a response in calving ease that is intermediate to the above examples. Alternatively, suppose a bull has his own ultrasound (u/s) observation and performance measured on 15 u/s and 20 carcass progeny. One s.d. of selection on sire EPDs for u/s IMF% would increase IMF% by 0.36 and marbling EPD by 0.48. In contrast, selection on the carcass EPD would get a 20% greater response in marbling (+0.57) with a slightly lower reduction (+0.3) in IMF%. Selecting directly on ERTs will more rapidly increase profit than selection that takes account of indicator traits that have been used in multi-trait assessment of the ERT EPD.

Key Words: EPD

461 Postweaning performance of purebred Angus and Romosinuano steers. W. A. Phillips*[1], S. W. Coleman[2], D. G. Riley[2], C. C. Chase, Jr.[2], and H. S. Mayeux[1], [1]USDA,ARS, Grazinglands Research Lab., El Reno, OK, [2]USDA,ARS,SubTropical Agricultural Res. Station, Brooksville, FL.

The objective of this study was to compare stocker and feedlot performance of purebred Angus and Romosinuano steers born and reared in a subtropical environment (Florida) and shipped to a more temperate environment (Oklahoma) for growth and finishing. A total of 160 steers were evaluated over two production cycles. Steers were born (January through March) and reared in central Florida, weaned in the fall and shipped (1900 km) for growth and finishing in central Oklahoma. Steers grazed annual cool season grasses (primarily Triticum aestivum) and were managed as a single group during the winter (125 d) and spring (84 d) stocker phases. Angus and Romosinuano steers had similar BW upon arrival (193 kg ± 3.5). During the winter stocker period, Romosinuano steers gained less ($P < 0.05$) BW than Angus steers (75.9 vs 102.2 kg). Gains in BW during the spring grazing season were similar between the two breeds, but Romosinuano steers had lower ($P < 0.05$) total stocker gains (118.3 vs 143.8 kg) than Angus steers. In June of each year, steers were blocked by breed and randomly assigned to a conventional confinement or a grain-on-grass (GOG) finishing system. In the GOG system, steers were finished on bermudagrass pasture using a combination of an intensive stocking rate (9 steers/ha) and ad libitum access to a high energy diet in a self-feeder. Under the conventional system, carcass marbling scores and quality grades were not different ($P > 0.10$) between the two breeds. However, the GOG Angus steers produced carcasses that had higher ($P < 0.01$) marbling scores and quality scores than Romosinuano GOG steers. Under conventional confinement feeding, Romosinuano steers had lower ($P < 0.10$) DMI than Angus steers, but feed efficiencies were similar. When compared to Angus steers, Romonsinuano steers had lower ADG during the stocker phase, but were as efficient as Angus steers during the finishing phase when fed under a conventional confinement feeding system.

Key Words: Wheat Pasture, Stocker Calves, Tropically Adapted Breeds

462 Strategies to optimize feed intake recording capacity for performance evaluated beef bulls. S. Miller*, University of Guelph, Guelph, Ontario, Canada.

Deterministic simulation using SAS proc IML compared five strategies (S1-S5) to use limited (200-head) capacity for feed intake recording for a company performance testing 1000 bulls to sell 500. Comparison was accuracy of index selection, considering feed intake and weight gain. Economic weights were $76 and $–9.5 per kg of 112-d test growth and feed intake, respectively. Reference strategies 1 and 2 measured feed intake on none or all bulls, respectively. Strategy 3 measured a random subset of 200 for feed intake. Strategies 4 and 5 consider pre-selection based on growth up to 56d on test. Strategy 4 selected 200 on growth up to 56d and measured these for feed intake during 57-112d. Strategy 5 split the 1000, staggering start of test dates by 56d to move 2 groups through the feed intake facility (after 56d growth) for a 176-d time span. All sources of information pertaining to different stages of selection were translated into accuracy of the selection index. Compared to not measuring feed intake (S1) the percent increase in progress ranged from 9% to 47% in S3 and S2, respectively. A 47% increase (S2) in response is then the upper limit of the advantage to measuring feed intake. Although the accuracy of pre-selecting bulls based on 56-d growth is low and the accuracy of evaluating feed intake is compromised because of this reduced (56d) measurement period, the response in S4 achieved 76% of S2. Strategy 5 increased response to 86% of S2. Alternatively, 600 bulls could be selected with S5 with the same mean genetic level as 500 bulls with S1. Genetic mean of the top 25 determined the advantages to measuring feed intake, where elite bulls were selected. Top 25 selected under S5 were 99% of S2, indicating feed intake measurement may have greatest relevance within a nucleus breeding scheme. Splitting groups of bulls and staggering test start dates can be effective for utilizing equipment more efficiently but advanced genetic evaluation programs are required for implementation.

Acknowledgements: Beef Improvement Ontario

Key Words: Beef Cattle, Feed Efficiency, Genetic

463 Associations between markers in the leptin gene and carcass traits in commercial feedlot steers and heifers. B. W. Woodward*[1], J. Li[2], Z. Zhang[3], R. L. Quaas[3], and E. J. Pollak[3], [1]Merial Limited, Duluth, GA,, [2]Institute of Animal Science, CAAS, Beijing, PRC, [3]Cornell University, Ithaca, NY.

A number of SNP have been discovered in the leptin gene. The objective of this study was to evaluate four leptin SNP (UASMS1, UASMS2, UASMS3, and Exon2) in a large commercial feedlot population with carcass trait measurements. A total of 1,633 steers and heifers were fed at a single feedlot and harvested between August and November at the same commercial abattoir. These data were analyzed using three different models, 1) regression on genotype, 2) allele substitution, and 3) haplotype. Contemporary groups were fit as a fixed effect and formed from source or owner of the cattle plus sex; breed type was essentially confounded with source. Multiple harvest dates within contemporary groups were determined by optimal economic endpoint, primarily fatness. Results indicated that UASMS1 and UASMS3 were in complete linkage disequilibrium. Results of Model 1 showed significant ($P<.05$) associations between UASMS1 and HCW, calculated live weight (CLW), and plant backfat (BFAT); between UASMS2 and HCW and dressing percentage (DP); and between Exon2 and ribeye area (REA), BFAT, and yield grade (YG). The combination of UASMS1 and UASMS2 was associated with HCW, REA, CLW, days on feed (DOF), BFAT, and YG. UASMS2 and Exon2 were associated with HCW, HCW value, REA, CLW, DOF, DP, BFAT, BFAT deposition rate (BFDR), and YG. Model 2 results showed the same significant associations as Model 1 for each SNP individually plus REA and YG for UASMS1; REA for UASMS2; and HCW and CLW for Exon2. Model 3 showed the same significant associations as Model 1, except YG, for the UASMS1 and UASMS2 combination plus DP and BFDR. Model 3 significant associations for UASMS2 and Exon2 were HCW, REA, DP, BFAT, BFDR, YG, and marbling score (MBS). The three SNP combination also showed significant associations for Model 1: HCW, REA, CLW, DP, BFAT, YG, and MBS; and Model 3: HCW, REA, DOF, ADG, DP, BFAT, BFDR, and YG. Not all of the statistically significant associations presented represent biological significance. Based on these results, these leptin SNP will be evaluated in additional populations with known sire and breed type.

Key Words: Leptin SNP, Carcass Traits, Feedlot Cattle

Extension Education: Environment and National Animal Identification System

464 Agricultural-environmental programming in Pennsylvania: making connections, building capacity, increasing credibility. V. Ishler*[1], A. Dodd[1], R. Meinen[1], B. Mikesell[1], C. Abdalla[1], G. Martin[1], and J. Weld[2], [1]Pennsylvania State University, University Park, [2]USDA Agricultural Research Service, University Park, PA.

Environmental protection is one of the most critical and complex issues facing our nation. Many audiences have questions about impacts of animal agriculture on water quality and air quality; farm-level management requirements and options; and changing environmental policies. In response to this educational need, the Penn State Cooperative Extension Dairy and Livestock Nutrient and Environmental Education Days (NEEDs) program was held in seven locations across the state from September 2003 through March 2004.

The NEEDs program is unique for several reasons. First, it aims to increase the understanding of linkages among phosphorus and water quality impairment, air quality, changing federal and state policy, and farm-level management tools to reduce environmental risk. Second, the program provides time-sensitive information as Pennsylvania's nutrient management and water quality regulations change. Third, the program is specifically targeted to conservation district and USDA-NRCS staff, a non-traditional audience for extension. Finally, the comprehensive program was developed in cooperation with the PA Environmental Agricultural Conservation Certification of Excellence, USDA Agricultural Research Service, and the departments of Dairy and Animal Science, and Agricultural Economics and Rural Sociology at Penn State.

To document knowledge changes, participants were asked to answer a 15 question pre and post questionnaire. A follow-up post-card, sent to participants three months after the program, was used to document actions taken as a result of the program. Evaluation results suggest the interdisciplinary and collaborative effort increased the visibility, credibility, and relevancy of extension's mission throughout the state.

Key Words: Environmental Protection, Water Quality, Education

465 Development of an on-farm feed management assessment tool for use with dairy comprehensive nutrient management plans. L. VanWieringen[1], J. Harrison*[1], R. Kincaid[1], A. Hristov[2], R. Sheffield[2], M. Gamroth[3], P. French[3], T. Downing[3], and A. Sutton[4], [1]Washington State University, Puyallup, [2]University of Idaho, Moscow, [3]Oregon State University, Corvallis, [4]Purdue University, West Lafayette, IN.

A requirement of the US EPA guidelines for concentrated animal feeding operations (CAFO) in 2003 is to develop a nutrient management plan. One form of a nutrient management plan is a comprehensive nutrient management plan (CNMP) that is described in the NRCS Field Office Technical Guide. There are six components of a CNMP: 1) Feed Management, 2) Manure and Wastewater Handling and Storage, 3) Nutrient Management, 4) Land Treatment, 5) Record Keeping, and 6) Other Manure and Wastewater Utilization Options. Feed represents the largest import of nutrients to the farm and feeding management practices and diet modification techniques currently exist to reduce imports of nutrients to the farm. These technologies and approaches to achieve nutrient reductions vary in their degree of economic feasibility and environmental impact. The NRCS has a practice standard called Feed Management Code 592 which outlines the expectations of the consideration of feed management. In order to document that feeding management has been considered at the CAFO for nutrient management planning, we developed an assessment checklist that is intended to be completed by the CAFO operator with the assistance of an adviser who is informed about feed management practices. The assessment checklist was developed based on feeding management categories of: targeting nutrient requirements, forage management practices, ration management practices, ration balancing, production aids and enhancers, and monitoring tools. For each category, the operator will check the following considerations: was it considered, will it be economical, will it be implemented, and will it be considered in the future. The checklist is a 3-page, 20 question document in paper format. The assessment checklist could be implemented by Professional Animal Scientists (PAS) or those with substantial knowledge of dairy feed management considerations.

Key Words: Feeding Management, Nutrition, Nutrient Management

466 Evaluation of whole-farm nutrient balances on a commercial dairy operation. T. Nennich*[1], J. Harrison[2], D. Davidson[2], J. Werkhoven[3], and A. Werkhoven[3], [1]Texas A&M University, Stephenville, [2]Washington State University, Puyallup, [3]Werkhoven Dairy, Monroe, WA.

Evaluations of whole-farm nutrient balances are an important part of understanding nutrient management on dairy operations. Whole-farm nutrient balances supply specific information as to the flow of nutrients on dairy operations and provide data as to whether or not dairy operations are net importers or exporters of nutrients. The objective of this project was to estimate the whole-farm nutrient balance on a commercial dairy with various methods of calculating nutrient imports and exports from the dairy operation. A 600-cow dairy in northwestern Washington was used to determine the amounts of N, P, and K that were imported and exported from the dairy over the period of a year. Feed imports were determined using both formulated diets and actual feed receipts. In addition, feed samples were collected and analyzed to determine imports of nutrients to the farm. Nutrients exported via milk were determined using daily tank weights or monthly averages. Nutrients excreted in manure were estimated

by three methods: 1) sample analyses and mass volume flow, 2) ASAE manure excretion standards, and 3) the Dairy WFNBNET model (J. Dairy Sci. 86(Suppl. 1):163). In 2004, the dairy operation exported approximately 8 million kg of milk and 39,000 kg of milk N. Estimates for export of P and K in milk were 7200 and 12,000 kg of P and K, respectively. Estimates of imported nutrients were approximately 10% greater when calculations were made from purchased feed as compared to formulated diets. This study provided insights into what information was most valuable in order to make an estimate of whole-farm balance, and emphasized that feed and manure sampling, as well as accurate record keeping, are important to determine nutrient balances for an operation.

Key Words: Nutrient Management, Whole-Farm, Dairy

467 Sampling strategies to determine nutrient flows on a commercial dairy operation. T. Nennich*[1], J. Harrison[2], D. Davidson[2], J. Werkhoven[3], and A. Werkhoven[3], [1]Texas A&M University, Stephenville, [2]Washington State University, Puyallup, [3]Werkhoven Dairy, Monroe, WA.

Continued emphasis on nutrient management will require livestock producers to increase the number of manure samples that are collected and monitored on livestock operations. Sampling at strategic points within a manure handling system may prove to be of value for estimating whole-farm nutrient balance. Sampling protocols were developed on a commercial dairy operation to determine the best strategy for taking samples from various points within the manure handling system. The manure handling system on the dairy is a flush system with sand bedding. Flumes and flow meters were installed at strategic points in the manure handling system. A flume was installed prior to the sand-settling basin to determine the volume of manure and sand-laden water entering the settling basin. An in-line flow meter was installed between the sand-settling basin and the solids separator, and a second flume was installed after a screen solids separator and solids settling basin. Manure flow from the second flume directly entered a storage lagoon. Flow rates through the flumes and the flow meter were recorded electronically. Samples were taken from the large flume, from the solids separator, and the second flume to determine nutrient contents of manure at each of the individual points in the manure handling system. Samples were collected to determine if the timing of sample collection varied within a flush cycle. Samples were also taken to determine if flushes originating from various pens altered the composition of the manure through any of the sampling points in the manure handling system. The pen sampled and the sampling time within each flush cycle had little affect on N and P contents, but there was some variation in the solids contents within a flush cycle. Evaluations of sampling strategies are important to determine how and when samples should be taken on commercial operations to provide accurate information for nutrient management decisions.

Key Words: Nutrient Management, Manure Sampling, Dairy

468 Implementing the NAIS. K. Olson*, J. Mattison, G. Marrs, D. Sheldon, and B. Dokkebakken, NDHIA, Columbus, OH.

The objective of the NAIS is to identify all animals and premises in the US so a complete traceback can be completed within 48 hours of discovering an animal disease outbreak. Animal and premises ID, along with records of all animal movement will be required. Full use must be made of existing data collection programs to minimize multiple reporting by producers and maximize efficiency. The DHIA system has collected and used animal and premises ID for 100 years. It currently includes approximately half the dairy cows in the US. The combination of identified animals, a large field force trained to collect and verify ID information, established databases and IT staff experienced in data management and transfer, make the DHIA system a valuable partner in implementation of the NAIS. Similar information is collected throughout the system; however, multiple organizations provide field services, several platforms are used for data entry and four DRPCs provide computing services. To fully meet the needs of NAIS DHIA must collect animal movement data prior to entry to the milking herd and verify movement from the herd. NDHIA is working with the Pennsylvania Department of Agriculture, through a cooperative agreement funded by USDA APHIS, to enter DHIA data into PA HERDS, the state NAIS data repository. The objective of the dairy portion of the project is to identify 50000 animals with RFID tags, enter them in PA HERDS and begin tracking animal movement. Lancaster DHIA and Dairy One provide DHIA field services in the state and DRMS provides data processing for both. Dairy One will use an intermediate platform to transfer data to PA HERDS and DRMS will provide the interface for Lancaster. A major meat processor is equipped with RFID readers and will be linked to PA HERDS to capture terminal movement. DHIA will begin to collect and transfer movement data from birth until entry to the milking herd. The project will provide experience working with multiple service providers and data transfer platforms as a part of the NAIS as well as in collection of new information. Successes and challenges will be shared as we work to make DHIA a valued partner in the NAIS.

Key Words: ID

469 The effectiveness of collecting and delivering RFID data to meet requirements of NAIS. J. S. Clay*[1], P. A. Dukas[1], J. L. Mylin[2], J. A. High[2], P. E. Knepley[3], and R. Miller[3], [1]Dairy Records Management Systems, Raleigh, NC, [2]Lancaster DHIA, Manheim, PA, [3]Pennsylvania Dept. Of Agriculture, Harrisburg, PA.

Approximately twenty-five thousand dairy animals in approximately 275 herds will be chosen by Lancaster DHIA to receive RFID tags as part of a project managed by Pennsylvania Dept. of Agriculture (PDA) and funded by USDA/APHIS to develop and test delivery mechanics and systems to meet requirements of the National Animal Identity System (NAIS). Herds will be chosen as being representative of Pennsylvania's dairy industry and will receive ISO compliant tags. Although most herds will be DHIA members, a subset of producers will not be current participants in DHIA. DHIA technicians will use ISO-compliant handheld tag readers and will coordinate the field application of the tags and tag reading by scanners connected by Bluetooth technology to handheld computers using PocketDairy. Subsequently, RFID and farm premises information will be transferred to PCDART and then via the Internet to DRMS where automated servers will deliver the data within minutes via the Internet to servers at PDA. DRMS servers will use NAIS-specified protocols and file formats in their delivery. The NAIS-compliant system will be delivered as a component of a full-featured RFID-based herd management system. Usage of the management-oriented features will permit insight into potential deployment in the absence of mandated RFID usage. The project's success will be measured by the level of completeness of tags delivered to the PDA servers compared with the number of tags applied to animals. For some herds, the project will measure the effectiveness of the technology and staff ability to meet the long-term goal of delivering data from scanned tags to the PDA database within 48 hours of application. Comparisons of effectiveness of the system in DHIA vs non-DHIA herds will provide insight to the potential of the system to collect data during non-routine or upon-demand interaction with producers. Producers will be surveyed on level of satisfaction with the tagging and reading process.

Key Words: RFID, Bluetooth, NAIS

470 Utilizing RFID technology to enhance accuracy of identification and data entry in herd recording. M. Tomaszewski*[1], J. Clay[2], and P. Dukas[2], [1]Texas A&M University, College Station, [2]North Carolina State University, Raleigh.

Soon, federal regulation will require all livestock to have radio frequency identification (RFID) tags. Anticipating that regulatory requirement, Dairy Records Management Systems has developed procedures using wireless wand, bluetooth, and hand held computer technologies to integrate collected data into the on-farm herd management system, PCDART. During management activities, animals with ISO-compliant RFID eartags are identified using a wireless wand reader. Bluetooth technology is used to transfer data from the wand to the handheld computer and then to the herd management database either through a

cable or again using bluetooth technology. Applications enable the user to wand an animal and if a management option is needed for that animal, the information is visually displayed and an audible alert is sounded. Additionally, a milk weight input program has been developed utilizing these same technologies. In a 450 cow herd in Texas, results show that misidentification of animals has been eliminated. On days that milk weights are obtained, time required to identify animals has been reduced by 70%. New applications, such as routine verification of cows in designated groups, are accomplished by passing the wand past each cowâ€™s ear in a particular management group. This application was not previously feasible with visually read eartags. RFID eartags facilitate advancements to herd recording by providing an inexpensive, accurate devise for animal identification that has been incorporated into the herd management system.

Key Words: Herd Management, RFID, Bluetooth

471 Use of radio frequency identification (RFID) eartags and barcoded labels for identification of laboratory submissions. S. Stewart*[1], C. Clobes[2], B. Dokkebakken[2], and S. Eicker[3], [1]University of Minnesota, St. Paul, [2]Minnesota DHIA, Buffalo, MN, [3]Valley Ag Software, Tulare, CA.

The National Animal Identification System (NAIS) is a system of premises and individual animal identification currently under development. The system will allow rapid traceback of animals in the case of an animal disease outbreak or a bioterrorism attack. Details are still being determined, but producer acceptance and adoption will be critical for the overall success of the program. Producers will be more likely to adopt these identification systems if there were additional uses for management. While other forms of identification may also be utilized, one leading candidate for individual animal identification is radio frequency identification (RFID) eartags. A project was designed to utilize electronic recording of RFID eartags to produce barcoded labels for milk and blood samples for diagnostic testing. At the lab, barcoding should greatly lessen manual entry, improve tracing of samples, and help integration of results. During this project, RFID eartags were placed in 3369 animals on 9 premises. Blood was drawn from 2575 of these animals. These samples were placed in ultracold storage after being labeled with the date, visual ID, RFID, and premise ID embedded in the barcodes. Milk samples were obtained from 229 additional animals for mastitis culture. The milk samples were labeled at the time of collection with a label containing the visual ID, RFID, premise ID, date, and the DHIA herdcode in both human readable text and barcodes. Equipment utilized included a handheld computer communicating via BlueTooth to a battery operated RFID reader and also communicating via 802.11b (WiFi) to a portable barcode printer. Software (PocketDC) was developed for data recording and transfer to herd management software as well as the BlueTooth and WiFi communication protocols.

Acknowledgements: This project was funded by the Wisconsin Livestock Identification Consortium.

Key Words: RFID, Dairy, Barcode

Extension Education: Training Programs, Program Evaluation, and Economics

472 Competency acquisition of workers participating in the Penn State Dairy Production Skills Certificate. S. S. Costello*, L. A. Holden, A. J. Heinrichs, E. P. Hovingh, M. O'Connor, V. A. Ishler, R. E. Stup, and B. J. Hilty, Pennsylvania State University, University Park.

High performing dairy workers must effectively apply key production competencies in their work. The Penn State Dairy Production Skills Certificate (DPSC) is intended to improve job competencies of new employees. DPSC consists of six 2-day modules taught on a commercial dairy. To obtain a certificate, workers must successfully complete the General Production module and 3 additional electives. Choices include Reproduction, Herd Health, Calf-Heifer, Feeding, and Milking Management. The study objective was to evaluate module effectiveness toward enhancing job competencies. Pre and post-training instruments were administered and a score of 70% or above indicated successful competency. An evaluation was used to measure training effectiveness and document plans for 1 to 3 months post-training. Results from Reproduction, Herd Health, and General Production are presented here. A mean of 10 workers attended each module. Pre-training scores ranged from 2 to 95% demonstrating diverse prior knowledge. Mean pre-training scores for Reproduction, Herd Health, and General Production were 46, 50, and 53%, respectively. Mean post-training scores were 89, 76, and 83%, respectively. Competency improvement from highest to lowest was 43% for Reproduction, 30% for General Production, and 26% for Herd Health. Of 28 employees participating in three modules, 89% scored 70% or above on post-training assessment. Based on survey instrument and paired t-test, students made significant improvement within each production area ($p<0.005$). Most common plans for change included: practice improved listening, 77.7%; improve time management, 66.7%; improve breeding timing, 44%; use estrous synchronization differently, 44%; improve heat detection, 44%; use new herd tools for diagnosis, 44%; and improve safety hazard awareness, 44%. Results from individual modules will be used to enhance DPSC and develop advanced and management certificates. Post-training scores indicate competency improvement for workers participating in DPSC.

Key Words: Dairy, Worker, Training

473 Calf sense: Learning to manage newborn dairy calves. R. E. Stup*, A. J. Heinrichs, R. Van Saun, and D. Wolfgang, Pennsylvania State University, University Park.

Calf morbidity and mortality continues to be a large problem on dairy farms across the United States. Although mortality rates of less than 2% are achievable, the average rate in the U.S. in 2001 was 8.7%. Calf management practices at birth and in the first hours immediately thereafter can have a profound impact on health and survivability. Management is more than simply understanding the science behind calf health and survival; it also involves taking steps to ensure that effective practices are consistently used in the workplace. Calf Sense is a one-day farm owner and employee training program designed to combine scientific knowledge with practical management schemes in a learning experience that helps participants transfer effective calf management to the workplace. Calf Sense includes presentation of scientific and background material along with small-group, hands-on workshops where participants practice what they have learned. Presentations are held in the morning; topics include newborn calf health, colostrum absorption and management, and achieving consistent calf care. Participants divide into small groups for afternoon workshops and rotate through four, one-half hour sessions focusing on: conducting a basic newborn health exam, testing colostrum quality using a colostrometer and understanding rumen physiology, testing for transfer of antibodies from colostrum to blood, and applying standard operating procedures and record-keeping systems. Evaluation results were overwhelmingly positive. Participants rated the usefulness of presentations and workshops on a scale from 1 to 5 with 1 = "not useful" and 5 = "extremely useful." Results from 75 participants on five separate workshops have been summarized. All presentations scored between 4 and 5, except immunity transfer which scored 3.9. On a scale from 1 = "strongly disagree" to 5 = "strongly agree," participants indicated that they would use the training (4.55) and equipment (4.44) they received to improve newborn calf management at their farm.

Key Words: Calf, Management, Labor

474 Documenting the impact of continuing and extension education on changing adult behavior. D. Moore*[1] and H. Slotnick[2], [1]University of California, Davis, [2]University of North Dakota, Grand Forks.

Behavior change is the ultimate goal of an educational program but is difficult to accomplish and document. Behavior change theory suggests that adults go through stages of change. This project tested a learning stage evaluation method in two different audiences. A survey using clinical scenarios was used to elucidate participant stage of learning before and after a 5-day continuing veterinary education course on dairy records management. Pre-program learning stage prevalences were compared with those of non-participants. Responses included: 1. I would refer this problem (not applicable); 2. I can handle this, no need to update (evaluation); 3. I need to update (learning); 4. I have recently updated (gaining experience). Differences in stage prevalence were analyzed using Chi-square analysis and a triangular graphical method which resulted in vectors of group movement through learning stages. Each vertex of an equilateral triangle represented each stage. Each side of the triangle represented up to 100% of each stage. Given three mutually exclusive responses, a single point representing the group was plotted before and after the program. A vector was drawn between them to show magnitude and direction of movement. The technique was also used to evaluate a short-term educational program (90-minute). Four scenario topics were covered in the lecture while three were not. After the 5-day program, learning stage prevalence for six of eight scenarios were different between attendees and non-attendees. Participants' rate of change ranged from 31-81%. For four scenarios, participants moved from learning to gaining experience. For the others, they moved through two stages, evaluation to gaining experience. After the 90-minute program, the majority moved toward evaluation for three scenarios not covered and to learning or gaining experience for four topics covered. Readiness to change dictates the change a person can make or whether they attend a program or not. A long-term program can move more people from one stage to another. A short program can make small changes in learning stage movement.

Key Words: Program Evaluation, Continuing Education, Extension

475 Benchmarking dairy information for efficient decision making using interactive visual tools. G. Boda*, R. Lacroix, and K. M. Wade, McGill University, Montreal, QC, Canada.

The objective of the study was to explore the concepts of benchmarking for dairy-herd decision making, specifically in North America. The major concepts of benchmarking are introduced and illustrated in the dairy-herd context. Internal and competitive benchmarking techniques are proposed as useful approaches in the identification of problem areas on the dairy farm over time. An existing interactive visual tool (IVT), [copy write dairy information systems group, 2004] is used for the visual representation of dairy data from different databases. Visually descriptive and interactive features of the tool are useful to choose the comparison group, focus on specific variables, filter the data according to selected criteria, and zoom in on specific traits to examine performance in greater detail. Such flexibility should allow users both to identify potential problem areas sooner and to concentrate on areas that will allow for a maximization of productivity. Dairy farm profitability is directly related to production management factors. However, simply increasing production does not necessarily lead to more profit. In order to improve overall profitability, targets are set for production parameters in dairy herds with the aim of enhancing the efficiency of production. Improvements to existing visual tools that allow for the study of various scenarios in existing management parameters may help in this regard. This study examined such a procedure using four of the main areas of management in Quebec dairy-herd management - namely, somatic cell count, calving interval, days dry, and age at first calving. If we consider a dairy farm of 60 cows with a bulk tank SCC of 234 thousand cells/ml, then the estimated loss is $32,292, considering a proposed optimum of 100 thousand cells/ml. An economic gain visual interactive tool is proposed, utilizing profit or loss estimates based on current herd performance parameters.

Key Words: Benchmarking, Interactive Visualization, Dairy

476 Changing to an internet-based aquaculture service program. G. J. Burtle*, University of Georgia, Tifton.

Distance diagnostics and E-mail usage has increased, but telephone calls, site visits, and office visits are still important service activities for aquaculture related issues in Georgia. Service requests included the issues of fish disease control, pond water quality, aquatic weed identification and control, and aquacultural economics. Communications between the Extension aquaculture specialist and Extension agents have traditionally been dominated by telephone calls that result in a site visit or the shipment of samples for diagnostics or analysis. A system of distance diagnostic image transfer was developed in order to replace visits to counties or individual producers which require large expenditures of time and resources. Two methods of image transmission were made available to Extension agents, 1) attachments to E-mail messages and 2) a Distance Diagnostics System with security protection. Images sent by E-mail were unformatted and included information at the discretion of the Extension agent. The Distance Diagnostics System required password protected access, a formatted report, a requirement for image submission, the option of referrals to other professionals, a submission filing system, and technical assistance. Digital imaging systems with microscopes and video cameras were placed in 57.6% of the counties strategically located to allow multi-county use. Over a four year period, Extension agents increased service calls (14.4%). The traditional service communications also increased (3.6%). Extension agents using the Distance Diagnostics System increased by 833% while use of E-mails to request services declined by 57.7%. However, Extension agents still used E-mail almost twice as much as the Distance Diagnostics System. Sample submission for analysis continues to be required after digital image submission due to poor image quality, the limitations of the imaging system, or need for laboratory analysis prior to recommendations.

Key Words: Aquaculture, Diagnostics, Service

477 Youth livestock handling safety education. J. Yost* and S. Boyles, The Ohio State University, Columbus.

The study group was composed of 273 4-H and FFA youth ranging in age from 8 to 19 years old. All participants are given a pre- and post-test on animal handling techniques and animal behavior. There were a total of 7 questions on each test relating to animal behavior. After the pre-test, a 15 min lecture on animal behavior was presented. Participants were then divided into groups of ten based on 4-H/FFA project species. Each group is given a sheet of paper (66 x 78 mm) and a permanent marker. The groups were allotted 20 min and instructed to develop the type of facilities they would house their animals in during their project. The groups would then present their designs to the rest of the participants. There is no critiquing allowed. The pre- and post-test had the same questions. All pre- and post-test questions were multiple choice and there could be more than one correct response to each question. One-way ANOVA was used with a confidence interval of 95%. There was an increase in the percent correct responses from the pre-test to the post-test questions relating to safe animal handling (+11), what causes injuries (+14), what frightens animals (+21), an animal's blind spot location (+21), causes of stress (+17), and why animals get excited (+21). However, no change was observed in their knowledge of an animal's flight zone. Participants increased their knowledge of the factors that effect safe animal handling. The youth also gained a greater understanding of the negative physiological effects stress impose on livestock. Through development of the facility and presentation of the drawing, members were allowed to develop their communication, teamwork, leadership, problem solving, and decision-making skills.

Key Words: Youth, Facilities, Animal Handling

478 Factors influencing the value of West Virginia feeder cattle. P. Osborne*, E. Rayburn, and J. Pritchard, West Virginia University, Morgantown.

West Virginia cattle producers have been marketing feeder calves through commingled graded sales since 1932. The sale price of feeder calves is influenced

by a number of factors such as sex, weight, grade, breed, lot size, location and health. A multiple regression analysis was conducted on data gathered from eight WV sale barns during the fall of 2000 to 2004 for special graded sales. The base calf for the analysis was a black, medium frame (M), No.1 muscle, steer calf weighing 550 lbs..The following table quantifies the average value of the factors influencing price. WVU Extension developed a feeder calf marketing program that specialized in the development and sales of Quality Assurance(QA) Cattle. The program was developed to pool and sell load lots of source and health process verfied calves under Beef Quality Assurance standards. An economic analysis was conducted to compare the QA and graded sales(GS) in 2001-2004. The comparison was made between the QA calves and the M1 & L1 Black & BWF calves in the graded sales. The QA calves had a market advantage in increased value of $61,$54,$66 and $61/hd in 2001 to 2004 respectively. The QA calves were heavier than the GS calves (P<.01) with average increase in weight ranging from 40 to 76 lbs/hd and an average value per head due to weight of $36 to $90. Historically, the pooled calves have sold for 12% more than comparable barn cattle.

Factors Influencing Calf Values

Year	<2000>	<2001>	<2002>	<2003>	<2004>
Avg. Base Value	483.55	464.37	417.83	516.99	592.48
Heifer	-51.68	-55.02	-47.05	-45.31	-46.54
Bulls	-29.41	-31.00	-37.97	-29.52	0.00
L1	-6.82	-9.62	-7.98	-6.31	-9.16
S1	-62.57	-70.12	-65.28	-72.04	-73.04
LM2	-42.72	-35.46	-30.06	-29.95	-41.96
No Grade	-65.33	-39.94	-53.95	-45.76	-56.44
BWF	2.97	-2.53	-0.49	6.30	7.24
CHARX	-15.40	-14.25	-15.62	-11.80	-12.61
REDX	-20.07	-23.49	-17.93	-20.03	-18.05
HERE	-45.53	-44.36	-38.86	-44.60	-59.97
LOT SIZE	0.41	0.56	0.61	0.50	0.71
WEIGHT	0.51	0.53	0.50	0.69	0.75

Key Words: Feeder Cattle, Value Added, Graded Sales

479 Beef artificial insemination economics. W. Ellis*, Southeast Missouri State University, Cape Girardeau.

The objective of the study was to compare gross sale income between calves sired by artificial insemination (AI) or a clean-up bull. One hundred and twenty animals were enrolled in the study (12 heifers, 108 cows). A 30-day CIDR-based AI protocol was used to synchronize estrus and computerized Heat Watch technology was used to detect estrus in heifers. Cows were Fixed-time AI following a CIDR-based protocol that included GnRH. One AI sire was used for all AI services. Cows were randomly assigned to one of two experienced AI technicians, stratified by age of cow, days postpartum, and body condition score. Clean-up bulls were introduced 14 days after fixed-time AI. Pregnancy diagnosis was determined by ultrasonography. First AI service pregnancy rate following estrus synchronization was 70/120 (58%) and pregnancy rate after the breeding season (AI and clean-up) was 113/120 (94%). There were 66 AI and 42 cleanup calves conceived. Calves were marketed as weaned calves (n=25, 5 AI), bred heifers (n=37, 23 AI) or harvest weight steers on a grid system (n=46, 38 AI). Overall, gross income per calf from AI and clean-up sires averaged $1169.97 ± 33.76 and $952.15 ± 60.76, respectively. Gross income per calf was significantly different between sire groups for weaned calves (p<0.05) and harvest weight steers (p<0.05) but not bred heifers (p>0.5). Bred heifer buyers were knowledgeable of their mode of conception. Weaned calves from clean up bulls were fed 119 days longer post weaning than their AI counterparts and had a higher gross sale value (+$220/calf). Gross income per bred heifer averaged $34 higher for AI over clean up bulls while gross income per harvest weight steer averaged $131 higher for AI. The cost of synchronization and AI was $31.29 per female and $56.89 per AI calf. The cost of synchronization and AI was recovered through higher sale income per AI calf in harvest weight steers but not in weaned calves or bred heifers.

Key Words: Beef, Artifical Insemination, Economics

FASS Symposium on Toxic Levels of Minerals

480 Sources and bioavailabilities of toxic levels of minerals. J. W. Spears*[1] and J. P. Goff[2], [1]North Carolina State University, Raleigh, [2]USDA, National Animal Disease Center, Ames, IA.

Most minerals, whether essential or nonessential, can produce negative effects on production and/or health of animals when consumed orally at high concentrations. This presentation will focus on potential sources and bioavailability of minerals most likely to present toxicosis in animals. For the essential trace minerals copper and selenium, oversupplementation or errors in formulation of mineral supplements are frequent causes of toxicosis. Depending on the mineral in question, other potential sources that may lead to toxicosis include: 1) feedstuffs, 2) water, 3) minerals present as contaminants of certain mineral ingredients, 4) consumption of animal waste or by-products, 5) soil ingestion, and 6) exposure to industrial products (batteries, paint, etc.). High concentrations of a mineral in feedstuffs can result from high soil mineral levels due to soil type, use of sewage or industrial sludge, or industrial pollution. In animals ingesting high concentrations of a mineral, bioavailability of the mineral from the source of exposure is a major factor determining whether toxicosis will occur. Chemical form of the mineral present in a given source and the presence of antagonists in the diet are primary factors that affect bioavailability

Key Words: Minerals, Toxicity, Bioavailability

481 Toxic levels of minerals in the diets of animals. J. Goff*[1] and J. Spears[2], [1]National Animal Disease Center, USDA-ARS, Ames, IA, [2]North Carolina State University, Raleigh.

Ingestion of any mineral at a high enough level can have detrimental effects on the health and productivity of animals. This presentation will provide examples of the maximal tolerable levels of a number of minerals commonly causing problems in food and companion animals. These maximal tolerable levels are, for most minerals, also dependent on the length of time they are fed. For most minerals a maximal tolerable level is noted for a single oral dose; an acute dose, at which problems would not be expected if feeding the mineral at this level for less than10 days; and a chronic dose, at which problems would not be expected if feeding the mineral at this level for more than 30 days. In general the maximal tolerable level implies no effect on productivity of the animal. For some minerals such as sulfur in ruminants, sudden death due to polioencephalomalacia may be one of the first indicators of decreased performance of the animal when the mineral is fed beyond the maximal tolerable level. In the case of minerals such as calcium, intolerable levels may be defined as levels interfering with feed intake or utilization of other minerals, rather than induction of pathological changes. The presentation will briefly review the new recommendations, especially as they contrast with the 1980 Mineral Tolerances of Domestic Animals publication.

Key Words: Toxicosis, Minerals, National Research Council

482 Potential adverse effects on humans consuming excess minerals in animal products. J. Greger*[1], F. Nielsen[2], and K. Klasing[3], [1]University of Connecticut, Storrs, [2]Grand Forks Human Nutrition Center, Grand Forks, ND, [3]University of Califronia, Davis.

The Committee on Mineral and Toxic Substances in Diet and Water for Animals was asked to identify potential risks to humans from consuming products from animals that ingested excess levels of minerals. This was complex question. These points had to be considered. Did a mineral accumulate in tissues of animals ingesting an excess level of the mineral? In which tissues (i.e. muscle, liver, kidney, bone, eggs, or milk) did the mineral accumulate? Was the accumulation different among species (e.g. poultry, cattle, swine, fish, other seafood)? How much of these tissues were ingested by the average adult and average child (categorized by age and weight) in the US? How much would individuals at the 99th percentile or those with unusual diets consume of these tissues? Using these data we estimated human exposure to minerals to humans consuming products from livestock that had ingested excess minerals. These estimates then were compared to the Tolerable Upper Intake Levels (ULs) (for boron, calcium, copper, fluoride, iodine, magnesium, manganese, molybdenum, nickel, phosphorus, selenium, vanadium and zinc) suggested for humans by the Food and Nutrition Board and WHO and FDA standards (for cadmium, lead, and mercury). We also had to consider the form or the mineral in the animal tissues when evaluating toxicity. For example, organic forms of arsenic in seafood have not been shown to be toxic and selenomethionine has different effects than selenite. These analyses demonstrated that chronic ingestion of high amounts of "protein rich" foods which were contaminated with excess (>5% by weight of the protein rich food) bone chips due to improper processing or the chronic ingestion of large quantities of organ tissues from animals that ingested excess minerals could result in humans consuming more of certain minerals than is considered safe.

Key Words: National Research Council, Mineral Toxicity, Effect on Humans

483 New developments in selenium toxicity. X. G. Lei*, Cornell University, Ithaca, NY.

Selenium is an essential trace element for both animal and human nutrition, but the gap between dietary Se requirements and chronic toxicity levels is relatively narrow. During the past two decades, major changes in our understanding of selenium biology have occurred. Using genomics tools, a total of 25 selenium-containing proteins have been identified in humans. Physiological functions of several selenoproteins have been well studied with the help of the gene-knockout mouse models. The potential of supranutritional levels of selenium in preventing certain types of cancers in humans has led to an interest in enhancing selenium concentrations in the edible animal products. Organic forms of selenium seem to serve that purpose well. However, the immediate risk of Se toxicity to the ecosystems has been highlighted by the fish kills and bird deformities at several aquatic resources as a result of Se bioaccumulation. Thus, establishing the accurate maximum allowable tolerable levels of selenium for various species has broad implications. The challenge is that these levels vary widely with the form and source of Se, exposure duration, nature of diet, and end points of tolerance.

Key Words: Selenium, Toxicity, Environment

484 The toxicity of minerals that may be advocated for animal health and production through reasons other than nutritional need. F. Nielsen*, USDA/ARS/Grand Forks Human Nutrition Research Center, Grand Forks, ND.

There are several mineral elements that are unlikely to be of toxicological concern under natural conditions for domestic animals, but whose tolerable intake levels may become of interest because of possible exposure through supplements given with the intention of boosting performance. These elements include silicon as sodium zeolite A that can increase chicken egg shell thickness, prevent parturient paresis in dairy cows, and decrease bone-related injuries in horses; rare earth elements that have been reported to increase feed conversion and weight gain in beef cattle, sheep, pigs, rabbits, chickens and ducks, milk production of dairy cattle, egg production of hens, and the output, survival rate and feed conversion of grass carp and prawn; boron that may enhance immune function and bone strength in pigs; lithium that may be useful as a food aversion agent for grazing animals; and chromium that apparently improves carcass characteristics in swine, immune response in stressed animals, and milk production in dairy cows. The fact that these elements have beneficial effects at intakes higher than that found with normal diets makes it important to determine when these higher intakes become excessive and result in toxicosis. The maximal tolerable intake of these elements can be influenced by dietary composition because their mechanisms of toxicity include interference with the utilization of other essential minerals (lithium, silicon, rare earths), enzyme inhibition (boron), and oxidative stress (chromium). The predominant sign of toxicosis of these elements is reduced growth. Recommendations for the maximal tolerable levels of these elements for animal health and the rationale for the recommendations will be provided at the symposium.

Key Words: Toxicity, Minerals, Ultra Trace Elements

485 New developments in heavy metal toxicity. K. Klasing*, University of California, Davis.

The Committee on Animal Nutrition of the National Research Council, National Academies of Sciences, established the Committee on Minerals and Toxic Substances in Diets and Water for Animals to update recommendations on maximum tolerable levels. Among the minerals examined, the heavy metals were of special concern. Cadmium, mercury, and lead are heavy metals that have a variety of industrial and domestic applications. These metals are not known to be nutritionally required by vertebrates but they are of to nutritionists because they are toxic at relatively low levels of exposure. Lead from batteries, paints, and contaminated soil is a common cause of accidental poisonings in animals. Mercury and cadmium have accumulated to high levels in some environments from a variety of anthropogenic sources. When consumed, these metals are not absorbed very efficiently from the intestines but they are excreted very slowly and they accumulate in tissues over time. Cadmium accumulates in kidney and liver, lead accumulates in kidney, brain and bone, and mercury accumulates in all tissues, including muscle. Levels of these metals in the diet and water that are tolerated by animals with no apparent effect result in unacceptably high levels in food products. Thus, the maximum tolerable levels of these metals in animal feeds have been based on issues of human health for decades. Toxicity of these metals in animals is due to several mechanisms. Their propensity to undergo redox reactions and their ability to bind to and deactivate antioxidants can cause cell death due to oxidative damage. These metals also antagonize the homeostasis of chemically related minerals that are nutritionally essential by impairing their absorption, transport, excretion, or incorporation into active sites of molecules. Mercury and lead affect development of the brain and the immune system while cadmium causes renal damage. Recommendations on the maximal tolerable levels for animal health and their rationale will be provided at the symposium.

Key Words: Lead, Mercury, Cadmium

486 Effects of menhaden fish meal or oil on the performance and immune response of nursery pigs. A. Gaines*[1], J. Carroll[2], R. Fent[1], and G. Allee[1], [1]University of Missouri, Columbia, [2]Livestock Issues Research Unit, ARS-USDA, Lubbock, TX.

A trial using 210 pigs (TR-4 X PIC C22) was conducted to determine the effects of menhaden fish meal (MFM) or oil (MFO) on the performance and immune response of nursery pigs. Pigs (17 d; 5.31 ± 0.16 kg) were weaned into a nursery facility and allotted to one of six dietary treatments (Trt; seven replicate pens/Trt): Trt 1, 0% MFM/MFO; Trt 2, 5% MFM; Trt 3, 10% MFM; Trt 4, 2.5% MFO; Trt 5, 5% MFO; and Trt 6, 5% pet food grade poultry-byproduct meal (PBM). Experimental diets were fed for 21 d. On d 13, a subset of pigs (six pigs/Trt) were fitted with a jugular catheter for blood collection (30-min intervals for 6 h). On d 14, all pigs (n = 210) were injected i.m. with LPS (15 μg/kg BW). On d 21, pigs were placed onto a common corn-soybean meal fortified diet and growth performance was evaluated until d 28. Prior to LPS challenge (d 0-14) there were no Trt differences for ADG ($P > 0.21$) or G/F ($P > 0.80$). However, there was a Trt effect ($P < 0.01$) for ADFI. Pigs fed 5.0% PBM had lower ADFI ($P \leq 0.05$) compared to pigs fed 0% MFM/MFO, 5% MFM, and 10% MFM. Post-LPS (d 14-28), there was a Trt effect for ADG ($P < 0.02$). Pigs fed 10% MFM had increased ($P \leq 0.10$) ADG compared to pigs fed 0% MFM/MFO, 2.5% MFO, 5% MFO, and 5% PBM. Furthermore, ADG was higher ($P \leq 0.10$) in pigs fed 5% MFM compared to pigs fed 0% MFM/MFO, 5% MFO, and 5% PBM. There were no Trt differences for ADFI ($P > 0.27$) or G/F ($P > 0.60$). There was no Trt effect ($P > 0.74$) for basal serum cortisol (-1.0, -0.5, and 0 h) prior to LPS challenge. However, post-challenge, there was an overall Trt effect ($P < 0.04$) on serum cortisol. Serum cortisol was lower in pigs fed 5% MFO compared to pigs fed 0% MFM/MFO ($P = 0.09$), 5% MFM ($P < 0.01$), 10% MFM ($P < 0.01$), and 5% PBM ($P < 0.05$). Additionally, serum cortisol was lower in pigs fed 2.5% MFO compared to pigs fed 5% MFM ($P = 0.06$) and 10% MFM ($P < 0.04$). This research demonstrated that feeding MFM or MFO altered the acute phase immune response, which, in the case of MFM, may have led to improved growth performance.

Key Words: Fish Meal, Fish Oil, Pigs

487 Evaluation of canola meal as an alternative plant protein source in nursery pig diets. J. Ele, S. Meers, M. Azain, and R. Dove*, University of Georgia, Athens.

Two experiments were conducted to evaluate the inclusion rate of canola meal (CM) on nursery pig performance, thyroid hormone status and nutrient digestibility. Experiment 1 used 384 nursery pigs (6.16 kg at 18 d) in three trials to determine the effects of CM as a replacement for dietary soybean meal (SBM) on a protein basis. Canola meal was used to replace 0%, 33%, 66% and 100% of the SBM in phase I (d 0 to d 11; 0, 11.5, 22.9, and 34.4% dietary CM, respectively) and phase II (d 11 to 35; 0, 13.3, 26.6, and 39.9% dietary CM, respectively) nursery pig diets. During phase I, pigs fed 33% or 66% CM were not significantly different ($P > 0.10$) from pigs fed the control diet. Pigs fed 100% CM gained less than other treatments ($P < 0.001$). Significant differences for gain ($P < 0.01$) and feed intake ($P < 0.01$) were seen from the phase II diet. The 33% CM was numerically higher but not different from the control diet. As CM increased beyond 33%, gain and feed intake decreased however, no significant difference ($P > 0.10$) was observed for feed efficiency. No differences ($P > 0.10$) were observed in the levels of triiodothyronine (T3) and thyroxine (T4) across all diet treatments. In Exp. 2, 16 barrows (8.83 kg at 37 d) were used to determine nutrient utilization. Dietary treatments were the same as in Exp. 1. Diets were fed in a 4 x 4 latin square design with a 5 d adjustment period and a 3 d total collection period. Digestibility parameters showed statistical differences in energy, CP and nitrogen, ash, DM ($P < 0.001$), and NDF ($P < 0.05$) digestibility among treatments. The control and 33% CM diets were significantly better in nutrient utilization of energy, CP and nitrogen, ash, and DM when compared to the 66% and 100% diets. NDF digestibility in the 33% CM diet was significantly increased ($P < 0.05$) compared to the 66% CM diet, but not significantly different ($P > 0.10$) from the control or 100% CM diets. In conclusion, these studies demonstrated that canola meal can replace up 33% of the SBM (13% dietary CM) in nursery pig diets without adverse effects on pig performance or thyroid function.

Key Words: Canola Meal, Nursery Pigs, Thyroid Hormone Status

488 Near infra-red reflectance spectroscopy for prediction of amino acids in feed ingredients leads to important cost savings in diet formulation. J. Goodson*[1], D. Hoehler[1], J. Fontaine[2], B. Schirmer[2], and A. Jaeger[2], [1]Degussa Corporation, Kennesaw, GA, [2]Degussa AG, Hanau, Germany.

Near infra-red reflectance spectroscopy calibrations used to predict amino acid levels in feed ingredients can be used to allow swine feed formulators to reduce safety margins in formulation programs. Reduction of these safety margins for amino acids allows the production of feeds which meet animal requirements for protein and amino acids without supplying excessive levels of either. These calibrations also enable formulators to take advantage of alternative feed ingredients when traditional ingredients become high priced compared to other sources of nutrients. Currently calibrations are available to predict DM, CP, Met, Cys, Met+Cys, Lys, Thr, Trp, Arg, Ile, Leu, Val, His and Phe. Ingredients including barley, corn, corn gluten meal, feather meal, fish meal, lupine, meat meal, meat and bone meal, peas, poultry meal, canola meal, rice bran and hulls, sorghum, soybean meal, full fat soybeans, sunflower meal, tritcale and rye, wheat, wheat bran and middlings have calibrations. These calibrations are being used to assess seasonal variation and regional variation in nutrients provided by these ingredients. A large data base of new crop soybean meal samples (n = 81) collected in the fall of 2004 show that there are important variations in CP as well as many important amino acid levels. A similar data set for new crop corn (n = 123) demonstrates amino acid variation also. Application of this technology to soybean meal and corn enables formulators to use very precise amino acids values. Several example formulations have been prepared showing that savings can range up to $1.50 per ton in a swine grower feed when precise data on amino acid levels in corn and soybean meal are available. These savings represent the extremes, since in this case the highest and lowest levels of Met and Lys found were used. In a more practical example, formulation cost was reduced by $0.29 per ton by changing the safety margin of Met and Lys by 0.5 standard deviations in soybean meal alone.

Key Words: Near Infra-Red Reflectance Spectroscopy, Amino Acids, Diets

489 Use of rice in substitution of corn in diets for young pigs. B. Vicente, D. G. Valencia, R. Lázaro, M. P. Serrano, and G. G. Mateos*, Universidad Politácnica de Madrid, Spain.

We studied the influence of feeding rice on the ileal digestibility (ID) of dry matter (DM), organic matter (OM), gross energy (GE) and starch and the morphology of the ileum of piglets at 37 d of age. The control diet was a complex diet without in-feed growth promoters and included 50% cooked corn (99°C for 50 min and then rolled). The experimental diets were similar but corn was substituted for rice either raw or cooked (mild and severe temperature). Each treatment was replicated seven times (one pig). Replicates were fed their respective diets from 25 to 37 d of age. Starch gelatinization of the cereal was 84% for corn, 11% for raw rice and 52% and 76% for the mild and severe cooked rice, respectively. Ileal digestibility of nutrients was higher for piglets fed rice than for piglets fed corn (88.0 vs. 87.1% for DM; 88.1 vs. 86.8% for OM; 86.5 vs. 85.2% for GE and 98.8 vs. 97.3% for starch; $P \leq 0.01$). Rice cooking improved DM (88.4 vs. 87.2%; $P \leq 0.01$), OM (88.4 vs. 87.5%; $P \leq 0.05$), GE (86.8 vs. 85.9%; $P \leq 0.05$), and starch (99.1 vs. 98.3%; $P \leq 0.05$) digestibilities but no differences were observed between mild and severe heat processing conditions of the rice ($P \geq 0.10$). Villus height was higher (413 vs. 336 μm; $P \leq 0.05$) and crypt depth was lower (110 vs. 152 μm; $P \leq 0.01$) for

piglets fed mild cooked rice than for piglet fed cooked corn. As a result, villous height: crypt depth ratio was higher for piglets fed mild cooked rice (4.0 vs. 2.3; $P \leq 0.001$). The morphological values of the ileum obtained from piglets fed raw rice were intermediate between those of piglets fed cooked corn and mild cooked rice. A more severe processing of rice increased starch gelatinization but tended to impair intestinal morphology as compared to mild cooked rice. The results indicate that the benefits on productivity previously observed with rice feeding of weanling pigs might be due, at least in part, to improvements in ileal morphology that results in better digestibility of nutrients.

Key Words: Rice, Ileal Digestibility and Morphology, Starch Gelatinization

490 Effect of dietary level of distillers dried grains with solubles (DDGS) on growth performance, mortality, and carcass characteristics of grow-finish barrows and gilts. D. Cook*[1], N. Paton[1], and M. Gibson[2], [1]Akey, Lewisburg, OH, [2]Dakota Gold Research Association, Sioux Falls, SD.

The objective of this trial was to determine the effect of feeding 0, 10, 20, or 30% DDGS from a new generation ethanol plant on growth performance and carcass characteristics of grow-finish barrows and gilts (42 kg initial body weight) reared in a commercial environment. Pigs were split-sexed housed (26 pigs/pen) in a commercial grow-finish barn (1,040 pigs per barn) and randomly allotted within sex and weight block (five blocks) to one of four DDGS levels. Diets were formulated on a digestible amino acid basis with the 1998 NRC values for corn and soybean meal. Key nutrient values used for DDGS were 3,420 Kcal ME/kg, 0.67, 0.62, and 0.31% digestible lysine, threonine, and methionine, respectively. Diets were formulated to be isocaloric by adjusting the dietary percentage of liquid fat. Pigs had ad libitum access to diets and water throughout the trial. There was no effect of DDGS inclusion on final pig bodyweight (116 kg), ADG, ADFI or gain to feed ratio, suggesting the nutrient values used for DDGS were appropriate. There was a linear decrease in mortality percentage (6.0, 2.8, 2.4, and 1.6%, respectively) as DDGS inclusion increased ($P < 0.05$). Carcass yield decreased linearly (77.3, 76.6, 76.2, and 75.6%, respectively) as dietary DDGS inclusion increased ($P < 0.01$). Back fat level and carcass lean percentage were not affected by the dietary DDGS level fed. The data suggest that up to 30% DDGS from this source can be included in the diet without affecting growth performance or carcass lean percentage and that DDGS may have value in a health challenged system for reducing mortality. The negative effect of feeding DDGS on carcass yield should be accounted for in evaluations of its economic value.

Key Words: DDGS, Pig, Carcass

491 Influence of feed soaking and feed fermentation on amino acid digestibility by growing pigs. C. Pedersen*, K. E. Strom, M. G. Boersma, and H. H. Stein, South Dakota State University, Brookings.

Two experiments were conducted to study the influence of feed soaking and feed fermentation on the apparent ileal digestibility (AID) of AA by growing pigs. Each experiment utilized six barrows that were equipped with a T-cannula in the distal ileum (initial BW: 77.2 ± 5.9 and 91.2 ± 5.9 kg for Exp. 1 and 2, respectively). Within each experiment, pigs were allotted to a repeated 3 x 3 Latin square design. A corn-soybean meal based diet (16.6% CP) was formulated and used in both experiments. In Exp. 1, this diet was fed in a dry form or after having been mixed with water in a 1:1 ratio or in a 1:3 ratio. In Exp. 2, the diet was fed to the pigs in a dry form or after having been fermented for 24 h using either 10% residual feed or 50% residual feed to initiate the fermentation. Feed was provided to the pigs in two equal meals in a daily amount that was equal to three times the maintenance requirement for energy. Each experiment consisted of three 7-d periods and ileal digesta were collected from the cannulas during the last 2 d of each period. Results from Exp. 1 indicated that there were no differences in the AID for any of the AA between the diet fed in the dry form and the diet mixed with water in a 1:1 ratio. However, the AID for all indispensable AA except His tended ($P \leq 0.08$) to be lower for the pigs fed the feed that was mixed with water in a 1:3 ratio compared to the AID from the other two groups. In Exp. 2, there were no differences in the AID for Arg, Met, and Thr between the three groups. However, for the remaining indispensable AA, higher ($P \leq 0.05$) AID were found for the dry feed compared to the feed that was fermented with 10% residual. The AID for the dry feed were also higher ($P \leq 0.05$) than for the fermented feed with 50% residual for Ile, Leu, Lys, Phe, and Val. Fermentation of the feed with either 10 or 50% residual feed also reduced the concentrations of all AA (on a DM basis) by approximately 7%. It is concluded that the mixing of feed with water in a 1:3 ratio and fermentation of feed prior to feeding may reduce the quantities of digestible AA that are absorbed by the pigs.

Key Words: AA Digestibility, Feed Fermentation, Feed Soaking

492 Relative bioavailability of phosphorus and true amino acid digestibility by poultry as affected by soybean extraction time and use of low-phytate soybeans. L. Karr-Lilienthal*, P. Utterback, C. Martinez Amezcua, C. Parsons, N. Merchen, and G. Fahey, University of Illinois, Urbana.

The objectives of this study were to determine if lengthening the time that soybeans (SB) spend in the extractor during preparation of soybean meal (SBM) result in increased relative bioavailability of phosphorus without negatively impacting true amino acid digestibilities, and to compare those modified SBM to that produced from a low-phytate SB. Three SBM were prepared under uniform conditions with the exception of the length of time SB spent in the extractor (45 min [300 rpm], 60 min [225 rpm], or 90 min [150 rpm]). A SBM prepared from low-phytate SB was obtained for comparison. Relative phosphorus bioavailability in chicks and true amino acid digestibilities in cecetomized roosters were determined. Data were analyzed as a completely randomized design using the mixed models procedure of SAS. Increasing the length of time that SB spent in the extractor from 45 to 90 min resulted in lower ($P < 0.05$) phytate phosphorus and increased phosphorus bioavailability from 34 to 56%. However, this increase came at the expense of available lysine status, with the SBM extracted for 90 min containing less total lysine and less digestible lysine ($P < 0.05$) than the SBM extracted for 45 min (traditional extraction time). Total essential, total nonessential, and total amino acid digestibilities were highest ($P < 0.05$) for roosters fed the SBM extracted for 45 min and lowest ($P < 0.05$) for the SBM extracted for 60 min. Phosphorus bioavailability from SBM prepared from low phytate SB was 1.5 times higher ($P < 0.05$) than for SBM extracted for 45 min. Increasing the length of time that SB spend in the extractor led to an increase in bioavailable phosphorus but a decrease in bioavailable lysine, potentially negating the positive effect on phosphorus.

Key Words: Phytate, Soybean Meal, Processing

493 The effect of particle size and feed form on laying hen performance. M. Scott*[1] and M. McCann[1,2], [1]The Queen's University of Belfast, Belfast, County Antrim, Northern Ireland, [2]Agriculture, Food and Environmental Division, Belfast, County Antrim, Northern Ireland.

Particle size in poultry diets has been reported to affect many characteristics, including feed consumption, body weight gain, egg size, egg production rate and nutrient digestibility. The effect of feed form, pellets, crumbs, mash or whole grain cereals on laying hen performance is less well established and inconsistent results have been published. The aim of the study was to determine the optimum particle size and feed form for laying hen performance. A total of 100 hens were offered a diet containing 600 g/kg wheat. Three particle sizes (2, 5 and 8 mm) were examined, and four feed forms (whole wheat plus balancer, pellets, crumbs and mash) were investigated. The experiment was a 3 x 3 + 1 factorial arrangement carried out for six weeks on individually caged hens. Particle size significantly affected many performance traits, including gizzard weight, eggs produced, total egg weight, average egg weight, dry matter intake (DMI), yolk diameter, yolk height and shell surface area. The optimum particle size for egg production, in terms of both number and weight, was 5 mm; the total number of eggs produced by the hens fed the 5 mm diet (39.00) was significantly higher ($P < 0.05$) than the total number of eggs produced by the hens

offered the 8 mm diet (35.18). Feeding whole wheat cereal grain significantly increased egg production, total egg weight, average egg weight and shell surface area. Gizzard weight was significantly increased with the inclusion of whole wheat grains in comparison to both the particle size and feed form treatments. The high grinding pressure and abrasive action generated in the gizzard to effectively crush whole grain cereals have resulted in muscle mass increase, therefore, significantly increasing the weight. Whole wheat grains plus balancer gave the best overall performance in terms of egg production and egg weight. In addition, DMI was significantly lower for the whole wheat plus balancer treatment than for the other treatments. It is concluded, in terms of particle size, 5 mm is optimal for egg production. Whole cereal grain plus balancer resulted in significantly better egg production, egg weight and DMI in comparison to the other feed forms investigated.

Key Words: Particle Size, Feed Form, Laying Hen

Production, Management and the Environment: Dairy and Livestock Management

494 Influence of rearing environment and season on growth performance of growing-finishing pigs. R. Myer* and R. Bucklin, University of Florida, Gainesville.

An eight year study was conducted to determine the effects of three different rearing environments on growth performance of growing and finishing pigs (from 28 to 107 kg avg. body wt.) reared during the summer or winter in north Florida USA (31°N latitude). The three rearing environments were 1) concrete-floored pens in a semi-confinement building or outside dirt lot pens with minimal shelter that 2) have ("old") or 3) have not ("new") been occupied previously by pigs. Two trials were conducted each year (summer and winter) and each involved 36 crossbred pigs. All pigs were routinely dewormed. Overall, pigs reared during the summer on average grew 3% slower (0.83 vs. 0.86 kg/d; P<0.001) but required 3% less fed (3.32 vs. 3.41 kg; P<0.001) per kg of weight gain than pigs reared during the winter. Rearing environment influenced ADG (P<0.001; 0.82, 0.85, and 0.86 kg/d for "old", "new", and concrete pens, respectively) and F/G (P<0.001; 3.48, 3.35, and 3.26). A pen x season interaction (P<0.01) was noted for F/G in that pigs reared on dirt had poorer F/G compared to pigs reared on concrete during winter but during summer, F/G was similar. Average backfat thickness (mean = 2.5 cm) was influenced by rearing environment (P = 0.01) and somewhat by season (P = 0.08). Results indicate that growing-finishing pigs can be effectively reared in outside dirt lots under the environmental conditions of the southeastern USA, in particular if the lots are periodically rotated to "new" ground. However, pigs reared outside will require slightly more feed per unit of weight gain than pigs reared in confinement, especially during the winter.

Key Words: Pigs, Housing, Season

495 Repeatability of measures of Brahman bull temperament and their association with serum cortisol concentrations. K. Curley, Jr.*[1,2], J. Paschal[3], T. Welsh, Jr.[1], and R. Randel[2], [1]Texas Agricultural Experiment Station, College Station, [2]Texas Agricultural Experiment Station, Overton, [3]3Texas Cooperative Extension, Corpus Christi.

The objectives of this study were (1) to compare temperament assessments, using multiple techniques, over repeated observations to gauge temperament over the long-term and (2) to evaluate the relationship of the temperament appraisals with serum concentrations of cortisol (CS). Measures of temperament were gathered over 3 repeated observations (60-d interval) of yearling, fall-born Brahman bulls (initial BW=320 ±4 kg; n=66). Temperament assessments included exit velocity (EV), the rate at which the bulls exited the squeeze chute and traversed a fixed distance (1.83 m); pen scores (PEN; 1=quiet to 5=excited), ascertained from animal behavior while penned in small groups (n=5); and chute scores (CHUTE; 1=quiet to 5=excited), determined from behavioral responses to restraint on the scale. All serial EV measures were positively correlated ($r \geq 0.31$, $P < 0.02$). All PEN were positively correlated ($r \geq 0.31$, $P < 0.01$), while serial measures of CHUTE were not ($P > 0.3$). EV was positively correlated with CS within times 1 and 3; EV1 to CS1 (r=0.26, P=0.04), and EV3 to CS3 (r=0.44, $P < 0.01$). The EV data obtained at Time 1 were transformed into a discrete variable, exit velocity ranking (EV RANK; 1 to 3 scale) where 1 equated to < 1 SD below the mean, and 3 equated to > 1 SD above the mean). Repeated measures ANOVA was conducted using the MIXED procedure of SAS for a factorial analysis of time and EV RANK effects on EV and CS. EV was influenced ($P < 0.01$) by time as mean EV decreased from Time 1 (2.82 ± 0.07 m/sec) to Time 3 (2.11 ± 0.10 m/sec). Time also influenced ($P < 0.01$) CS, as mean CS dropped between Time 1 (14.56 ± 0.65 ng/mL) and Time 3 (11.12 ± 0.82 ng/mL). A time by EV RANK interaction ($P < 0.01$) was also observed. Measures of EV can be a valuable tool for both the assessment of cattle temperament and a possible predictor of both temperament and stress responsiveness to future animal handling events.

Key Words: Exit Velocity, Temperament, Cortisol

496 Postpartum productivity of suckled beef cows supplemented with the fibrolytic enzyme Cattle-Ase™. L. Jonovich*[1,2], D. Neuendorff[2], A. Lewis[2], T. Welsh, Jr[1], and R. Randel[2], [1]Texas Agricultural Experiment Station, College Station, [2]Texas Agricultural Experiment Station, Overton.

The effect of Cattle-Ase™ (Loveland Industries Inc., Greeley, CO) supplementation on postpartum productivity was studied in suckled multiparous Brahman (B, n=44) and Romosinuano crossbred (R, n=39) cows. Within 24 hours after calving cows were weighed, body condition scored, calves identified and weighed and the cow-calf pair randomly allotted to either a control (C) or Cattle-Ase™ (A) ration. The pairs were maintained in a dry-lot 7d after calving and then moved to pasture for the remainder of the trial. While in pens the diet consisted of free choice Coastal bermudagrass hay and 3:1 corn:soybean meal supplement (1.8 kg/hd/d). Once moved to rye-ryegrass pasture the diets included 4:1 corn:soybean meal supplement (0.9 kg/hd/d). Cattle-Ase™ was supplemented at a rate of 2.5 g/hd/d. Data were analyzed using SAS's ANOVA procedures. Cow ADG to the end of supplementation was affected by treatment (C=4.8±38.4g, A=150.7±36.5g, P<0.01), though ADG until weaning was not affected (P=0.61). Calf ADG to weaning was affected by breed of calf (BXAngus=952.3±35.3g, B=861.8±12.5g, R=845.8±15.7g, P<0.01) and sex of calf (M=889.2±16.0g, F=844.9±12.7g, P<0.01) but not treatment (P=0.95). Calf ADG to the end of supplementation was also affected by sex of calf (M=1027.3±23.1g, F=953.8±16.8g, P=0.04) but not treatment (P=0.13). Cow BCS change to the end of the trial was not affected by treatment (P=0.82) but was affected by breed (B=-0.07±0.10, R=0.51±0.15, P<0.01). Cow BCS through the end of supplementation was also affected by breed (B=0.32±0.08, R=0.89±0.12, P<0.01) but not treatment (P=0.37). Calf weaning weight was not affected by treatment (P=0.89) but was affected by calf breed (BXAngus=203.4±6.9kg, B=189.7 ±3.2kg, R=214.4±4.5kg, P<0.01). Postpartum interval was not affected by treatment (P=0.30) but was affected by breed (B=62.3±3.5d, R=80.2±3.5d, P<0.01). Number of days to conception was also affected by breed (B=78.5±3.2, R=100.6±3.5, P<0.01) but not treatment (P=0.52). It was determined that Cattle-Ase™ supplementation only affected cow ADG during the supplemental feeding portion of the trial while all other parameters were unaffected.

Key Words: Fibrolytic Enzyme, Postpartum, Cattle

497 Production traits differ in different breedtypes of suckled beef cows. L. Jonovich*[1,2], D. Neuendorff[2], A. Lewis[2], T. Welsh, Jr[1], and R. Randel[2], [1]Texas Agricultural Experiment Station, College Station, [2]Texas Agricultural Experiment Station, Overton.

Milk production (MP) and its effect on postpartum productivity was studied in suckled multiparous Brahman (B, n=44) and Romosinuano crossbred (R, n=39) cows. The cows were maintained on rye-ryegrass pasture and received 4:1 corn:soybean meal supplement (0.9 kg/hd/d). Four-hour milk production was assessed between postpartum d 26-28. Cows were classified as having moderate (M) MP if MP was within 0.5 standard deviations of the mean for their breedtype and as low (L) MP if they produced more than 0.5 standard deviations less than the mean or high (H) if they produced more than 0.5 standard deviations greater than the mean for their breedtype. Data were analyzed using SAS's ANOVA and correlation procedures. MP was not affected by treatment (P=0.62) or cow breed (P=0.26). MP was correlated to calf ADG in R (r=0.56, P<0.01) but not B. Within R, L had lower calf ADG (L=747.8±36.4g) than M (M=862.3±36.4g, P<0.01) and H (H=885.3±17.5g, P<0.01). Calf ADG did not differ within B (P=0.29). Calf weaning weight was significantly correlated in R (r=0.49, P<0.01), but not B. Level of MP did not effect weaning weight in B (P=0.18), but within R L had lower weaning weights (L=199.1±8.9kg) than M (M=222.2±4.3kg, P=0.02) and H (H=225.8±6.7kg, P<0.02). Calf BCS at weaning tended to be correlated to MP in R (r=0.32, P=0.08), but not B. Level of milk production did not affect calf BCS in B, but within R L had lower calf BCS (L=5.1±0.2) than M (M=5.6±0.1, P=0.01). MP was negatively correlated with PPI in B (r=-0.43, P=0.03), but not R. Within B, L had longer PPI (L=87.7±9.1d) than H milk producers (H=54.6±6.2d, P<0.01). Level of MP had no effect on PPI within R (P=0.59). R tended to have a negative correlation between days to conception and MP (r=-0.34, P=0.08), but not B. The number of days to conception tended to differ between levels of MP in B (L=89.3±3.5d, M=90.3±6.3d, H=73.5±4.2d, P=0.07) and R (L=115.8±6.5d, M=98.0±4.4d, H=103.1±5.6d, P=0.07). Thus, B and R differ in the effect of milk production on postpartum productivity.

Key Words: Milk, Beef Cattle, Postpartum

498 Comparison of cattle identification costs using conventional or electronic systems in Spain. C. Saa, M. J. Milán, G. Caja*, and J. J. Ghirardi, Universitat Autònoma de Barcelona, Bellaterra, Spain.

Regulation EC 1760/2000 established a mandatory system of identification and registration for cattle in the European Union based on double ear tagging (before 20 d of age or leaving the farm of birth), an individual passport (to record and communicate animal movements), and a national data base. A decision on the use of electronic identification (by using ISO complying transponders) is foreseen in the regulation but no information is available on the cost impact of the decision. With this aim, a simulation model was built up to evaluate the cost of cattle identification when different strategies are used. Strategies were: 1) CID, conventional identification of all animals by using two officially approved ear tags (polyurethane flaps and antifraud; 1.3 $/each; 6% annual loss rate); 2) EID, electronic identification of all animals by using one electronic ear tag (button; 2.86 $/each; 3% annual loss rate) and one conventional ear tag; and, 3) BID, electronic identification of all animals by using one electronic bolus (ceramic; 3.25 $/each; 0.3% annual loss rate) and one conventional ear tag. The model was applied to the total Spanish cattle population in 2002 (6,477,900 animals) and for three types farms according to productive option and size: dairy (100 cows), suckler (600 cows) and fattening (1,000 calves/year). Annual costs of identification(conversion rate 1 euro = 1.3 US$). in the total cattle population were 15.86, 20.05 and 20.41 $/animal for CID, EID and BID, respectively. Annual values by farm type were (for CID, EID and BID, respectively): dairy (8.98, 8.92 and 8.48 $/animal), suckler (9.07, 8.03 and 7.41 $/animal), and fattening (2.38, 1.20 and 0.79 $/animal). The EID and BID were the cheapest strategies for the farmer, in the three farm types considered. Moreover, extra benefits for EID and BID are foreseen. Results indicated that electronic identification of cattle is a cost benefit affordable option for cattle farmers and cattle industry in Spain. A reduction of device and equipment prices would make the use of electronic identification the cheapest strategy in the future.

Acknowledgements: EU project QLk1-2001-02229

Key Words: Animal Identification, Cost Analysis, Electronic Identification

499 Economic study of milk production in Iran. A. Karbasi*[1] and A. Sarvari[2], [1]Zabol Islamic Azad University, [2]Zabol University.

Milk is one of the most essential foods in stabilizing a nation's food supply. Securing a stable milk supply is also important for development of a country's livestock sector and related industries. In addition, milk has a special place in diets of Iranian families, due to the economic impact of employing people in traditional and industrial livestock sectors. In recent years, the Iranian government has provided increased support of the dairy sector through policy and subsidies. With increased emphasis on the dairy sector, milk supply and consumption has increased. This study has two objectives. First, to determine cow productivity, milk price and the production breakeven level in the Khorasan province (second largest dairy province in Iran in 2003) for traditional, semi-industrial and industrial dairy operations. Secondly, after estimating milk demand and supply, determine the effect of increasing prices on producer and consumer welfare in 1959-2003. Based upon this analysis, forecasting methods were used to estimate the effect of milk prices on producer and consumer welfare from 2004-2010, using the ARIMA and Holt methods. The results showed that productivity, milk price and production breakeven level in industrial dairy operations is greater than traditional and semi-industrial dairy operations. Also, increasing milk price increased producers' welfare and decreased consumers' welfare.

Key Words: Milk, Economic, Product

500 Development of an intraruminal device for data sampling and transmission. A. K. Sievers*[1], K.-H. Suedekum[1,2], H.-J. Laue[3], N. B. Kristensen[4], and S. Wolffram[1], [1]University of Kiel, Kiel, Germany, [2]University of Bonn, Bonn, Germany, [3]University of Applied Sciences, Kiel, Germany, [4]Danish Institute of Agricultural Sciences, Tjele, Denmark.

In Europe, the number of cows per herd is increasing whereas, the time available for surveillance of each cow decreases. The objective of the present study was to develop an intraruminal device for monitoring changes in intraruminal conductivity, pressure, and temperature in individual cows. An intraruminal device is independent of external disturbing factors, can not be manipulated from the outside, and cannot be lost easily. We developed a plastic bolus (length, 16.5 cm; outer diameter, 3.6 cm; weight, 245 g; specific weight, 1.47 g/cm^3) which contains a barometer, a thermometer, an electrical conductivity meter, a chip for data storage and energy management, and a rechargeable battery. For loading and programming, the bolus is connected to a computer by a serial interface. In a series of in vitro and in vivo experiments, the basic functioning of the bolus was evaluated and data was compared to those obtained by external reference devices.

Water temperatures could be recorded in vitro with an accuracy of 0.1°C. In vivo, using four ruminally cannulated lactating cows, a significant correlation was found between intraruminal temperature recorded by the device and the rectal temperature (n = 36; Pearson r = 0.918; r^2 = 0.843). Pressure changes were recorded in vitro with an efficiency of 66%. In vivo pressure recordings were successfully used for registration of contractions of the reticulo-rumen and to detect changes in contraction frequency. During the in vitro evaluation all changes in conductivity, effected by the addition of single VFA, silage particles, or changes in osmolarity, were recorded by the device, and were correlated with those recorded by an external conductivity meter (n = 14; Pearson r = 0.916; r^2 = 0.839). The in vivo situation, however, is much more complex due to a high number of overlapping effects. The conductivity values determined in vivo by the bolus and the reference device were of no value. In conclusion, the intraruminal device successfully monitored changes in body temperature and

forestomach motility and might be beneficial to future management systems for cattle.

Key Words: Dairy Cow, Rumen, Data Sampling

501 Open-air windrows for winter disposal of large animal mortalities: effects of ambient temperature and windrow dimensions. K. Stanford*, V. Nelson, and B. Sexton, Alberta Agriculture, Food and Rural Development, Lethbridge, AB, Canada.

Three open-air mortality compost windrows were constructed in January 2004 (REP1). Windrow A included a base of barley straw (min. 46 cm), a layer of cattle mortalities (n=12) and a layer of stockpiled manure (min. 46 cm) covering the mortalities. Windrow B was similar in makeup to windrow A, although 2 layers of straw, mortalities and manure were constructed containing a total of 9 mortalities. After 1 mo, replicate windrows of each type were constructed using the same number of mortalities and organization of layers (REP2). Due to low ambient temperatures, cattle mortalities(n=66, 236-673 kg) were frozen before addition to windrows. Type 'T' thermocouples were embedded within the lower layers of B and C windrows, while temperatures within 1 m of the surface were measured on all windrows using a stainless steel dial probe (C.E. Franklin Ltd, Calgary AB). Windrows were turned 3 times at approx. 3 mo intervals and 10 1-kg samples were collected from initial compost amendments and at each turning for determination of DM, OM, N and C. Temperatures were measured daily for the first wk after windrow construction and weekly thereafter. Ambient temperature was higher ($P < 0.05$) during the heating of REP2 as compared to REP1 compost, as evidenced by the 13°C mean differential between replicates during the initial heating period. Accordingly, temperature decline of REP2 compost was more gradual ($P < 0.001$) than that of REP1. However the time spent at maximum temperature did not differ ($P > 0.74$) between replicates and all windrows heated in excess of 55°C. Temperature profiles were not affected by windrow type (A, B, or C). After 3 heating periods and 9 mo, flesh was not evident and only fragments of bones (max wt. 740 g) were found. Results of this study demonstrate that reduced ambient temperatures and frozen mortalities provide no barrier to the use of open-air windrows for disposal of cattle mortalities.

Acknowledgements: The cooperation of Van Raay Farms and of D. Rea of the Technical Services Division of AAFRD is gratefully acknowledged.

Key Words: Mortality Disposal, Compost, Cattle

Production, Management and the Environment: Heat Stress

502 Evaluation of environmental conditions in 4 and 6 row freestall barns that are tunnel ventilated with evaporative pads and located in Indiana. J. F. Smith*[1], M. J. VanBaale[2], M. J. Brouk[1], B. Prokop[3], and J. P. Harner[1], [1]Kansas State University, Manhattan, [2]The University of Arizona, Tucson, [3]Herrema Dairy, Fairoaks, IN.

Throughout July and August of 2003, HOBO Pro RH/Temp/Data Loggers® were installed to collect temperature and % relative humidity (RH) in recently constructed 4 and 6 row freestall barns with tunnel ventilation and evaporative pads located in northern Indiana. The 4 row barn had evaporative pads located in the middle of the barn with fans located on the east and west ends. In the 4 row barn four loggers/pen were evenly spaced in 4 pens over the head to head stalls. The 6 row barn had evaporative pads located on the east end and fans on the west end. In the 6 row barn eight loggers/pen were evenly spaced in two rows over the head to head stalls and over the single row of stalls in two pens. Loggers were set to take measurements at 15 min intervals 24 h daily. Data was averaged by hour and analyzed using the mixed procedure in SAS. Average ambient high and low temperature was 30.3 and 17.7°C and average ambient high and low % RH was 100 and 63.2, respectively. Overall maximum afternoon temperature was 2.9°C cooler, THI was 4.9 points lower and % RH was 23.6 higher in the 4 row barn as compared to ambient conditions. During hours 0:00 - 7:59 and 21:00 to 23:59, the 4 row barn temperature (1.3± 0.9) and THI (2.2±1.2) were higher as compared to ambient conditions. Similar differences in temperature, and THI were observed in the 6 row barn. However, the magnitude of these differences was lower on the outside rows of freestalls in the 6 row barn compared to the inside row (head to head stalls). Temperature, THI, and % RH differed from air intake to air exhaust in both the 4 and 6 row barns. Specifically, temperature was 1.8°C higher, THI was 4.2 points higher and RH was 9% lower at the air exhaust as compared to the air intake. In summary afternoon temperature and THI were lower in both the 4 and 6 row freestall barns as compared to ambient conditions. Early morning temperature and THI were higher in both 4 and 6 row structures versus ambient conditions, respectively. Air moving through these buildings increased in temperature and THI and decreased in % RH.

Key Words: Tunnel Ventilation, Evaporative Cooling, Dairy Cattle

503 Impact of using feedline soakers in combination with tunnel ventilation and evaporative pads to minimize heat stress in lactating dairy cows located in Thailand. J. F. Smith*[1], D.V Armstrong[2], M. J. Brouk[1], V. Wuthironarith[3], and J. P. Harner[1], [1]Kansas State University, Manhattan, [2]University of Arizona, Tucson, [3]Charoen Pokphanol Group Co., LTD, Bangkok, Thailand.

Twenty four lactating Holstein cows housed in a two row tunnel ventilated free stall barn equipped with evaporative pads and a feedline soaker system were arranged in a 4 x 4 Latin square design. The free stall barn was 16 by 113 m with a ceiling height of 2.6 m. The structure had 55.7 sq m of evaporative pads on end and eleven 130 cm fans on the opposite end of the barn. Treatments included control, feed line soaking in the afternoon (12:00 to 21:00), feedline soaking at night (21:00 to 6:00), and feed line soaking afternoon and night (12:00 to 6:00). Treatments were rotated from pen to pen each day. Individual cows were fitted with vaginal temperature recorders that allowed temperature to be recorded every minute. Feedline soakers operated when the barn temperature exceeded 21°C. The soaker cycle was 0.5 minute on and 4.5 minutes off. The median ambient temperature (°C) was 29.8 ± 5.0, percent relative humidity of 69 ± 26 and a THI of 79.8 ± 4.7. The median barn temperature was 25.5 ± 2, percent relative humidity was 94 ± 7 and THI was 77 ± 3.4. On average, barn temperature was 4.2°C lower, percent relative humidity was 28 higher and THI was 3.1 lower than ambient conditions. The maximum differences occurred in the heat of the day and when barn temperature was 9.1 lower, percent relative humidity was 52 higher and THI was 6.0 lower in the barn. Feedline soaking both in the afternoon and night was more effective in reducing respiration rates than soaking only at night. Feedline soaking in the afternoon was as effective as feedline soaking both afternoon and night in lowering respiration rates. Vaginal temperatures were lower when cows had access to soaking both afternoon and night as compared to soaking the control. The results of this trial suggest that feed line soaking can be used in combination with tunnel ventilation and evaporative pads to reduce heat stress.

Treatments	Control	Afternoon	Night	Afternoon+ Night	SE
Vaginal Temperature, °C	39.29[a]	39.24[ab]	39.26[ab]	39.20[b]	0.03
Respiration Rate, Breaths/min	64.1[c]	62.3[cd]	65.4[c]	59.5[d]	1.94

[ab]Means in the same row with unlike superscripts differ P<0.01 [cd]Means in the same row with unlike superscripts differ P<0.05

Key Words: Evaporative Cooling, Heat Stress, Lactating Dairy Cattle

504 Combining air cooling and feedline soaking for heat abatement of lactating dairy cattle housed in north central Florida. M. Brouk*[1], J. Smith[1], D. Armstrong[2], M. VanBaale[2], D. Bray[3], and J. Harner[2], [1]Kansas State University, Manhattan, [2]University of Arizona, Tucson, [3]University of Florida, Gainesville.

The study was conducted in a 213m long four-row dairy barn equipped with tunnel ventilation (north to south airflow) and a high-pressure fogging system. The fogging system operated when the temperature exceeded 26.7°C between 11:00 to 22:00 and when temperature exceeded 28.3°C between 22:00 to 11:00 the next day and was used to evaluate a combination cow cooling system. A feedline soaking system was installed in the two pens. Sidewall height was 3.6m and the peak height was 4.0m with a 1/12-pitch roof. Curtain sidewalls were closed during the cooling study. Environmental conditions inside the barn were 23.8 ± 3.0°C, relative humidity 84.6 ± 15.4 percent and THI 74.7 ± 5.3. The evaporative cooling system lowered average barn temperature by 0.5°C and reduced afternoon temperatures by a maximum of 5.1°C. Eight lactating Holstein cows were selected from each of two pens and fitted with a vaginal temperature recorder. In a switch back design two soaking treatments were applied to the pens. Treatments were, soaking in the afternoon and at night (10:00 to 6:00 the following morning - A&N) or just at night (22:00 to 6:00 the following morning - N). Feedline soakers were activated when the barn temperature exceeded 22.2°C and the system soaked for 1.6 min (followed by 4.8 min off. Approximately 1.1L of water was applied to each cow standing area per soaking. Respiration rates of cattle fitted with the vaginal probes were observed and recorded at 16:00, 22:00 and 6:00 of each study day. Vaginal temperature was recorded every minute and averaged into 15-min periods. All individual cow data were averaged by pen, treatment and time of observation prior to statistical analysis. Average respiration rates were lower (58.5 vs 66.9 breaths/min) for A&N as compared to N. Differences were greatest at the 22:00 observation (55.0 vs 73.3 breaths/min). Average vaginal temperature was also lower (38.9 vs 39.2°C) for A&N. Data indicate that heat stress was reduced more by the combination of cooling the air and feedline soaking during both the afternoon and at night than night only.

Key Words: Cow Cooling, Heat Stress, Facilities

505 Utilizing data loggers and vaginal temperature data to evaluate heat stress of dairy cattle. M. Brouk*, B. Cvetkovic, J. Smith, and J. Harner, Kansas State University, Manhattan.

Body temperature rise may indicate heat input has exceeded the heat exchange capacity of the dairy cow. Previous studies show a strong positive correlation between vaginal temperature and respiration rate. This indicates the stress response of the cow to increased body temperature. The ability to measure body temperature over time could help producers operate and select heat abatement systems. Vaginal temperature data collected multiple times per hour would provide a more sensitive testing tool than periodic respiration rates. Utilization of data loggers may provide a means of obtaining body temperature data over an extended period for free-ranging cattle. Data loggers (models HOBO®U12 and HOBO® H08-031-08) from Onset Computer Corporation, Pocasset, MA have been utilized in several experiments evaluating heat stress of dairy cattle. The external probe of the H08-031-08 model was inserted into the vagina and held in place with foam and the logger body was secured to the thurl with tape. Data measurements were recorded during a 2 hr period. The U12 model was 17.5mm in diameter x 101.6mm and weighed 72g. It was held in the vagina with foam and a blank CIDR®. The U12 had a stainless steel housing and was utilized continuously in free-ranging cattle for 5-7 days. Data were collected and analyzed from four dairies to evaluate heat stress abatement systems. Vaginal temperature was recorded at 1-min intervals and then averaged into 5-min blocks. Data were then graphed over a 24-hr period of time. Vaginal temperature increased with activity and heat stress. Effective heat abatement systems were shown to reduce vaginal temperature. On commercial farms, data were utilized to identify where heat abatement needed to be improved. Heat stress issues with milking parlor holding pens were easily identified. Producers and industry personnel could utilize data loggers to evaluate heat stress and the effectiveness of heat abatement systems on free-ranging dairy cattle. Devices could also be utilized to validate the effectiveness of modifications to heat abatement systems identified by the initial evaluation.

Key Words: Heat Abatement, Facilities, Body Temperature

506 Assessment of heat increment in dairy cattle by monitoring heart rate. A. Arieli*[1], U. Moallem[2], I. Halachmi[2], and Y. Aharoni[2], [1]Hebrew University of Jerusalem, Rehovot, Israel, [2]Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel.

A trial was conducted during summer in mid-lactating cows (145 DIM, BW 607 kg) to evaluate the effect of whole cottonseeds (WCS) on cow's energy expenditure (EE). Forty cows were blocked into 2 treatments. In TRT diet, 2 kg of WCS replaced similar amount from CON diet of wheat hay, barley grain and corn gluten meal, providing 15.7% CP and 33% NDF in both diets. Cow's intake was measured continuously by a computerized system. The heart rate (HR) was measured in 5 cows per group during a 6 d period, and EE was estimated by calibrating HR with oxygen consumption (VO2). The diurnal pattern of EE was calculated from the diurnal pattern of HR and VO2 per heart beat. The mean and maximal ambient temperature, relative humidity and thermal humidity index during the EE determination period were: 26 and 34°C, 67 and 88%, and 73 and 82, respectively. The DMI was 18.4 kg/d in both groups. Meal numbers in TRT cows (9.8 meals/d) were higher than in CON (8.5 meals/d, P=0.06). Meal size (2.2 kg) and overall eating time (233 min/d) were similar between groups. Average HR was lower in TRT (74 b/min) than in CON (79 b/min, P=0.032) but daily EE (805 kJ/kg $BW^{0.75}$-d) was similar among groups. The effect of intake on EE was estimated assuming delayed effect of feed ingestion, up to 8 hours postfeeding. The diurnal patterns of feed intake and EE data were analyzed using a linear mixed model including fixed effects on EE of treatment, hour of the day and feed ingested (g of DM/kg $BW^{0.75}$-d) 0,1,2,3,4,5,6,7,8 hrs prior to the hour of EE measurement, and a random factor of cow. In both treatments significant EE increases of 0.4 to 0.8 kJ/g DM were found for 0 to 8 hrs from meals, with a peak at 6 hrs postfeeding. The model adjusted r^2 was 26%, and the heat increment during 9 hrs postfeeding was 4 kJ/g DM intake. More data and larger between diets variability seem to be needed in order to elucidate the suitability of the HR method as a tool for quantifying heat increment in dairy cattle.

Key Words: Energy Expenditure, Heart Rate, Heat Increment

507 Use of physiological measures as predictors of heat dissipation during heat stress in dairy cattle. B. C. Pollard*, P. C. Gentry, and R. J. Collier, University of Arizona, Tucson.

The use of infared thermography to measure surface temperature is a very practical tool for dairy farmers to evaluate heat stress in dairy cattle. Data was compiled from three trials conducted in climatic rooms at the University of Arizona-Agricultural Research Complex. In these trials, Holstein dairy cattle (n=36) both lactating and dry were exposed to dry bulb temperatures (T_{db}) and relative

humidities (RH) varying from 20.4 to 40.5ºC and 12 to 39%RH, respectively, resulting in temperature-humidity indexes (THI) ranging from not stressful (50) to very stressful (84). Data was collected for four physiological parameters: rectal temperature (RT), surface temperature (ST), respiration rate (RR), and sweating rate (SR). Regression equations were created to quantify relationships between variables. The variability in RR and SR can be described by changes in T_{db}, 50.3% and 53.8%, respectively, and THI, 49.6% and 55.2%, respectively, as cattle need to increase heat loss during thermal stress. THI is used commonly to classify the potential stress of an environment, and 75% of the variability in ST can be explained by changes in THI. ST can also be used to accurately predict both RR (R^2 = 0.557) and SR (R^2 = 0.435) whereas RT is not precise for SR (R^2 = 0.035). Stepwise regression analysis yielded equations for SR with RH, bodyweight, presence or absence of solar radiation, T_{db}, RR, and RT as predictors (R^2=0.517) and for RR with ST and RT as predictors (R^2=0.429). Overall, surface temperature is a more predictive measure of heat dissipation through evaporative methods than rectal temperature and can be used as a tool to evaluate environments in order to prevent productive losses due to heat stress in dairy cattle.

Key Words: Heat Stress, Surface Temperature, Dairy Cattle

508 Evaporative heat loss from pigs at different temperature and relative humidity. T.T. Huynh[1,2], J. A. Aarnink*[2], W. A. Verstegen[3], J. J. Gerrits[3], M. J. Heetkamp[4], and B. Kemp[4], [1]Department of Animal Health, Ho Chi Minh city, Viet Nam, [2]Livestock and Environment, Wageningen University and Research Center, the Netherlands, [3]Animal Nutrition Group, Wageningen University and Research Center, the Netherlands, [4]Adaptation Physiology, Wageningen University and Research Center, the Netherlands.

The distribution of evaporative water from respiration and from the skin at high ambient temperature (T) and relative humidity (RH) was studied using twelve groups (10 gilts per group) in partially slatted pens (40%) inside respiration chambers. The climate chamber was programmed so that T remained constant within a day. Each day, T was increased by 2°C from low (16°C) to high (32°C). RH was kept constant at 50, 65 or 80 %. The pigs' initial BW was 61.7 kg (58.0 to 65.5 kg). Total water evaporation (WE) was determined by measuring RH in the incoming and outgoing air and the total air flow. WE per m^2 wet floor area was estimated by weighing water buckets and video observations. WE by respiration was estimated from the measured respiration rate, the volume per respiration stroke, and the RH of the exhausted air. Furthermore, skin temperature (ST) and total heat production was measured and wallowing observed. The animals had free access to feed and water. The T above which evaporative heat loss (EH) started to change was determined (inflection point temperature (IPt)).

On average IPt for WE was 20.3°C. Results showed no effect of RH on IPt. At 32°C and 80 %RH, most (67%) of the total EH from our pigs was achieved as heat loss by respiration. There were differences in regression coefficients of WE by respiration: 0.15, 0.11, and 0.08 for 50, 65, and 80 %RH ($p<0.05$), respectively. The findings show that at high RH the pigs depended on EH from the skin. They wetted their skin by wallowing. Wallowing was observed earlier in the 80 %RH group than in the 50 and 65 %RH groups ($p<0.05$). This resulted in lower ST of the pigs at 80 than at 50 and 65 %RH ($p < 0.05$).

It was concluded that at high T and RH pigs have less possibilities to lose heat by respiration. They compensated it by employing skin moisture evaporation. The implication is that pigs at high T, especially in combination with a high RH, should be able to wet themselves. For animal welfare and environmental reasons it is important that the pigs do not have to do so with their own excreta. Water should be available for the pigs, in a water bath or from sprinklers.

Key Words: Evaporation, Heat Stress, Pig

Ruminant Nutrition: Dairy—Feed Additives

509 'Rumen-up': New plants and plant extracts to decrease methane and nitrogenous emissions from ruminants and to alleviate nutritional stress. R. J. Wallace[1], R. Ningrat[1], K. Becker[2], E. Hoffman[2], S. Muetzel[2], N. Selje[2], S. Lopez[3], D. E. Beever[4], K. E. Kliem[4], R. Morgan[4], F. L. Mould[4], C. Duffy[5], M. Frehner[6], and R. Losa*[6], [1]RRI, Aberdeen, UK, [2]Inst An Prod Un, Hohenhein, Germany, [3]Dept Prod An Un, Leon, Spain, [4]Dept Agric Un, Reading, UK, [5]Alltech Irland Ltd, Dunboyne, Irland, [6]CRINA SA, Gland, Switzerland.

The aim of this EC FP5 project was to develop new plants (plant extracts) as dietary additives for ruminants. Five hundred plant materials were collected, based on criteria such as traditional uses and phytochemical content. They were evaluated for their ability to prevent lactic acidosis and bloat, to decrease formation of the greenhouse gas, methane, and to decrease nitrogen excretions by inhibiting ruminal proteolysis and protozoal activity. The samples were also investigated to ensure that potentially useful samples had no detrimental effect on the other basic functions of the fermentation, such as fiber digestion and volatile fatty acid production. A total of 23 samples were identified to have potential for development as feed additives which could manipulate fermentation in one or more of the target areas without having detrimental effects on overall fermentation. A smaller number of samples was then taken forward for more detailed experimentation on persistence and dose response. These included Bellis perennis (antiprotozoal), Carduus pycnocephalus (antimethane), Gentiana asclepiadea (antiprotozoal), Knautia arvensis (antiproteolytic), Lactuca sativa (antiacidosis), Peltiphyllum peltatum (antiproteolytic) and Urtica dioica (antiacidosis). None of the short-listed samples gave any indication of toxicity. Generally, the materials were not potent at low concentrations. Most would have to be included in the diet at 3-5%. Differential solvent extraction and HPLC are being used to identify the likely active phytochemical components. Antimicrobial effects of samples are being assessed using both cultural and molecular profiling. Production-type trials are being carried out with three of the most promising samples. http://www.rowett.ac.uk/rumen_up/.

Key Words: Plant Extracts, Ruminants, Methane and Nitrogen

510 Effect of a specific blend of essential oils on the colonization of starch-rich substrates by rumen microorganisms. S. Duval*[1], N. McEwan[2], R. Graham[2], R. Wallace[2], and C. Newbold[1], [1]The Institute of Rural Science, Aberystwyth, Wales, UK, [2]Rowett Research Institute, Aberdeen, Scotland, UK.

A number of studies have found that essential oils (EO) are able to manipulate ruminal fermentation. Our group has previously shown that a commercial blend of EO was able to decrease the rate of degradation of some starch-rich supplements in the rumen. It was suggested that this effect may have been due to the EO decreasing the colonization of the substrates by rumen bacteria, and particularly by Ruminobacter amylophilus. R. amylophilus is one of the major starch degraders in the rumen, and its growth in pure culture was inhibited by the EO blend to a greater extent than many other rumen bacteria. In the present study wheat, maize and barley were incubated for 6 h, in the rumen of sheep receiving a diet of grass silage plus a high or low protein concentrate, plus or minus a commercial EO mixture (CRINA RUMINANTS fed to supply 110 mg per sheep per day) fed in a 4 x 4 latin square. DNA was extracted from the samples using a commercial kit and was used as template for 16S rDNA PCR-DGGE and real time PCR. Cluster analysis of DGGE band polymorphism showed that the treatment (supplementation with EO and the protein content of the concentrate) explained most of the similarity in the attached bacteria. Real time PCR enabled precise quantification of R. amylophilus and its abundance relative to total bacteria. Colonization by R. amylophilus was significantly affected by the substrate but there was no effect of essential oils. These results support the observation that EO influence the attachment and colonization of starch rich substrates in the rumen but do not support the hypothesis that this effect was mediated via R. amylophilus.

Acknowledgements: Study sponsored by CRINA S.A., 15, Chemin de la Combe, Gland, CH-1196, Switzerland

Key Words: Rumen, Essential Oils, Colonization

511 Impact of rumensin premix on reproductive performance in dairy cows. T. Duffield*[1], S. LeBlanc[1], D. McClary[2], H. Green[2], and J. Wilkinson[2], [1]University of Guelph, Guelph, ON, Canada, [2]Elanco, Greenfield, IN.

Reproductive data were gathered from 966 Holstein dairy cows in a field trial at 9 sites in North America. Primiparous and multiparous cows were randomized to receive 0, 8, 16, or 24 ppm of monensin in the diet from 3 weeks before expected calving, through lactation, into the dry period and for 7 days into the subsequent lactation. At all sites the voluntary waiting period was 50 days in milk (DIM) and breeding was stopped at 200 DIM. No hormonal aids for breeding were allowed until 135 DIM and cows receiving hormonal therapy for a reproductive tract condition prior to 135 DIM could not be bred on an estrus within 6 days of therapy. Health events were recorded comprehensively. Previous evaluations of these data have not employed survival analysis or considered covariates that might have confounded the results. Survival analysis was performed using proportional hazards regression controlling for within-site clustering. Covariates (parity, at-calving events, and pre-breeding diagnoses) were screened for their association with the probability of non-pregnancy beyond 200 DIM. Variables meeting a P<0.25 cutoff were included in a backward elimination multivariable survival model of pregnancy rate. 869 cows entered the breeding period. There was no univariate association of treatment with time to pregnancy, but there were tendencies for reduced reproductive performance (hazard ratio (HR) = 0.93, P=0.28; HR=0.86, P=0.10; HR=0.88, P= 0.11 for 8, 16, 24 ppm respectively, relative to control). The final model included parity, retained placenta, dystocia, apparent anestrus, and cystic ovaries in addition to the treatment variables, and controlled for clustering. Accounting for these covariates, there was no significant effect of treatment on time to pregnancy (HR = 0.93, P=0.26; HR=1.00, P=0.99; HR=0.93, P= 0.27 for 8, 16, 24 ppm respectively, relative to control). It was concluded that Rumensin did not significantly influence reproductive performance, which is consistent with several peer-reviewed publications.

Key Words: Reproduction, Monensin

512 Effect of a low-moisture buffer block on subacute ruminal acidosis (SARA) in lactating dairy cows. K. M. Krause*[1], G. R. Oetzel[1], and D. V. Dhuyvetter[2], [1]University of Wisconsin, Madison, [2]Ridley Block Operations, Ridley Inc., Mankato, MN.

The objective of this study was to evaluate the effect of a low-moisture buffer block (BB; ~40% buffer and alkalinizers) on ruminal pH and milk production in cows challenged with SARA. Sixteen ruminally cannulated cows were randomly assigned to the treatment (access to BB) or the control (no BB) group. Ruminal pH was recorded each minute; DMI, milk yield and milk composition were measured daily. The trial lasted 12 d and consisted of a 3-d baseline period (without BB; d 1-3), after which the 8 treatment cows had access to BB, 4-d period to evaluate response to BB (d 4-7), 1-d of 50% restricted feeding (d 8), 1-d of challenge feeding (addition of 4 kg wheat/barley pellet to baseline TMR; d 9), and a 3-d recovery period (d 10-12). Intake of BB averaged 0.33 kg DM/cow/d and was highest (P=0.05) on d 8. Total DMI (TMR plus BB) was not affected by treatment, but DMI tended to be higher during the recovery period for cows with access to BB (19.7 vs. 18.0 kg/d, P=0.12). Challenging cows with SARA decreased milk yield from 28.5 to 23.7 kg/d (from d 4-7 to d 9; P<0.001). Cows with access to BB tended to drop less in milk when comparing d 4-7 to the recovery period (1.5 vs. 4.2 kg milk/d; P=0.08). The SARA challenge decreased ruminal pH in all cows from 6.15 on d 4-7 to 5.78 on d 9 (P<0.001). Drop in ruminal pH from d 4-7 to the SARA challenge (d 9) was less (P=0.03) for cows with access to BB than control cows (0.20 vs. 0.55 pH units). Cows with access to BB tended to have higher mean ruminal pH during recovery (6.26 vs. 6.07; P=0.13). Cows with access to BB spent fewer hours (6.04 vs. 9.25 hr/d; P=0.05) and had less area (111.2 vs. 200.0 min x pH/d; P=0.03) below pH 5.5 during the SARA challenge (d 9). Cows with access to BB increased less in time (P=0.03) and area (P=0.11) below pH 5.5 from d 4-7 to the recovery period than did control cows. Access to BB reduced duration and severity of a SARA challenge and tended to assist cows in returning to pre-SARA levels.

Key Words: Buffer Block, Subacute Ruminal Acidosis, Dairy Cows

513 Effects of a Yucca Schidigera extract on microbial metabolism in continuous culture of rumen contents. J. Clark*[1], T. Miller-Webster[1], W. Hoover[1], and B. Clyburn[2], [1]Rumen Fermentation Profiling Laboratory, West Virginia University, Morgantown, WV, [2]Distributors Processing, Inc., Porterville, CA.

Two experiments were conducted using dual flow continuous cultures to evaluate the effect of a Yucca schidigera extract product, Micro-Aid® (MA) on microbial metabolism and efficiency. In both experiments fermenters were maintained at constant temperature (39°C), solids (4.55%/h) and liquid (13%/h) dilution rates. Fermenters were fed 25 g DM four times daily at 6-h intervals. The diets contained 17 – 18% CP, 34% NDF and 30% nonstructural carbohydrates (NSC). Culture pH was allowed to cycle after feeding and was recorded at 0.5 h intervals. Fermentation periods consisted of 6-d for adaptation and 3-d for sampling. Treatments for Exp. 1 were: no additive (Control, C), and MA (2.60 mg/d, MA1). Exp. 2 included an additional treatment, MA2 (5.2 mg/d). In Exp. 1 digestion of ADF was significantly increased, 58.4 vs. 54.5 (P < 0.04) and digestion of NSC, decreased, 81.2 vs. 83.2, (P < 0.02) by the addition of MA. Digestion of DM, OM, NDF, CP, total volatile fatty acids (VFA) and average fermentation pH were unaffected by treatment. Non-ammonia-N was higher for MA (P < 0.006) due to greater production of microbial nitrogen. Microbial efficiency expressed in g micN/kg CHO digested was numerically improved by the addition of MA (44.8 vs. 52.5). In Exp. 2 MA2 tended to increase digestion of DM and CP (P = 0.15 and 0.16, respectively) while digestion of NSC was significantly decreased (P < 0.006) relative to the control and MA1. No differences due to treatment were noted in VFA production or fermentation pH in Exp. 2, however, microbial nitrogen and microbial efficiency (micN/kg CHOD) increased (P < 0.09, and P < 0.08, respectively) with addition of MA. Values were 1.92, 1.97, and 2.33 g; 43.0, 44.9, and 53.4 for C, MA1 and MA2, respectively. Under the conditions of these experiments MA appears to have potential as a rumen enhancing compound and was most effective when fed at 5.2 mg/d.

Key Words: Yucca schidigera, Continuous Culture, Microbial Efficiency

514 The effect of method of dietary addition of a fibrolytic enzyme on the performance of lactating dairy cows. D. Dean*, A. Adesogan, C. Staples, K. Arriola, S. Kim, N. Krueger, M. Huisden, S. Chikagwa, and B. Amaral, University of Florida, Gainesville.

The objective was to investigate whether the strategy used to apply a cellulase enzyme (Promote; Cargill; Minnetonka, MN) to feedstuffs influences the performance of lactating dairy cows. The ration consisted of Tifton 85 bermudagrass silage, corn silage, and concentrate (35, 10 and 55% DM basis respectively). Ingredients were mixed and fed as a totally mixed ration (TMR) in ad libitum amounts twice daily. Thirty Holstein cows (129 average days in milk) were assigned randomly to the following five treatments: 1) control (no enzyme addition), 2) enzyme applied to bermudagrass at ensiling (1.3 g/kg of DM), 3) enzyme applied to a concentrate mix every week, 4) enzyme applied to bermudagrass silage at feeding, and 5) enzyme applied to the TMR at feeding. Cows received approximately 4 g/cow per day of enzyme when added at feeding. The experiment was a partially balanced, completely randomized design consisting of two-28 d periods, with 14 d for adaptation and 14 d for data collection. Least significance difference analysis was conducted. Mean intake of DM (21.5, 20.9, 21.9, 19.8, and 22.1 kg/d; SE=0.9), DM intake as a proportion of BW (3.44, 3.30, 3.53, 3.17, and 3.61% of BW), and gain in BW (7.7, 7.6, 19.0, 6.5, and 10.3 kg/28 d; SE=5.8) for treatments 1 to 5, respectively, did not differ. Mean milk production was 33.7, 31.9, 31.0, 30.9, and 32.3 kg/d (SE=1.0) for cows fed treatments 1 to 5 respectively, with control cows tending to produce more milk than cows fed treatments 3 or 4 (P<0.051). Milk fat concentrations were 3.74, 3.79, 3.39, 3.78, and 4.21% (SE=0.14) for treatments 1 to 5 respectively, with means for cows fed enzyme-treated TMR greater than those fed diets 1, 3, and 4 (P<0.05). Milk true CP concentrations were 2.96, 2.91, 3.13, 3.01, and 3.0% (SE=0.10) for treatments 1 to 5 respectively, and did not differ. Strategy of adding a cellulose-type enzyme to the dietary ingredients influenced milk yield and component concentrations

Key Words: Fibrolytic Enzyme, Bermudagrass, Dairy

515 Effect of an enzyme mixture on dairy cow performance. S. Ghasemi* and A. A. Naserian, Ferdowsi University, Mashhad, Khorasan, Iran.

The use of enzymes as additives in ruminant diets has received considerable research interest recently following positive responses observed in feeding trials. The objective of present study was to determine the effects of an enzyme mixture (Natuzyme, Bioproton, PTY. LTD.), on dairy cow performance. Nine lactating Holstein cows, in early lactation, were randomly assigned to treatments in a 3 × 3 Latin squares design. Treatments were, 1) no enzyme 2) enzyme was added to concentrate portion of the TMR (0.5 kg/ton) 3) enzyme was added to concentrate portion of the TMR (1 kg/ton). Cows averaged 53.88 ± 8.19 days in milk. The cows were given ad libitum a TMR composed of 34% forage (20% alfalfa, 14% corn silage) and 66% concentrate (25% barley, 8% corn, 7% cotton seed, 6% soybean meal, 9% cotton seed meal, 5% beet pulp, 4.3% bran, 0.2% urea, 0.5% lime, 0.2% premix, 0.2% salt, 0.6% fat meal). Data were analyzed using General Linear Models procedure of SAS V6.12 for ANOVA to evaluate differences among experimental groups, means compared with Duncan test. Milk production, protein, lactose and digestibility of dry matter, were higher in cows fed enzyme compared to those fed control diets, but it was not significant. Dry matter intake was significantly higher in control group ($P \leq 0.05$), feed efficiency was significantly higher in treatment groups($P \leq 0.05$). Milk production increased 4.5% in cows received enzymes in comparison with control group. So, data showed that the enzyme can improve dairy cow performance.

Effect of enzyme on cow performance

Treatment	1	2	3	SEM
Dry matter intake(kg/d)	25.56[a]	24.02[c]	24.76[b]	0.17
Milk production(kg/d)	32.86	33.2	34.34	0.65
Protein(%)	3.34	3.37	3.35	0.01
Lactose(%)	4.64	4.65	4.66	0.05
Fat(%)	3.59	3.4	3.64	0.14
Digestibility of dry matter(%)	78.22	80.4	79.03	0.01
Feed efficiency	1.29[b]	1.38[a]	1.38[a]	0.02

Key Words: Enzyme, Dairy Cow, Nutrition

Sheep Species

516 Analysis of probability distribution of some serum and hematological variables of dairy sheep. C. Dimauro[1], P. Bonelli[2], N.P.P. Macciotta[1], P. Nicolussi[2], C. Patta[2], and G. Pulina*[1], [1]Università di Sassari, Italia, [2]Istituto Zooprofilattico per la Sardegna, Italia.

Serum and hematological parameters are widely used in nutrition and in health diagnosis of farm animals. They are also used to check the metabolic and health status of animals involved in scientific trials. Usually these variables are analyzed by standard ANOVA methods and statistical inference is based on the assumptions of normal distribution and of homoscedasticity of variance. Because of the strict metabolic control, it is not logical that these parameters should adapt to a normal distribution. To check this hypothesis, a set of about 700 observations for serum and about 1000 observations for hematological parameters have been analyzed for direct or transformed normality, for agreement to the Central Limit Theorem (CLT) and for the nearest distribution shape. The variables taken into account are listed in table 1. Results show that few variables are normally distributed and in general, they can not be normalized by using the usual transformate (lnx, 1/x, √x), but most of them follow the CLT.

	Direct Normality	Transformed Normality	CLT	Nearest Distribution Shape
Serum Parameters				
Alkaline phosphatase	No	No	No	Lognormal
Creatine phosphokinase	No	No	Yes	Lognormal
Glucose	No	No	Yes	Normal
Urea nitrogen	No	No	Yes	Gamma
Cholesterol	No	Yes (lnx)	Yes	Lognormal
Hematological Parameters				
Hemoglobin	No	No	Yes	Lognormal
Hematocrit	Yes	No	Yes	Normal
Mean corpuscular volume	No	No	No	Loglogistic
Mean corpuscular hemoglobin	No	Yes (1/x)	Yes	Loglogistic
Platelets	No	Yes (Öx)	Yes	Weibull
Granulocytes	No	Yes (Öx)	Yes	Gamma

Key Words: Probability Distribution

517 Comparison of East Friesian and Lacaune sheep breeds for dairy production. D. L. Thomas*, Y. M. Berger, R. G. Gottfredson, and T. A. Taylor, University of Wisconsin, Madison.

East Friesian (EF) and Lacaune (LA) dairy sheep germplasm (semen, embryos and sheep) was imported into North America (NA) in recent years to improve milk production of dairy sheep flocks. No studies have been reported on comparative performance of these two breeds in NA, and few studies are available from other countries. Progeny of 14 EF and 6 LA rams, representing all EF and LA lines in NA, were compared from 1999 through 2004 for growth, reproduction, and milk production at the Spooner Agric. Res. Sta. F1 lambs were produced by mating EF or LA rams to Dorset-cross, Rambouillet and Polypay ewes. EF- and LA-sired F1 ewes, and subsequent generations of crossbred ewes, were mated to both EF and LA sires to produce animals of a higher % dairy breeding with various combinations of EF and LA breeding. Growth, reproduction, and milk production data were available on 1794, 942 and 402 animals, respectively. Data were analyzed with PROC MIXED of SAS with sire breed and other appropriate effects fitted as fixed effects and ewe and sire fitted as random effects. EF-sired lambs had heavier ($P < 0.05$) birth and 30-d weights than LA-sired lambs (5.05 vs. 4.64 and 14.3 vs. 13.3 kg, resp.). 150-d weights were not significantly different between the two breeds but were slightly greater for LA-sired lambs. Breeds did not differ for ewe fertility, but EF-sired ewes had larger ($P < 0.05$) litter sizes than LA-sired ewes (1.85 vs. 1.69 lambs/ewe, resp.). EF-sired ewes lactated for 4% more days and produced 7.5% more milk than LA-sired ewes, but these differences were not significant. LA-sired ewes produced milk with a higher ($P < 0.05$) % fat and % protein than EF-sired ewes (6.3 vs. 5.8% and 5.2 and 4.8%, resp.). There were no significant differences between breeds for kg of milk fat and milk protein. EF-sired ewes would be expected to be more profitable than LA-sired ewes, due to their greater lamb production. However, the advantage of EF-sired ewes would be lessened, although not eliminated, if payments for milk were based on fat and protein content.

Key Words: Dairy Sheep, East Friesian, Lacaune

518 Reproductive performance and milk yield in Awassi and its crosses with either Charollais or Romanov breeds. R. Kridli*[1], A. Abdullah[1], N. AL-Smadi[1], and M. Momani-Shaker[2], [1]Jordan University of Science and Technology, Irbid, Jordan, [2]Czech University of Agriculture, Prague, Czech Republic.

The objective of this study was to evaluate the effect of Awassi or Awassi crossbred breed types on reproductive performance, milk production and composition and udder measurements. One hundred, 2- to 6-year-old multiparous ewes of three genotypes [Awassi (A; n = 30), F_1 Romanov-Awassi (RA; n = 36) and F_1 Charollais-Awassi (CA; n = 34)] were used in the study. Upon lambing, ewes and their offspring were placed in a large pen in which they remained until the end of the experiment. Body weights (BW) and body condition scores (BCS) of all experimental ewes and BW of their lambs were recorded at the beginning of the study (one wk postpartum) and weekly thereafter, until the end of the ex-

periment (weaning of lambs at 70 d of age). Udder dimensions were recorded on the first milking day following parturition (one wk postpartum). Milk production was estimated weekly from parturition to weaning. Lambing rates were not influenced by genotype. The number of multiple births tended to be greater (P = 0.10) in RA compared with CA ewes. Similarly, the number of lambs born per lambed ewe was greater (P < 0.05) in RA than CA ewes while A ewes were intermediate. Milk production was greater (P < 0.05) in A than RA and CA ewes. The CA ewes, however, had greater BW (P < 0.01), BCS (P < 0.01) and milk ash percentage (P < 0.05) than the other genotypes. Lamb body weights from birth to weaning, udder dimensions, and milk crude protein and dry matter percentages were similar (P < 0.05) among the different genotypes. These results indicate that crossing Awassi ewes with Charollais and Romanov breeds lowered milk production without affecting lamb growth rate. Crossing Awassi with Charollais improved ewe BW and BCS while crossing Awassi with Romanov improved reproductive performance.

Acknowledgements: This project was funded by Jordan University of Science and Technology and the Czech Ministry of Agriculture

Key Words: Sheep, Reproduction, Milk Yield

519 The use of Dorper crossbred ewes in an accelerated lambing and extensive management system in the tropics. R. E. Dodson* and R. W. Godfrey, University of the Virgin Islands, St. Croix, US Virgin Islands.

Dorper sheep are being used in the US Virgin Islands for crossbreeding with the local hair sheep. The objective of this study was to evaluate the production traits of St. Croix White X Dorper (DPRX) ewes in an extensive management and accelerated lambing system. The DPRX ewes (n = 14; 9.6 mo of age) were compared to an established flock of Barbados Blackbelly (BB; n = 22; 38.2 mo of age) and St. Croix White (STX; n = 21; 50.8 mo of age) ewes managed on guinea grass pastures. Breeding occurred in October 2003 (BRD1) and June 2004 (BRD2) using DRPX, BB and STX rams for 35 d. Ovulation rate was determined by laparoscopy on d 7 to 9 after mating. Lambs were born in March 2004 (LMB1) and November 2004 (LMB2). On 7, 21, 35, 49 and 63 d of lactation 24-h milk production was measured. Lambs were weaned at 63 d of age in May 2004 (WEAN1) and January 2005 (WEAN2). Ovulation rate at BRD1 and BRD2 was lower (P < 0.003) in DRPX than in BB or STX ewes (1.1 ± 0.1 vs. 1.6 ± 0.1 vs. 1.9 ± 0.1%, respectively). Number of lambs born at LMB1 was higher (P < 0.03) for STX than for BB or DRPX ewes (2.1 ± 0.1 vs. 1.7 ± 0.1 vs. 1.2 ± 0.2, respectively) but there was no difference at LMB2 (1.6 ± 0.1). The DRPX ewes had fewer (P < 0.01) multiple births at LMB1 than BB or STX ewes (18.2 vs. 63.6 vs. 90.5%, respectively) but not at LMB2. Litter birth weight was lower (P < 0.003) for DRPX than for BB or STX ewes at LMB1 (3.4 ± 0.4 vs. 4.9 ± 0.3 vs. 6.2 ± 0.3 kg, respectively) but not at LMB2. There was no difference (P > 0.10) in litter weaning weight at WEAN1 but at WEAN2 it was greater (P < 0.05) in DRPX than in BB or STX ewes (20.9 ± 1.7 vs. 14.8 ± 1.4 vs. 16.3 ± 1.5 kg, respectively). Milk production, reported as area under the lactation curve, was similar (P > 0.10) among breeds during both lactations (51034.7 ± 2319.7 units). These results show that it is possible to incorporate DRPX ewes into an accelerated lambing and extensive management system and achieve production levels that are similar to those of local hair sheep under tropical conditions.

Key Words: Sheep, Crossbreeding, Accelerated Lambing

520 Change in ultrasound loin and fat measurements in growing lambs of different breeds. C. Hiemke*, D. Thomas, T. Taylor, and R. Gottfredson, University of Wisconsin, Madison.

The objective of this trial was to estimate rates of fat thickness (FT), loin muscle area (LMA), and loin depth (LD) change in growing Hampshire (H, n = 121), Polypay (P, n = 78), Rambouillet (R, n = 45) and Targhee (T, n = 18) ram and ewe lambs by repeated ultrasound measurements. Loin width (LW) growth was estimated on 45 H and 39 P lambs. Linear and quadratic regressions of ultrasound measurements on weight were calculated by the PROC MIXED procedure in SAS. All linear FT coefficients were positive and different (P < 0.05) from zero, except for T rams and R ewes and rams. Quadratic FT coefficients were negative and different (P < 0.05) from zero for P rams and T ewes. All linear LMA coefficients were positive and different (P < 0.05) from zero, except for the T ewes and rams. Quadratic LMA coefficients were negative and different (P < 0.05) from zero for the H and R ewes. All linear LD coefficients were positive and different (P < 0.05) from zero, except for T rams and ewes. Quadratic LD coefficients were different (P < 0.05) from zero for H and P ewes and R rams and ewes. Linear and quadratic LW coefficients for H rams and ewes were different (P < 0.05) from zero. P rams had a positive linear LW coefficient different (P < 0.05) from zero. All 19 of the 28 significant linear regressions were positive and all 10 of the 28 significant quadratic regressions were negative; indicating that FT, LMA, and LD increased at a slower rate as lambs grew in some breeds and sexes and that changes in these measurements continued at a constant positive rate in other breeds and sexes. Seven of the 10 significant negative quadratic regressions were in ewe lambs. Significant quadratic regressions were more common with LD than with other measurements. These data suggest that a linear adjustment of ultrasound measurements for body weight generally is adequate for ram lambs, whereas both a linear and quadratic adjustment may be more appropriate for ewe lambs. A few regression plots did not follow expected biological growth and may be explained by some other environmental effects.

Key Words: Lamb, Loin Growth, Fat Growth

521 Postweaning growth and internal parasite tolerance of lambs differing in percentage hair sheep breeding and raised on pasture. D. K. Aaron*, R. A. Zinner, D. G. Ely, W. P. Deweese, and E. Fink, University of Kentucky, Lexington.

The objective of this study was to compare postweaning growth and internal parasite tolerance of lambs differing in percentage Dorper (D) breeding and raised on pasture under conditions of natural Haemonchus contortus infection. A random sample (n = 44) was obtained from 197 Polypay (PP), 1/2 D x 1/2 PP (1/2 D), 3/4 D x 1/4 PP (3/4 D), and 7/8 D x 1/8 PP (7/8 D) lambs born in April, 2004. Lamb body weights (BW, kg), egg counts/g feces (FEC), and packed cell volumes (PCV, %) were measured at weaning (d 70) and at 3-wk intervals postweaning. Lambs were treated with anthelmintic at weaning and at each collection date thereafter (d 91, 112, 133, 154, and 175) according to routine flock management procedures. Data were analyzed as repeated measures using mixed model procedures. Distribution of FEC was not normal, so data were transformed as ln (FEC + 100) prior to statistical analysis. Lamb genetic type and collection date influenced (P < 0.05) all traits. Lamb genetic type x collection date interaction was present (P = 0.005) for BW. On most collection dates, 1/2 D lambs had highest FEC but were better able to tolerate parasite infection as evidenced by higher PCV (P < 0.05) and similar or heavier BW. Lambs with higher percentage D breeding had similar FEC and PCV but grew slower (P < 0.05) compared with PP lambs. Final (d 175) BW (kg), back-transformed FEC (eggs/g feces), and PCV (%) for PP, 1/2 D, 3/4 D, and 7/8 D were: 46, 830, and 33.4; 46, 1525, and 34.2; 42, 1250, and 31.8; and 40, 1100 and 32.9, respectively. Residual correlations between BW, FEC, and PCV, obtained via multivariate analysis of variance, revealed an inverse relationship between FEC and PCV (-0.21; P = 0.003). All other correlations were small and nonsignificant. In conclusion, performance of 1/2 D lambs was equal to or superior to PP lambs. Higher percentage D lambs grew slower; however, this was likely the result of a loss of heterosis rather than decreased tolerance to parasite infection.

Key Words: Lambs, Growth, Parasites

522 Interaction of copper oxide wire particles and molybdenum sulfate in lambs. J. Burke*[1], J. Miller[2], and D. Pote[1], [1]USDA, Agricultural Research Service, Booneville, AR, [2]Louisiana State University, Baton Rouge.

Copper oxide wire particles (COWP) have been used in lambs to reduce Haemonchus contortus infection. However, COWP use may lead to copper toxicity.

The objective was to determine the effectiveness of dietary molybdenum/sulfur (MS) in returning lambs to a normocupremic state after COWP use and whether MS inhibited anthelmintic properties of COWP. Male hair breed lambs that were naturally infected with H. contortus were administered 0 or 2 g COWP on D 0 and 49 and fed a TMR (DM: 37% corn, 16% wheat mids, 14% soybean meal, 13% cottonseed hulls, 10% alfalfa pellets, 4% molasses, 4% soybean hulls, 1% calcium carbonate, 0.5% salt, 0.5% ammonium chloride, 0.15% vitamin premix, and 27.5 mg/kg lasalocid) with additional calcium carbonate (0.25%; C) or MS mineral (74.9 mg/kg sodium molybdate, 0.21% sodium sulfate, and 0.25% calcium carbonate). Lambs were randomly assigned to one of four treatments (2 × 2 factorial; n = 7/treatment). Fecal egg counts (FEC) and packed cell volume (PCV) were determined every 7 d between D 0 and 70. Plasma was collected on D 42 and 70 for determination of aspartate aminotransferase (AST) activity. To simulate a pasture nematode infection, lambs were inoculated between D 21 and 49 with 1500 L3 larvae weekly. FEC were reduced in COWP-treated lambs (COWP × day, $P < 0.03$). By D 21 FEC were reduced from more than 2500 eggs/g (epg) to less than 500 epg in COWP-treated and C-fed lambs and inoculation with L3 larvae failed to increase FEC in these three groups. FEC remained higher in the MS/no COWP group. PCV was reduced in MS-fed lambs (diet × day, $P < 0.001$). Plasma AST activity was similar among all groups on D 42, but 21 d after the second COWP treatment, AST activity was elevated in COWP-treated C-fed lambs (diet, $P < 0.03$; COWP × diet, $P = 0.10$). The MS diet alleviated potential copper toxicity and did not inhibit COWP from depressing H. contortus infection. However, the MS diet may have led to copper deficiency, perhaps decreasing natural immunity against gastrointestinal parasites. The complete ration fed to lambs appeared to have a protective effect against H. contortus as FEC remained low in C-fed lambs.

Key Words: Copper Oxide, Haemonchus contortus, Molybdenum

Swine Species: Swine Nutrition and Management

523 Studies on causes of sow disposal at different parities of Large White sows. J. Arango*[1], I. Misztal[1], S. Tsuruta[1], M. Culbertson[2], and W. Herring[2], [1]University of Georgia, Athens, [2]Smithfield Premium Genetics, Roanoke Rapids, NC.

Different reasons of sow removal (RR) at consecutive parities were analyzed with 13,838 records of Large White sows. Data were from seven pure-line farms having, on average, 5.9% unknown RR. Three traits were defined, each corresponding to a classification of RR (reproductive, no reproductive and others) as a five-category trait, according to parity of removal (0 to 4 or later). Univariate and multivariate linear and threshold models were implemented via animal or sire models. Additional analyses used pooled RR across parities as trait definition. Models included the effects of year, region, season, contemporary group and animal additive genetic effects. The most common RR was related to reproduction (48.5 %). Illnesses of different origin and cause, old age/parity, and sow death or loss accounted for about 18, 7 and 4 % of total culls, respectively. Analyses were by single trait censored model for each reason separately, and by three-trait threshold models where only one trait was observed and the other two censored. Genetic correlations from the last analyses could suggest whether all the reasons could be described collectively as fitness, or whether they need to be addressed separately. Estimates of variance components were consistent across models and methods of analysis, showing unrealistically small estimates of residual variance. The apparent model saturation led to large estimates of heritability, except when an additional uncorrelated random effect of sire was fitted in the model. With that model, estimate of heritability for reproductive RR in different parities was 0.09 and 0.07 using linear and threshold model, respectively. Data structure and volume are major limitations in studies of sow survival.

Key Words: Sow Removal, Sow Disposal, Sow Culling

524 Relations between lactation-, and slaughter/carcass traits in pigs. E. F. Knol*, D. T. Prins, and R. Bergsma, Institute for Pig Genetics (IPG), Beuningen, The Netherlands.

Pork industry benefits from uniformity. Meat companies start to tighten weight grids and implement bonus/malus systems for carcass grading. We were interested in the relation between early development and final slaughter traits in pigs.

Data came from a 180 (3 week batch) farrow to finish experimental farm testing 6 sire lines on 3 dam crosses. 14.500 piglets, including stillborns, with birth-, and weaning weights, foster and mortality data were available. Resulting in 6700 slaughter records and 1688 dissected carcasses. Birth deviation is the difference between individual birth weight and litter average to give indication of competition challenge.

Within litter variation in weight at birth and at weaning was not related to any of the slaughter and carcass traits (not in the table). Absolute birth weight was equally or more important than relative birth weight. High carcass gain started already at birth and (auto) correlated with all youth stages. Fat accretion appeared to start during nursery. Ham, but not loin, deboned weight was positively correlated with birth-, and weaning weight.

In a subset of the data (crossfostered (22%) piglets; n=1541), we added biological mother (sow) and nurse sow to model 1. Both HGP-fat and HGP-loin were significantly related (***) to sow, and not to nurse, suggesting a genetic influence and no milk quality or quantity effect. In contrast, lactation gain related only to nurse (***). Variation in carcass gain was related (***) equally to both sow and nurse, as was nursery gain (***).

Residual correlations between lactation-, and slaughter- traits. Corrected for batch, sire line, dam cross, sexe (model 1) and carcass weight (2).

	Birth weight	Birth deviation	Lactation gain	Weaning weight	Nursery gain
Carcassgain 1	0.33 ***	0.26 ***	0.36 ***	0.38 ***	0.43 ***
HGP fat 2	-0.06 ***	-0.08 ***	-0.04 *	-0.04 **	0.07 ***
HGP loin 2	-0.05 ***	ns	ns	ns	ns
Loinweight 2	ns	ns	ns	ns	ns
Ham weight 2	0.14 ***	0.09 **	0.06 *	0.10 ***	ns

ns non significant; * P<0.01; ** P<0.001; *** P<0.0001

Key Words: Pigs, Lactation, Carcass Quality

525 Estimation of variance components including competitive effects of Large White growing gilts. J. Arango*[1], I. Misztal[1], S. Tsuruta[1], W. Herring[2], and M. Culbertson[2], [1]University of Georgia, Athens, [2]Smithfield Premuim Genetics, Roanoke Rapids, NC.

Records of on-test average daily gain (g) of Large White gilts were used to estimate variance components of direct and associative genetic effects. Models included the effects of contemporary group (farm-barn-batch), birth litter, pen-group and two additive genetic effects: direct and associative. The total genetic variance was a function of the number of competitors in a group, the additive relationships between the animal performing the record and its pen mates, and the additive relationships between pen mates. To partially account for differences in pen size and in relationships among members of the pen a covariable (q_i = 1, 1/n or $1/n^{½}$) was added to the associative genetic effect. There were 4,946 records from 2,409 litters and 362 pen-groups. Pen size ranged from 12 to 16. There were, on average, 1.2 and 2.6 full and half sibs per pen. Within the BLUPF90 family of programs, the mixed model equations can be set up directly. For variance component estimation, simple programs (REMLF90 and GIBBSF90) worked without modifications, but the more optimized programs

did not. Analyses by restricted maximum likelihood converged slowly. Estimates obtained using the three values of qi were similar. Estimates of direct and associative heritability were 0.15 and 0.03, respectively, and their correlation was 0.1. A grid search showed that the likelihood function was almost flat when the additive genetic associative effect was fitted. Estimation of the competitive effects may be more reliable with more relationships across and within pens, when pen sizes are lower, and when the environment forces higher expression of competitive effects. The last condition may be particularly relevant in commercial populations, where housing is denser and food limited.

Acknowledgements: Thanks are due to Dr. L. D. Van Vleck for providing simulated data to test models and computation programs.

Key Words: Genetic Effects, Associative Effects, Growth

526 The effect of different grinding grades of soybean hulls on nutrient digestibility and performance in starting pigs (15-30kg). I. Moreira*[1], M. Kutschenko[1], D. Paiano[1], C. Scapinello[1], A. E. Murakami[1], and A. R. B. Qradros[1,2], [1]Universidade Estadual de Maringá, Maringá, Paraná, Brazil, [2]Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brazil.

The effects of ground soybean hulls (SH) on the nutritional value of SH for starting pigs were studied in two experiments. Soybean hulls were ground in different screen-opening diameters (2.0, 2.5, 3.0 and 3.5mm). Experiment I consisted of a digestibility trial using 12 barrows (21.9 ± 1.29kg of BW). On a feed basis, SH values were: DM= 92.22%; GE= 3,850 kcal/kg; CP= 15.76%; Ca=0.44%; P= 0.26%; ADF= 40.48%; NDF= 55.22%; KOH protein solubility= 28.96%; and urease activity= 0.324. Values for geometric mean particle size (GMP) were: S2.0 (2.0mm)= 436µm; S2.5 (2.5mm)= 439µm; S3.0 (3.0mm)= 545µm; S3.5 (3.5mm)= 751µm; and WSH (whole SH)= 2,043µm. Energy values of SH were 2,207kcal of ME/kg for S2.0; 2,278kcal of ME/kg for S2.5; 1,932kcal of ME/kg for S3.0; 1,775kcal of ME/kg for S3.5; and 1,325kcal of ME/kg for WSH. Comparison between SH and WSH indicated better digestibility coefficient (DC) of DM and GE for S2.0 and S2.5 and worse DC of CP for S3.5. The DE of S2.0 and S2.5 were higher for WSH. Results suggest that grinding SH in a screen up to 2.5mm improves DM and GE digestibility, whereas digestibility of CP is improved in screen up to 3.0mm. In Experiment II the nutritional and economic feasibility of SH (S2.5) for starting pigs was evaluated. Diets with increasing levels of SH (0, 3, 6, 9 and 12%) were formulated. Forty piglets (15-30 kg) were allotted into a RCB, with two piglets per experimental unit. There was a quadratic effect on daily weight gain (DWG) due to SH inclusion, with the worst DWG at 7.75% inclusion. Daily feed intake (DFI), feed: gain ratio (FGR) and plasma urea nitrogen (PUN) were not affected by SH inclusion. Comparison between inclusion levels against 0% level indicated the worst DWG at 6% inclusion level. There were no economic advantages in using SH on starting pig diets. The inclusio of SH affects the individual feed intake of piglet and leads to high CV of variables, which impede detection of difference in the treatment effects of SH. Results suggest that the utilization of SH on starting pigs diet is economically unfeasible.

Acknowledgements: CNPq, UEM

Key Words: Alternative Feedstuffs, Nutritional Evaluation, Piglets

527 Reduced crude protein effects on aerial emissions from swine. W. Powers*[1], S. Bastyr[1], and B. Kerr[2], [1]Iowa State University, Ames, [2]USDA-ARS, Ames, IA.

The effects of feeding reduced protein diets on air emissions was evaluated using groups of barrows housed in rooms with continuously measured gas concentrations and airflows. Pig weights and feed intake were recorded weekly over the course of four feeding phases: G1 (beginning at 24.5 kg BW), G2 (55.3 kg BW), F1 (87.2 kg BW), and F2 (111.4 kg BW). Pigs were offered one of three isocaloric, isolysinic diets: a control diet (C), a low crude protein diet (LCP) and an ultra low crude protein diet (ULCP), each supplemented with varying amounts of amino acids. Formulated CP of G1 was 22.5, 20.0, and 18.4% for the C, LCP, and ULCP diets. As feeding phases progressed there was a decrease in the formulated CP such that F2 was formulated to contain 16.6, 15.4, and 13.8% CP in the C, LCP and ULCP diet. Dietary treatment had no effect on ADG, ADFI or F:G (P<0.05). Pigs fed the LCP diet had greater intakes than pigs fed the C or ULCP diets during the grower phases but reduced intake during the finisher phases (P=0.0287). A diet effect was observed for average daily NH_3 concentrations (P<0.0001) with concentrations from the LCP diet-fed rooms 16% less than the C diet (3.86 vs. 4.57 ppm). Ammonia concentrations were reduced 25% (2.93 ppm) in the ULCP diets compared to the LCP diet and 36% compared to the C. Airflow-corrected NH_3 emission rates were 26.8, 21.0, and 14.5 mg min^{-1} for the C, LCP, and ULCP diets, corresponding to a daily mass of NH_3 emitted per kg of animal liveweight, of 88.0, 68.9, and 46.0 mg kg^{-1}. Feeding phase effects were observed for NH_3 concentration, NH_3 emission rate, daily mass emitted and daily mass per unit of liveweight with increases from G1 to G2 followed by a decrease from F1 to F2. Similarly, feeding phase effects were observed for hydrogen sulfide concentration and daily emitted mass of hydrogen sulfide per unit of liveweight. Hydrogen sulfide concentration and emissions were not different between rooms offered the different dietary treatments. Diet had no effect on mass of manure produced however TKN and NH_3-N concentration decreased with decreasing diet CP (7.9, 6.7, 5.7% and 5.4, 4.4, and 3.5%, respectively for C, LCP and ULCP diets).

Key Words: Emissions, Swine, Diet Modification

528 Effects of albuterol on the growth and carcass characteristics of finishing pigs. B. Richert*[1], R. Hinson[1], R. Marchant-Forde[2], D. Lay, Jr.[2], K. McMunn[2], and J. Marchant-Forde[2], [1]Purdue University, West Lafayette, IN, [2]USDA-ARS, Livestock Behavior Research Unit, West Lafayette, IN.

The use of ractopamine as a repartitioning agent has become increasingly popular in US pig production. This experiment examined the effects in finishing pigs of a pure form of albuterol, a beta agonist proposed to deliver positive production effects without negative behavioral effects. The study used 192 pigs (88.8±.9 kg BW) housed in groups of six in 32 pens (1.4 m x 4.1 m) and assigned to one of four treatments: 1) Control - 0 ppm albuterol, 2) ALB-2R - diet 1 with 2 ppm of the pure R-enantiomer of albuterol, 3) ALB-4R - diet 1 with 4 ppm of pure R-albuterol, or 4) ALB-8RS - diet 1 with 8 ppm of a racemic mixture of R- and S-enantiomers. All diets supplied 18.3% CP, 1.1% lysine and 3534 kcal ME/kg and were offered ad libitum for 4-wk. All pigs were weighed and pen feed intakes recorded weekly. At slaughter, individual hot carcass weights (HCW) and measurements of 10th rib loin eye area (LEA), color, marbling, firmness, and backfat, last lumbar and midline backfat depths were collected. Data were analyzed using Proc GLM of SAS, with pen as the experimental unit. Overall, ALB-2R and ALB-4R pigs had greater ADG than control pigs (1.30 and 1.26 vs 1.13 kg/d; P<0.01 and P<0.05, respectively) and at slaughter, were heavier than control pigs (124.6 and 124.7 vs 120.1 kg, respectively; P<0.01). Overall, ALB-8RS pigs had lower ADFI (P<0.05) and control pigs had poorer G:F (P<0.001) than the other three treatments, respectively. Control pigs had 5-6 kg lighter HCW (P<0.001), 2-3% less carcass yield (P<0.001), 5.6 cm^2 smaller LEA (P<0.01), greater 10th rib (3-4 mm, P<0.01) and last lumbar backfats (2 mm, P<0.05) than all albuterol fed pigs. However, control pigs had higher loin eye color (P<0.05) and marbling (P<0.001) scores than all albuterol-treated pigs and higher firmness scores (P<0.05) than the R-albuterol treated pigs. As little as 2 ppm R-albuterol has a positive effect on pig growth and carcass composition. However, negative effects of albuterol on meat quality requires further research.

Key Words: Albuterol, Pigs, Growth

529 Effect of diet supplementation with grass-meal and antioxidant supplementation on performance and carcass composition of Duroc and Landrace cross- bred pigs. P. G. Lawlor*[1], P. B. Lynch[1], J. Kerry[2], and S. Hogan[2], [1]Moorepark Research Centre, Fermoy, Co. Cork, Ireland, [2]University College, Cork, Ireland.

The objectives of this study were to assess (1) the effect of diet dilution with grass-meal and (2) the effect of supplemental antioxidant on pig performance. Pigs (n = 1080) from Duroc (D) or Landrace (D) boars mated to crossbred sows were weaned (mean 26 d; 8.2kg), into same-breed, single-sex groups of 15 (n = 72). At 21 days post-weaning, pigs were allocated at random to the following treatments: (1) High density diets (HD) to slaughter, (2) Diets with grass-meal (GM) to slaughter, (3) Diets with GM to 50kg followed by HD. (4) Diets with GM to 80kg followed by HD. (5) Diets with GM to 80kg followed by a vitamin E enriched (200 mg alpha-tocopherol/kg) diet with 50g/kg of 00-rapeseed oil, (6) As 5 with tea extract instead of alpha-tocopherol. Pigs were slaughtered at approximately 105kg liveweight. Interaction effects were not significant. Males were more efficient than females (G:F: 0.41 v 0.38; P < 0.01) but had similar growth rates. Pigs from L boars grew at the same rate (707 v. 694g/d; NS) but more efficiently (G:F 0.39 v. 0.38; P < 0.01) from weaning to slaughter and had leaner carcasses than pigs from Duroc sires (596 v. 592 g/kg; P < 0.01). Feeding GM depressed pig performance (growth rate and G:F). Growth rates from weaning to slaughter were 730, 675, 710, 686, 698 and 704g/d; P < 0.05 for treatments 1 to 6 respectively while G:F values were 0.41, 0.36, 0.40, 0.37, 0.38 and 0.39; P < 0.01. Supplementation of the diet in the final stages of finishing with vitamin E or tea extract had little effect on pig performance.

Key Words: Grass Meal, Fiber, Antioxidant

530 Evaluation of low-phytate soybeans on swine performance and phosphorus excretion. W. Powers*, E. Fritz, W. Fehr, and S. Bastyr, Iowa State University, Ames.

A study was conducted to evaluate the impacts of feeding full-fat extruded low-phytate (LP) soybeans on performance and P excretions from growing swine. Ninety-six crossbred barrows (initail BW = 18 kg, end BW = 70 kg) were allocated to 24 pens and fed one of four treatment diets: normal phytate soybeans without supplemental phytase (NP-np), normal phytate soybeans plus 500 FTU kg^{-1} phytase (Ronozyme P (CT) 2500; DSM Nutritional Products; Basel, Switzerland; NP-p); LP soybeans (USDA-ARS line CX1834-1) without supplemental phytase (LP-np) and LP soybeans plus phytase (LP-p). Four feeding phases occurred that were 2, 3, 3, and 2 wk in duration. All diets within a feeding phase were formulated to be isocaloric, isolysinic and similar in non-phytin phosphorus content; allowing P content to vary. Non-phytin P content was 0.45, 0.36, 0.32, and 0.32% for phase 1-4, respectively. Pens were randomly assigned to treatments at the start of each feeding phase. Individual pig weights and pen fecal samples were collected and feed disappearance recorded weekly. No phytase inclusion nor soybean source effects were observed for pen ADG, ADFI and F:G. Apparent digestibility of DM and OM were not different among treatment groups. Apparent digestibility of P was greater when pigs were offered diets containing the LP soybeans (49.1% vs. 42.3%; P<0.0001) and less when diets included phytase (44.1% vs. 47.3%; P<0.0001). Total P (TP) and water-soluble P (WSP) excreted were affected by diet (TP: 19.7, 18.1, 16.7, 13.9 g kg^{-1}; P<0.0001 and WSP: 10.9, 10.2, 8.9, 8.2 g kg^{-1}; P<0.0001 for NP-np, NP-p, LP-np, and LP-p diets, respectively). Inclusion of phytase decreased TP and WSP excreted (P<0.0001) as did use of LP soybeans (P<0.0001). Diet effects on the fraction of excreted TP that was WSP were observed (P<0.0001) however, source of soybeans did not result in a significant difference (57%; P>0.10). However, inclusion of exogenous phytase in diets did increase the proportion of TP that was excreted as WSP (59% vs. 55%; P<0.0001 for diets with and without phytase, respectively). The findings suggest that there is a viable need for LP soybeans to minimize farm environmental impact.

Key Words: Swine, Low-Phytate, Phosphorus

Animal Behavior and Well-being: Sow and Boar Behavior and Housing

531 Sexual behaviors in boars treated with an inhibitor of prostaglandin synthesis. M. Estienne*, A. Harper, and W. Beal, Virginia Polytechnic Institute and State University, Blacksburg.

Previous work from our laboratory demonstrated that a single i.m. injection of PG (Lutalyse; Pfizer Inc., New York, NY) acutely enhanced sexual behaviors in boars via some undetermined mechanism. The objective of this experiment was to test the hypothesis that an acute, endogenous release of PG is necessary for the expression of normal sexual behaviors. Landrace x Yorkshire boars, trained to mount an artificial sow and allow semen collection, were moved to a semen collection pen 30 min after i.m. treatment with 500 mg flunixin meglumine (Flunixamine; Fort Dodge Animal Health, Fort Dodge, IA) (n = 6), a potent inhibitor of PG synthesis, or 10 mL 0.9% saline (n = 6). One wk later, the experiment was repeated, but boars that previously received Flunixamine were treated with saline and vice versa. The interval between entering the collection pen and first interaction with the artificial sow (18.5 vs. 13.3 s; SE = 2.7; P = 0.21), the interval between entering the collection pen and start of ejaculation (225.5 vs. 294.0 s; SE = 73.5; P = 0.52), duration of ejaculation (393.7 vs. 350.9 s; SE = 34.1; P = 0.40), false mounts (mounting artificial sow but dismounting before allowing a complete collection of semen) (1.5 vs. 1.0; SE = 0.6; P = 0.58), and libido score (1 to 5; 1 = displayed no interest in artificial sow, 5 = mounted artificial sow and allowed semen collection) (4.3 vs. 4.5; SE = 0.1; P = 0.34) were similar for Flunixamine-treated and control boars, respectively. We suggest that an acute, endogenous increase in PG synthesis and release is not a necessary antecedent for the display of normal sexual behaviors in boars exposed to an artificial sow for semen collection.

Key Words: Boar, Prostaglandin, Sexual Behavior

532 The effects of boar presence on the frequency of agonistic behaviour, occurrence of shoulder scratches and stress response of group-housed bred sows. M. J. Séguin*[1], R. M. Friendship[1], R. N. Kirkwood[2], A. J. Zanella[2], and T. M. Widowski[1], [1]University of Guelph, Guelph, ON, [2]Michigan State University, East Lansing.

The effects of boar presence on the expression and consequences of aggression among newly mixed bred sows were investigated. Groups of fifteen sows were exposed to one of three levels of boar presence in an incomplete block design (N=5 per treatment): PHYSICAL (boar in pen with sows, 2.15m^2/sow), FENCELINE (boar housed in pen opposite sows, 2.3m^2/sow) or CONTROL (no boar present in room, 2.3m^2/sow). The boar was removed six days after mixing. During the 24h pre- and 24h post-mixing periods the number of shoulder scratches were assessed and saliva samples were collected twice daily. All incidences of sow-to-sow physical contact (bite, body knocks, fights, head knocks and levering) or non-physical (threat) interactions and the duration of fights were collected from video-recordings from the point of mixing to 24h post-mixing (avg. 22h). Data were analyzed using PROC MIXED with group as the experimental unit and boar and block as random effects. Means were compared using a Tukey test. During the 24h post-mixing period, treatment had no effect on the frequency of physical (Control, 5.3 ± 0.9; Fenceline, 8.9 ± 1.0; Physical, 7.5 ± 1.2; P> 0.1) and non-physical interactions (Control, 4.9 ± 0.4; Fenceline, 6.5 ± 0.9; Physical, 6.2 ± 2.4, P> 0.1) occurring per group per hour. The duration of fighting (s/group/h) was also unaffected by treatment (Control, 58.9 ± 16.8; Fenceline, 39.1 ± 4.4; Physical, 37.1 ± 6.5, P> 0.1). The mean scratch score was significantly lower for PHYSICAL versus CONTROL (2.0 ± 0.1 vs. 2.6 ± 0.3; P <0.05) 24h post-mixing. Salivary cortisol (ng/mL) was higher for PHYSICAL versus FENCELINE treatments 24hr post-mixing (0.41 ± 0.12 and 0.19 ± 0.04, P<0.05). There is no clear advantage of boar presence on reducing aggression and stress among newly mixed bred sows.

Acknowledgements: Funding for this project was provided by the National Pork Board and the Ontario Ministry of Agriculture and Food

Key Words: Sow, Aggression, Boar

533 Effects of space on individual- and group-kept dry sows: behavior and immune status. J. L. Salak-Johnson*, M. A. Sutherland, M. J. Horsman, S. L. Rodriguez-Zas, and S. R. Niekamp, University of Illinois, Urbana.

The effect of grouping pregnant primiparous and multiparous sows at different space allowances was studied to determine impacts of space on sow behavior and immune status. Six replicates of 5 sows per treatment were allotted to each of 4 experimental treatments: groups 5 at (a) 1.4, (b) 2.3, or (c) 3.3 m2/sow or (d) individual stall (1.3 m2/sow) for two successive parities. Behavior data were collected between gestation d 90 and 110. Blood samples were taken 1-h post-feeding (0800 h) on gestation d 25, 30, 60, 90, 108, and 110. Data were analyzed using PROC MIXED with repeated measures. Gestation environment influenced number of times a sow was observed lying, sitting, and drinking. Frequencies of sitting (P<0.001) and drinking (P<0.05) were higher among sows kept in stalls than those in groups. Lying was highest (P<0.05) among sows grouped at 3.3 m2/sow. Frequencies of walking and oral-nasal-facial behavior (ONF) were influenced by space. As space increased, walking increased among group-kept sows (P<0.01). A quadratic trend for frequency of ONF occurred among group-kept sows (P<0.05.) such that ONF was higher in sows kept at 2.3 m2/sow. Sow BW influenced lying and standing behaviors; as BW increased the frequency of lying increased (P<0.05). Conversely, heavier sows spent less time standing (P<0.05). Gestation environment influenced cortisol and immune status. Sows kept in stalls had higher cortisol (P=0.08), N:L ratio (P<0.05), phagocytosis (P<0.05), and B-cell proliferation (P<0.05) than did those in groups. Conversely, those kept in groups had higher (P<0.01) lymphocytes. Among group-kept sows, space allowance influenced B-cell proliferation and NK cytotoxicity. As space increased, B-cell proliferation increased (P=0.01) and NK decreased (P=0.01). Several other immune measures (e. g., total WBC, N:L ratio, T-cell proliferation, phagocytosis) were influenced by sow BW (P<0.05). Also, immune status was influenced by gestational period. Overall, gestation environment had limited impact on behavior and immune traits studied.

Key Words: Environment, Immune, Behavior

ADSA Production Division Symposium: Forage Analysis: Concept to Application

534 Dairy nutritionist survey on forage carbohydrate analysis: Implications for methodology application. L. Chase*[1], M. Raeth-Knight[2], J. Linn[2], and W. Mahanna[3], [1]Cornell University, Ithaca, NY, [2]University of Minnesota, St.Paul, [3]Pioneer Hi-Bred International, Des Moines, IA.

A survey of field dairy nutritionists was conducted to assess their current use of carbohydrate analysis in feed programming. This survey was specific to NDFD (NDF digestibility), starch and sugar analyses. The information in this abstract is based on about 200 returned surveys. NDFD analysis was never used by 14% of the respondents. Occassional use of NDFD was reported by 52% of respondents and routine use by 33%. Corn silage and haycrop silages were the primary forages analyzed for NDFD (>90% of survey responses). Analytical methods used to obtain NDFD values were wet chemistry (26%), NIR (14%) or both (54%); however, preferences of analytical method for NDFD were wet chemistry (50%), NIR (16%) or no preference (34%). The analytical time points used to determine NDFD were 24 hours (29%), 30 hours (40%) and 48 hours (36%). Respondents indicated a preference for 24 hours (49%) followed by 30 hours (39%) and 48 hours (12%). The most common uses of NDFD results were to make crop feeding decisions (50%), to adjust fiber digestion rates in models (49%) and to compare against similar forages in previous years (46%). The use of a certified lab was indicated as important by 85% of the respondents. The use of either NFC or NSC in ration formulation was indicated by 91% of the respondents. Over half of the respondents (54%) indicated that an NFC (or NSC) value was as good as individual starch or sugar values for ration formulation. The results of this survey have significant implications for forage testing labs. There is a strong preference that forage labs be certified. There are also preferences for the use of wet chemistry methods to obtain NDFD values. This will require forage labs to obtain better standardization of NDFD analytical procedures and measurement time points. These results also indicate that additional education is needed regarding the applicability of NIR for NDFD analysis.

Key Words: NDFD, Forage Analysis, NIR

535 Starches and sugars: conceptual and analytical challenges. M. B. Hall*, U. S. Dairy Forage Research Center, USDA-ARS, Madison, WI.

For use in diet formulation, partitioning of carbohydrates should reflect differences in digestion and fermentation characteristics and effects on animal performance. Indices of digestibility would be useful. Partitioning of NFC has been problematic in terms of designating fractions based upon nutritional characteristics, and selecting analytical methods to separate them. The relative dearth of information on digestion characteristics of various NFC and their interactions in diets means that fractions will not soon be perfectly established. Starch and sugars are fractions for which there is some consensus. Native starch is an α-(1-4)-linked-glucan with α-(1-6) linked branch points. In feedstuffs, it can be analyzed by specific enzymatic hydrolysis and detection of glucose, or by polarimetry, though sugars can interfere with both analyses. Key challenges with starch analysis include reliability of estimates (varies by lab and method) and description of digestibility; the latter is greatly affected by processing and source. "Sugars" are an ill-defined fraction. They may include mono-. di-, and oligosaccharides (80% ethanol- and water-soluble) and water-soluble polysaccharides such as fructans. The nutritional equivalence of fructans, sucrose, glucose, and fructose has not been well explored. Resolution is needed as to which carbohydrates comprise sugars before a definitive analytical method can be chosen. Another challenge when dealing with carbohydrates that vary greatly in molecular weight is the basis on which to express them to reflect their value to animal and microbes. The greater the degree of polymerization, the greater the proportional content of hexose after accounting for water incorporated for hydrolysis. For example, 1 kg of glucose (monosaccharide) = 1 kg of hexose, whereas 1 kg of sucrose (disaccharide) or starch (polysaccharide) yield 1.05 and 1.11 kg of hexoses released upon hydrolysis, respectively. Expressing carbohydrates on a hexose basis would seem to be more reflective of equivalence than is current practice. Improved methods and nutritionally relevant definitions will improve the utility of these carbohydrate fractions in ruminant nutrition.

Key Words: Sugar, Starch, Analysis

536 Applying starch and sugar analyses in dairy nutrition. S. Emanuele*, Land O' Lakes Inc., Caledonia, NY.

The objective is to review why and how starch and sugar analyses are used in routine dairy ration formulation. If one balances dairy diets based on crude protein, NDF and NEl concentration, it is not necessary to analyze feeds for starch and sugar. It has become necessary to utilize these analyses because of the adoption of a metabolizable energy and protein system for balancing dairy diets. Published research indicates that the metabolizable energy and protein yield of a specific diet is influenced by the fermentation of carbohydrates. When feeds are analyzed for starch and sugar we observe the following: 1. Starch and sugar content of corn silage are highly variable and influenced by variety, grow-

ing season, maturity and type of fermentation undergone by the plant material. Starch content of corn silage will be 25 to 40% on a DM basis; 2. Starch content of alfalfa hay or silage is low, less than 5% but the sugar content of alfalfa is variable and influenced by growing season, moisture, sunlight, and plant maturity. Alfalfa hay grown in the western U.S. routinely contains 5 to 9% sugar on a DM basis; 3. It is necessary to assay citrus pulp, beet pulp, distiller's grain, bakery meal and corn gluten feed because of variability in starch and sugar content. The rumen ecosystem does not always respond positively to extra starch or sugar in the diet. This ecosystem will respond positively when ruminal conditions favor the use of starch and sugar for growth of rumen bacteria and yeasts. Physical factors of the diet will influence response to starch or sugar. In diets with less than 27% NDF, and small particle size, increasing dietary sugar concentration to 5%- 6% diet DM may not increase feed intake and milk production. Excess starch can reduce the ME and MP of a diet because of inefficient energy use by rumen bacteria and a decrease in NDF digestion (Russell, 2002). Starch and sugar analyses are useful in dairy ration formulation because starch and sugar alter rumen microbial population and growth and impact ME and MP predictions.

References:

Russell, J.B. 2002. Rumen Microbiology and Its Role in Ruminant Nutrition, Cornell University, Ithaca, NY

Key Words: Starch, Sugar, Dairy

537 NDF digestibility: conceptual and analytical challenges. M. S. Allen*, Michigan State University, East Lansing.

Demonstration of the beneficial effects of NDF digestibility on feed intake and milk yield has created demand for analytical services by forage testing laboratories and for recommendations for utilizing NDF digestibility information. Variation in the methods used and proficiency at determining NDF digestibility across laboratories limit successful application of NDF digestibility information. Laboratories should provide information regarding intra- and inter-assay variation and validation of their method by showing relationships between NDF digestibility and lignin concentration as a percent of NDF (generally $r \geq 0.7$ within forage type). Analytical methods should identify limitations to NDF digestibility inherent in the feed rather than those imposed by the method which will compress differences among feeds. Grinding is necessary to increase surface area of potentially fermentable fiber exposed by chewing in vivo but it overestimates rate of digestion because the increase in surface area is at the beginning of fermentation rather than gradually over time. Incubation time should reflect residence time in the rumen, which is inversely related to feed intake, but shortened to account for effect of grinding on rate of digestion. It is unrealistic to use laboratory NDF digestibility values to adjust energy content of feeds because digestion characteristics of feeds affect retention time in the rumen and feed intake response. Feed intake response to forages with greater in vitro NDF digestibility is positively related to milk yield across cows and affects the relationship between in vitro and in vivo NDF digestibility. Comparisons of NDF digestibility across forages should be limited to within forage type; retention times for perennial grasses are generally greater than for legumes. Laboratory NDF digestibility values are best used as an index of filling effect of NDF and forages with high NDF digestibility should be targeted to cows with high milk yield for which feed intake is most limited by physical fill.

Key Words: NDF Digestibility, Dairy Cows, Physical Fill

538 Collecting, interpreting and using corn silage NDF digestibility data as a consulting nutritionist for commercial dairies. W. Nelson*[1], C. Renken[1], C. Holtz[3], and B. Kloss[2], [1]Nelson Dairy Consultants, Inc., Lakeville, MN, [2]Nelson-Kloss Dairy Production Nutrition, LLC, Visalia, CA, [3]Holtz-Nelson Dairy Consultants, LLC, Dryden, NY.

Corn silage has become the primary source of NDF in the diets of lactating cows throughout most of the United States. Our group of 25 nutrition consultants in the Upper Midwest, Central California, and New York State has been using corn silage NDF digestibility analyses to help consultants and clients for 6 years. I will explain the origin of our desire for anaylitical insight on corn silage fiber beyond that of traditional analysis packages. All data and discussion of samples, rations and cow responses originate from commercial dairies. Corn silage sample data will be presented comparing 20, 30 and 48-hour incubation times involving three different commercial laboratories over six years. Discussion will emphasize apparent shortcomings of traditional fiber analyses as well as shortcomings of the nutritional and agronomic conclusions derived from traditional analyses. I will share my experiences on the extent to which dairy producers and/or their contract growers are responding to the information provided by NDF digestibility analysis of corn silage and how they are or are not pursuing improvements in corn silage NDF digestibility from year to year. We are convinced that corn silage NDF digestibility is and will continue to be of primary importance to both nutritionists and dairy producers. Our group continues to pursue ways to better analyze and incorporate the added information that corn silage NDF digestibility data bring to the table when planning and formulating diets for commercial dairies.

Acknowledgements: All of our clients and consultants who participated, Dairy One Laboratory, Dairyland Laboratories, Cumberland Valley Laboratory

Key Words: Forage Quality, NDF Digestibility, Corn Silage

Animal Behavior and Well-being: Weaning and Animal Welfare

539 Effect maze task on salivary cortisol of pigs at weaning and on subsequent fear response. J. Siegford*, G. Rucker, and A. Zanella, Michigan State University, East Lansing.

Learning, memory and regulation of the stress response are mediated by the hippocampus. Biologically relevant hippocampal-dependent tasks that develop and integrate cognitive processing of this region may not be available to piglets in some current production systems. We measured the effects of a hippocampal-dependent maze task (MT) on the stress response at weaning (12 days of age) and subsequent fear response (at 50 days of age). Twenty-seven pigs from 4 litters were assigned to one of 3 treatments: hippocampal enhancement (HE), isolation control (IC), or control with sow (CS), then combined into same sex groups with each treatment represented. Each group worked 4 times per day in the morning, with 10 minutes between sessions from 5-11 days of age. Prior to the start of work, groups were removed from the sow for 30 seconds. HE animals navigated the MT to return to sow and litter. IC were isolated while HE navigated the MT. CS were returned to sow as HE entered the MT. Data were analyzed with mixed model repeated measures analyses of variance, and Bonferroni tests revealed differences in multiple comparisons. Saliva was collected immediately pre- and post-MT on day 11 to measure cortisol, which were lower pre-MT ($F(1,8)=5.65$, $P=0.04$). Weaning at 12 days of age increased cortisol levels 2h post-weaning ($F(4,75)=5.67$, $P<0.001$). On day 14 male IC pigs were slower than others ($F(2,21)=3.09$, $P=0.07$) to solve a modified Morris water maze (WM), examining spatial learning. Lower cortisol levels were seen pre-WM versus post-WM ($F(1,19)=27.62$, $P<0.001$). At 50 days of age, fear response of pigs was examined in 3 open field tests (OF: 1=alone, 2=w/ball, 3=w/person) consisting of 1 m acclimation and 4 m testing. Animals spent more time in OF center in OF3 than OF1 ($F(2,75)=8.75$, $P<0.001$) and time spent in OF periphery was greater in IC in OF1 than in IC or HE in OF3 ($F(2,75)=4.18$, $P=0.02$). In OF3, HE touched the person more times than other groups ($F(2,49)=6.31$, $P=0.008$). MT may result in less fear of novel persons and places suggesting benefits of hippocampal activation for young pigs.

Acknowledgements: USDA NRI #2001-02440 to AJ Zanella.

Key Words: Spatial Memory, Open Field, Stress Response

540 Odor preference of pre-weaning piglets to biologically relevant and non-relevant odors. N. Krebs* and J. McGlone, Texas Tech University, Lubbock.

The sense of smell is highly developed in pigs and could reduce weaning stress. To determine which odors were attractive, piglets were separated from their mother, grouped and exposed to different odors for 24 h and weight loss was measured over the same period. Two separately ventilated rooms (with 2 pens each) were used to test a single odor per room per block. A wick soaked with a single odor was placed in the back of the feeder so that the fan blew the odor from the wick through the feeder at piglet's height in the pen. Enough liquid was provided that the wick was soaked by capillarity for 24h. The air movements in the room were symmetrical to avoid pig preference for parts of the pen. In each experimental unit (total 43, average 4 replications/odor), four 15-to-20-d old pigs (2 males and 2 females) from four litters were put in a pen. Treatments randomly assigned to one side of the pen were: amyl acetate (AA), n-butanol (n-BUT), ammonia (NH3), phosphate buffered saline (PBS), maternal feces (FECES), maternal pheromone Suilence (MPH), androstenone (ANDRO), isopropyl alcohol (IA), lactose (LACT) and milk replacer (MILK). The position of the pigs was observed continuously for 24 h and a preference index (PI) was calculated for each treatment (=time spent in the half of the pen closer to the odor/total time). Pigs had a preference (PI > 50%) ($P < 0.0001$) for ANDRO compared to FECES (73.16% + 9.92 vs 45.88% + 7.50). There were no significant differences in PI among other treatments. Pigs significantly preferred ($P < 0.001$) at multiple hours for ANDRO, NH3, and n-BUT. The PI was not significantly different ($P > 0.10$) from 50% at any time for PBS, MPH, LACT, MILK, or FECES. Pigs lost less ($P < 0.05$) weight over 24 h when exposed to NH3 than PBS (-.245 vs -.158 ± 0.027 kg). In conclusion, according to these preliminary data, newly weaned piglets spent more time near ANDRO. Piglets were attracted at times of the day to NH3 and n-BUT. Odors can be used to direct the behavior of weaned pigs and might be used as a tool to improve performance.

Key Words: Pigs, Odors, Weaning

541 Performance and behavior of calves reared in groups or individually following an accelerated-growth feeding program. M. Terre*[1], A. Bach[2,1], and M. Devant[1], [1]Unitat de Remugants-IRTA (Institut de Recerca i Tecnologia Agroalimentàries), Barcelona, Spain, [2]ICREA (Institució Catalana de Recerca i Estudis Avançats), Barcelona, Spain.

Nineteen calves were reared in individual pens (IP), and 20 calves were grouped in 4 pens of 5 calves each (GP) to study the effects of rearing calves in groups or individually on behavior and performance. All calves were on an accelerated-growth feeding program and had unlimited access to starter. Total DMI, BW, serum urea, NEFA and glucose concentrations, and immune response to vaccination were measured. Also, behavior was monitored by continuous recordings of 20 min twice weekly following the morning and afternoon milk replacer consumption. After weaning, the observations were conducted at the same time as in the preweaning period (0730 and 1730). Behavior patterns were categorized in: non-nutritive sucking, cross-sucking, inter-sucking, and self-grooming. Performance and serum data were analyzed using a mixed-effects model with repeated measures. Behavior differences between and within treatments before and after weaning were assessed with a Mann-Whitney test and a Wilcoxon test, respectively. There were no differences in final BW and total DMI between treatments. The decrease of ADG during the week following weaning was more pronounced ($P < 0.05$) in GP than in IP calves. Serum NEFA concentrations tended ($P = 0.06$) to increase the week after weaning in GP calves. Serum urea concentrations were greater ($P < 0.05$) in GP than in IP calves 1 wk before (21.3 vs 16.6 mg/dL, respectively) and after weaning (27.2 vs 16.0 mg/dL, respectively). After weaning, non-nutritive behaviors increased ($P < 0.05$) in both treatments, but GP calves increased ($P < 0.01$) self-grooming behavior and decreased ($P < 0.001$) cross-sucking and inter-sucking behaviors. Positive immune response 3 wk after vaccination tended ($P = 0.08$) to be greater in IP (84%) than in GP calves (55%). Calves housed in groups struggled more at weaning, and appeared to mobilize more body reserves and have a slower immune response than calves housed individually.

Key Words: Calves, Behavior, Growth

542 Weaning cattle in two stages reduces the behavior changes typically associated with weaning stress. D. B. Haley*[1,2] and J. M. Stookey[1], [1]Western College of Veterinary Medicine, Saskatoon, SK, Canada, [2]Alberta Agriculture, Food & Rural Development, Red Deer, AB, Canada.

Our objective was to evaluate a novel two-stage weaning procedure against the traditional method of abrupt weaning. Pairs weaned in two stages were prevented from nursing (stage 1) for either 8 d (n=6) or 4 d (n=6) prior to physical separation (stage 2). Anti-sucking devices worn by calves prevented nursing. Control calves (n=6) nursed until they were abruptly weaned by separation. Behavior was recorded for 4 d prior to initiating the two-stage treatment, on all 4 d that two-stage pairs were prevented from nursing, and for 4 d following cow-calf separation. Activity was recorded directly by instantaneous sampling every individual animal at 10-min intervals, from 0700 to 1900 h. Also, for 2 min during each 10-min interval, we recorded the number of vocalizations by individual animals. The mean values below (calls/h, min/d) were calculated to represent the entire 12-h observation period based on results from interval sampling. The two-stage treatments produced similar results whether nursing was prevented for 8 or 4 d. Both groups showed a reduced behavior response to weaning compared to controls. When nursing was prevented, two-stage animals were more vocal than controls, but treatment differences may be of questionable biological significance (two-stage treatments combined vs. controls: cows=5.1 vs. 0.6 calls/h, $P<0.01$; calves=1.5 vs. 0.1 calls/h, $P<0.001$). Compared to controls, following separation, two-stage cows called 84% less (14.3 vs. 89.4 calls/h, $P<0.0001$), spent 60% less time walking (28.5 vs. 70.8 min/d, $P<0.001$) and 13% more time lying (165.2 vs. 146.3 min/d, $P<0.05$). After separation, compared to controls, two-stage calves called 97% less (1.9 vs. 56.0 calls/h, $P<0.0001$), and spent 30% more time eating (267.9 vs. 206.3 min/d, $P<0.01$). Use of the anti-suckling device for 4 d prior to physical seperation offers a practical solution to reducing the signs of distress shown by cattle when they are weaned abruptly. Benefits of this procedure such as reduced calling, reduced walking, and increased time spent eating can be achieved simply by preventing nursing between cows and calves for 4 d, before separating them.

Key Words: Beef Cattle, Weaning Stress, Behavior

Animal Health II

543 Assessment of Antibiotic Usage in Dairy Herds in Pennsylvania. A. Sawant*, L. Sordillo, and B. Jayarao, Pennsylvania State University, University Park.

A survey of 113 dairy herds from 13 counties in Pennsylvania indicated that fifty percent of dairy farms maintained antibiotic treatment records. Only 21% had written plans for treating sick animals. Antibiotics were mostly administered (93%) by the owner/manager or designated herdsman, but only 32% of farms sought a veterinarian's advice before administration. Only 24% of dairy producers followed label instructions. The majority of dairy producers used extralabeled antibiotics, with guidelines from a veterinarian; separated and visibly marked treated cows; and milked treated cows last with a separate milking unit. Records of 33 farms indicated that the most common conditions were pneumonia and enteritis in calves; mastitis, metritis, and foot rot and in cows; and mastitis and pneumonia in dry cows. Antibiotics were mostly used for treating

enteritis in calves (36%), followed by pneumonia in calves (25%) and foot rot in cattle (16%). Twenty four antibiotics including beta-lactams, spectinomycin, and florfenicol were widely used for therapy whereas oxytetracycline and neomycin were used in milk replacers for prophylaxis. Feeding medicated milk replacers to calves (70%) was widely practiced. Beta-lactam antibiotics were mostly used for dry cow therapy, clinical mastitis, and on some farms for pneumonia and metritis. Ceftiofur was also used as an extralabel drug on 18% farms for mastitis therapy. This study suggests that beta-lactams and tetracyclines were the most widely used antibiotics. Extralabel use of antibiotics was practiced on many farms. Current practices related to the antimicrobial usage on farms could contribute to the development of antibiotic resistant bacteria

Key Words: Antibiotics, Mastitis, Management

544 The early detection of bovine respiratory disease (BRD) with infrared thermography and treatment with nitric oxide. A. L. Schaefer*[1], B.J. Perry[2], N.J. Cook[3], J. S. Church[3], C. Miller[2], and A. Stenzler[2], [1]Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada, [2]Pulmonox Medical Inc, Edmonton, Alberta, Canada, [3]Alberta Agriculture Food and Rural Development, Lacombe, Alberta, Canada.

Bovine respiratory disease (BRD) is one of the most costly health afflictions affecting the beef industry. Unlimited treatment with antibiotics either before or following the appearance of clinical signs is not optimally effective and moreover, is raising concerns globally regarding the promotion of resistant micro organisms. Clearly, an earlier, more targeted treatment and prudent selection of medications is needed. In the present pilot study the early detection of BRD with infrared thermography(IRT) and treatment either as a prophylactic or upon IRT detection with nitric oxide (NO) was investigated. Thirteen weaned and transported calves weighing 450 lb were used. Eleven of these calves were exposed for three days to a commercial herd known to display a number of BRD viruses. These eleven calves were then allocated to single daily treatments as; prophylactic (n=4) with a NO respiratory treatment of 600 breaths of 160-200 ppm NO administered via a nasal tube for three consecutive days immediately following exposure to the commercial herd; early detection (n=4) with the NO treatment applied only upon the calves showing thermal (IRT) signs of infection or thirdly, a clinical group (n=3) where NO was applied only upon the appearance of clinical signs. Two calves served as uninfected controls. The presence of BRD was verified by a bank of clinical signs as well as hematology and serology data. All calves treated with NO either as a prophylactic or upon early detection displayed orbital IT temperatures (36.35 ± o,89 SD) similar to controls but significantly lower than the clinical treatment group (37.1 ± 1.02; P< 0.01). Other clinical health data followed this same pattern. The data suggest that IRT may assist with the earlier detection of BRD in cattle and that nitric oxide may be an effective treatment for BRD.

Key Words: Bovine respiratory disease, Infrared, Nitric oxide

545 Cytokine expression of T cell subsets in bovine peripheral blood. S. Tanaka*, K. Miyazawa, K. Watanabe, S. Ohwada, H. Aso, and T. Yamaguchi, Tohoku University, Sendai, Japan.

Bovine T cells are classified into T cell subsets, $CD4^+$, $CD8^+$, $WC1^+$ γδ and $WC1^-$ γδ T cells, based on the existence of CD molecules and T cell receptors. The percentage of T cell subsets in peripheral blood and the distribution of T cell subsets in lymphoid organs have been reported by several researchers. However, cytokine expression of individual subsets in bovine T cells is not still cleared. In the present study, we tried to investigate T cell activation marker, CD25 expression, and cytokine mRNA expression of $CD4^+$, $CD8^+$, $WC1^+$ γδ and $WC1^-$ γδ T cells. The peripheral blood was collected from Holstein caws (n=3). T cell subsets were isolated by magnetic cell sorting (MACS) method and were cultured with or without 4 μg/ml concanavalin A (ConA). After 12 hrs, the cells were stained with anti-CD25 mAb and $CD25^+$ cells were analyzed by flow cytometry. Total RNA was prepared from $CD4^+$, $CD8^+$, $WC1^+$ γδ and $WC1^-$ γδ T cell cultures. The cytokine mRNA expression of IL-2, IL-3, IL-4, IL-6, IL-10, IFN-γ, GM-CSF, TNF-α and TGF-β was analyzed by PCR method using bovine cytokine primers. The results showed that CD25 expression was increased in $CD4^+$, $CD8^+$ and $WC1^+$ γδ T cells but decreased in $WC1^-$ γδ T cells after ConA stimulation. In $CD4^+$ T cells, IL-2, IL-6, IL-10, TNF-α and TGF-β mRNA were expressed without ConA stimulation and the mRNA of all cytokines were expressed after ConA stimulation. In $CD8^+$ T cells, IL-6, TNF-α and TGF-β mRNA were expressed without stimulation. After stimulation with ConA, IFN-γ and GM-CSF mRNA expression were newly detected in the T cells. In γδ T cells, $WC1^+$ γδ T cell subset expressed IL-2, IL-6, TNF-α and TGF-β mRNA. Following stimulation with ConA, the mRNA of cytokines except for IL-3 and IL-4 were expressed. Whereas $WC1^-$ γδ T cells expressed only TGF-β mRNA with or without ConA stimulation. These results demonstrated that cytokine production of T cell subsets was intrinsically different and suggested that $WC1^+$ γδ T cells may be more functional than $WC1^-$ γδ T cells.

Key Words: T cell subset, cytokine, γδ T cell

546 Probiotics affect the establishment of T lymphocytes in the gut and prevent bacterial translocation in pigs. M. Lessard*[1], M. Dupuis[1], N. Gagnon[1], J. Matte[1], J. M. Fairbrother[2], E. Farnworth[3], and J. Goulet[4,5], [1]Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Lennoxville, Qc, Canada, [2]Montreal University, St-Hyacinthe, Qc, Canada, [3]Agriculture and Agri-Food Canada, Food Research and Development Centre, St-Hyacinthe, Qc, Canada, [4]Laval University, FSAA, Québec, Qc, Canada, [5]Institut Rosell Lallemand inc., Montreal, Qc, Canada.

In this study, the influence of Pediococcus acidilactici (PA) and Saccharomyces cerevisiae boulardii (SC) on immunity and bacterial translocation was evaluated in piglets. Thirty litters were allocated at birth to the following treatments: 1) Control without antibiotic (C) or 2) with tiamulin as antibiotic added into feed (C+A), 3) PA, 4) SC and 5) PA+SC. During lactation, probiotics (10^9 CFU) were given orally three times a week. Piglets were weaned at 21 d of age. After weaning, probiotics were added into the diet (10^9 CFU/kg). Three piglets per litter were slaughtered at 18 and 24 days of age, respectively (weaning period), or at 56 days of age after challenge with an enterotoxigenic E. coli. Blood, ileum and mesenteric lymph node (MLN) samples were analysed by flow cytometry to characterize mononuclear cell populations during the weaning period. IgA levels were determined in ileal flush and bacterial translocation was measured in MLN. Growth of piglets was not affected by treatments. In the gut, a significant interaction between treatments and weaning period ($P = 0.08$) indicated that the percentage of $CD4^-CD8^{low}$ cells in the ileum was higher in pigs treated with PA than in those of groups PA+SC and C before weaning whereas there was no treatment effect after weaning. In the MLN, a similar interaction showed that the number of $CD4^-CD8^{high}$ cells was increased before weaning in PA compared to SC and C groups. In blood, $CD8^+$ populations were not affected by treatments and weaning whereas percentage of $CD4^+$ cells in PA and PA+SC pigs was lower ($P = 0.07$) than in C pigs after weaning. After E. coli challenge, bacterial translocation was significantly reduced ($P \leq 0.05$) in pigs treated with PA, SC, PA+SC or antibiotic compared to control group. In pigs treated with PA, PA+SC or antibiotic, IgA concentration in the ileum tended to be lower ($P = 0.11$) than in controls. In conclusion, probiotic treatments appear to affect the establishment of $CD8^+$ cells in the gut and to protect the host against bacterial translocation. Probiotics could be considered as a reliable tool to prevent intestinal bacterial infections.

Key Words: Probiotics, Immunity, Pigs

547 Long-term effects of weaning age on immune function of pigs. S. R. Niekamp*, M. A. Sutherland, and J. L. Salak-Johnson, University of Illinois, Urbana.

Weaning is a common stressful event that involves abrupt social, nutritional, and environmental changes that cause an acute stress response and compromises well-being. The objective of this study was to evaluate the impact of weaning age on pig immune responses and growth through the finishing phase.

Piglets were weaned at 14 or 28 d of age and housed by litters until they reached 20 wk of age. Pig BW and blood samples were taken at weaning, 1, 7, and 14 d post-weaning and 8, 12, 16, and 20 wk of age. Cortisol (CORT), total white blood cell counts (WBC), lymphocyte counts (Lymph), neutrophil counts (Neut), lymphocyte proliferation (LPA), natural killer cell cytotoxicity (NK), neutrophil chemotaxis (CHTX) and phagocytosis (PHAG), and IgG concentrations were all measured. Pigs weaned at 14 d of age had higher total WBC ($P < 0.001$) and Lymph ($P < 0.001$) at 8 wk of age and higher Neut ($P < 0.001$) at 16 wk. In general, pigs weaned at 14 d had higher ($P < 0.001$) NK activity at various times throughout the study. They also had higher ($P < 0.001$) LPA response at weaning and 7 and 14 d post-weaning ($P < 0.001$). Pigs weaned at 28 d of age were heavier at weaning ($P < 0.001$) and until 8 wk of age ($P < 0.001$) than those weaned at 14 d of age. Total WBC ($P = 0.005$) and Lymph ($P < 0.001$) were higher at 24 h and 14 d post-weaning among pigs weaned at 28 d. CORT was also higher at weaning, 24h and 14d post weaning ($P = 0.017$) in these pigs. These data provide support that weaning age may have long-term consequences on pig immune function.

Key Words: Pig, Immune, Weaner-finisher

548 A comparison of serum harvesting methods and different instruments for total solid refractometry in calves to determine failure of passive transfer. B. Jarvie, M. Wallace, N. Perkins, and K. Leslie*, University of Guelph, Guelph, ON, Canada.

Successful transfer of antibodies in neonatal calves is determined by the amount, quality, and absorption of colostrum ingested within the first 24 hours of life. It is critical to the health of the calf and should be monitored routinely. Refractometry on serum from calves at 1 to 7 days of age to measure total solids (TS) is a valid technique for measuring failure of passive transfer of immunoglobulins (FPT) that can be adapted for on-farm use. However, the necessity of having a centrifuge to harvest serum has kept this method from widespread adoption. In the current study, serum TS refractometry results were compared between duplicate blood samples that were centrifuged and non-centrifuged prior to harvesting the serum. A total of 234 calves from 61 dairy herds across southern Ontario were enrolled in this study. The mean serum TS concentration was 5.5 g/dl and 5.4 g/dl for the centrifuged and non-centrifuged serum, respectively. The Spearman rank coefficient assessing the linearity between TS results from centrifuged and non-centrifuged methods of serum harvesting was 0.95, indicating a high degree of correlation between the two sources of serum. Using less than 5.0 g/dl as the cut-off value for defining FPT, 25% and 28% of the serum TS values from centrifuged and non-centrifuged samples, respectively, were identified as having FPT. A two-tailed Fisher's exact test indicated that the TS results, in categories of success and failure of passive transfer, did not differ significantly between the serum harvesting methods ($p=0.53$). On a subset of 164 calves, the serum TS was measured using both digital and hand-held refractometry instruments. The Spearman rank coefficient was 0.96, indicating that a high degree of correlation between the two measurement methods. The results of this study suggest that serum TS refractometry, as measured from non-centrifuged serum and with two different refractometry instruments, can be successfully used to identify calves at risk of FPT.

Key Words: Refractometry, Calves, Failure of passive transfer

549 Effects of OmniGen-AF on growth and innate immune function in growing rats: identification of a mechanism of action. E. Georges*, Y. Wang, and N. Forsberg, Oregon State University, Corvallis.

The goal of this study was to evaluate the effects of OmniGen-AF on innate immune status and on growth in healthy and in immuno-deficient rats. The study was conducted as a 3X2 factorial with 6 rats per treatment. Six male rats (ca. 300g) were randomly assigned to a control diet or an OmniGen-AF-supplemented diet (1% of diet DM: Factor 1) and to one of three levels of dexamethasone (DEX) treatment (0, 0.1 or 1.0 mg/kg of BW/day: Factor 2). Animals were maintained on these treatments for a period of 14 days after which they were weighed and anesthetized. Under anesthesia, 10 ml of blood were taken and neutrophils were purified using Percoll gradient centrifugation. RNA was extracted from neutrophils using Trizol reagent after which concentrations of mRNA encoding L-selectin, a neutrophil adhesion molecule, and B-actin were assessed using quantitative real-time PCR. Injection of both concentrations of DEX resulted in substantial weight loss ($P<0.05$). Rats injected with 0.1 and 1.0 mg/kg/d lost approximately 3.5g and 8g of BW/day, respectively, irrespective of diet. Control animals gained 2 g/hd/day whereas OmniGen-AF increased weight gain ($P<0.027$) in control-fed rats from 1.9 to 2.8 g/hd/day. The benefit of OmniGen-AF on gain was not mediated by an increase in intake. Instead, OmniGen-AF-fed rats had significantly improved feed efficiency. Effects of the six treatments on innate immune function were assessed using L-selectin as a marker. L-selectin mRNA was expressed as a ration of a housekeeping gene (B-actin). Injection of DEX caused marked reductions (immunosuppression) in the L-selectin/B-actin ratio. Immunosuppressive effects of DEX were not countered by addition of OmniGen-AF to the diet. In control-fed animals, however, OmniGen-AF increased the neutrophil L-selectin/B-actin mRNA ratio by 6-fold ($P<0.01$). The data indicate that OmniGen-AF increases growth in male rats by improving feed efficiency. Further, the feed additive boosted an index of innate immune function. The ability of this feed product to reduce incidence of disease in livestock may be related to its ability to augment innate immune function.

Key Words: OmniGen-AF, Innate immunity, Non-ruminant

550 The process of porcine M cell differentiation within the follicle-associated epithelium. K. Miyazawa*, A. Hisashi, K. Takashi, K. Taketomo, K. Watanabe, S. Ohwada, and T. Yamaguchi, Tohoku University, Sendai, Japan.

Aim: The follicle-associated epithelium (FAE) is important for antigen sampling system. The FAE is different from the surrounding villous epithelium and contains membranous cells (M cells). M cells are believed to act as an antigen sampling cells from the gut lumen. It has been reported that cytokeratin 18 (CK 18) is a marker for M cells of pig. However, the origin, differentiation system and death of M cells are still a matter of controversy. Therefore, we addressed on the process of porcine M cell differentiation. Methods: Three-way crossbred female pigs aged 3-6 month were used for this study. After slaughter, the fresh ileum was removed immediately and used for several experiments. The anti-CK 18 and anti-PCNA antibodies were used for immunohistochemical study. Alkaline phosphatase (ALP) activity was detected by enzyme histochemistry. Cell migration was detected by BrdU injection. Apoptotic cells were detected by TUNEL method. Results: In porcine ileum, M cells were mostly observed until the FAE periphery. On the other hand, M cells were hardly detected in the FAE apex. These were supported by the results of SEM examination. By mirror sections method, CK 18^+/$PCNA^+$ proliferative M cells were detected in the FAE side of the crypt. BrdU analysis indicated that the life span of ileal epithelial cells was almost similar in the crypt-FAE axis and the crypt-villus axis. Apoptotic cells were detected exclusively at the FAE apex. In mouse, rat and human, M cells are lack or very weak for the staining of ALP activity on their brush border. Double staining for ALP activity and CK 18 showed that ALP activity was not or weakly stained in CK 18^+ M cells of the FAE periphery in porcine ileum. In addition, we observed CK 18^+/ALP^+ cell that was transient cell type from M cell to enterocye. Conclusion: Our findings provide the evidences described as follows: The porcine M cells are directly derived from stem cells and committed as a distinct cell lineage in the crypts. The committed M cells are differentiated to mature M cells at the FAE periphery. Finally, M cells trans-differentiated to entrocytes at a near position of the FAE apex and are excluded by apoptosis.

Key Words: Swine, Intestine, M cells

551 Comparison of direct-fed microbial and antibiotic supplementation on peripheral blood immune cell populations of weanling pigs. M. E. Davis*[1], D. C. Brown[1], C. V. Maxwell[1], Z. B. Johnson[1], and T. Rehberger[2],

[1]University of Arkansas, Fayetteville, [2]Agtech Products, Inc., Waukesha, WI.

A study was conducted to determine the effect of an antibiotic and direct-fed microbials on peripheral blood immune cell populations in pigs. At farrowing, pigs were provided milk supplement during lactation with or without Lactobacillus brevis (1E1). Treatments were continued during the nursery period, in which pigs administered 1E1 in lactation continued to receive 1E1 through the watering system. During the nursery, pigs were fed: 1) a control diet (CON), 2) CON supplemented with Bacillus (BAC), or 3) Carbodox (CARB), in a 2 × 3 factorial arrangement. On d 10, 20, and 38 after weaning, blood was collected from 12 pigs (2 pigs/trt) for flow cytometric analysis of immune cells. Monoclonal antibodies against the cell surface markers CD3 (70% T cells), major histocompatability complex class II (MHCII; antigen-presenting cells), CD4 (T helper cells), CD8 (cytotoxic T cells), TCR1 (T cell receptor γδ), and CD25 (lymphocyte activation) were used to detect leukocyte populations. The proportion of $CD3^+MHCII^+$ cells on d 20 was higher ($P < 0.05$) in pigs administered 1E1 and CON, compared to pigs fed CON and BAC without 1E1 and those fed BAC and CARB with 1E1. However, on d 38, pigs fed BAC with and without 1E1 had a higher proportion of $CD3^+MHCII^+$ than any other treatment (1E1 × diet × day, $P < 0.05$). The proportion of T cells with TCR1 did not differ among treatments on d 10 or 38, however, on d 20, pigs fed CARB without 1E1 and CON with 1E1 had a higher ($P < 0.05$) proportion of T cells with TCR1 than pigs fed CON or BAC without 1E1 and those fed BAC with 1E1 (1E1 × diet × day, $P < 0.05$). On d 10, pigs fed BAC without 1E1 had a higher proportion of $CD25^+CD4^+CD8^-$ T cells than pigs fed CON without 1E1. However, the proportion of $CD25^+CD4^+CD8^-$ T cells was higher ($P < 0.05$) in pigs fed BAC with 1E1 compared to pigs fed BAC and CARB without 1E1, and CON and CARB diets with 1E1 on d 38 (1E1 × diet × day, $P < 0.05$). This study indicates that 1E1 and the combination of 1E1 and BAC initiate similar peripheral blood immune cell populations as those present in the CARB-supplemented pigs.

Acknowledgements: Funding provided by the National Pork Board

Key Words: Swine, Probiotics, Immunity

552 Effects of weaning age on pig immune response to mixing stress. S. R. Niekamp*, M. A. Sutherland, and J. L. Salak-Johnson, University of Illinois, Urbana.

Mixing is a stressful event that often occurs throughout the grower/finisher phase of swine production which may have negative consequence on health and performance. The objective of this study was to evaluate the effect of weaning at different ages on the immune response of pigs subjected to mixing stress later in life. Piglets were weaned at 14 or 28 d of age and remained as litter groups until mixing. Pigs were assigned to no mixing (control), once mixing (at 8 wk), or twice mixing (at 8 and 16 wk). Blood samples were taken at 3 and 24 h post-mixing. Cortisol (CORT), total white blood cell counts (WBC), lymphocyte counts (Lymph), neutrophil counts (Neut), lymphocyte proliferation (LPA), natural killer cell cytotoxicity (NK), neutrophil chemotaxis (CHTX) and phagocytosis (PHAG), and IgG concentrations were all measured. In general, pigs mixed once had higher WBC ($P = 0.004$), Neut count ($P = 0.015$), and CORT ($P < 0.001$) at 8 wk of age. At 3 h post-mixing, pigs weaned at 28 d of age had higher WBC ($P = 0.05$) and Neut counts ($P = 0.05$) while those weaned at 14 d of age had higher CORT ($P = 0.02$) and tended to have higher NK ($P = 0.096$) at 8 wk. At 16 wk of age, pigs weaned at 14 d had higher Neut counts ($P < 0.001$) and lower Lymph counts ($P < 0.001$) compared to those pigs weaned at 28 d. Similarly, at 3 h post-mixing, Neut counts were higher ($P = 0.06$) and Lymph counts lower ($P = 0.009$) in pigs weaned at 14 d and mixed either once or twice. CORT was highest ($P = 0.03$) at 3 h post-mixing in pigs weaned at 28 d and mixed twice. These data provide support that a pig's immune response may be indicative of their ability to cope with stressors evoked later in life.

Key Words: Stress, Immune, Weaning age

553 Effects of Melengestrol Acetate on bovine inflammatory response during Mannheimia haemolytica challenge. M. Corrigan*, J. Drouillard, D. Mosier, M. Spire, J. Minton, J. Higgins, E. Loe, B. Depenbusch, and J. Fox, Kansas State University, Manhattan.

Previous research from our lab indicated that Melengestrol Acetate (MGA) improved growth rates and reduced chronicity in heifers naturally challenged with bovine respiratory disease. This study was completed to provide further insight into the possible immunomodulatory effects of MGA. Crossbred heifers (n=47; 232 ± 5.5 kg) were used in a randomized complete block design to determine effects of MGA on lung pathology and markers of inflammation in cattle following Mannheimia haemolytica (MH) challenge. On day 0, cattle were stratified by weight and randomly assigned, within strata, to diets (54% concentrate) that provided 0 or 0.5 mg MGA per heifer daily for the duration of the experiment. Twenty ml of inoculum containing between 1.3×10^9 and 1.7×10^9 CFU MH were instilled at the bifurcation of the trachea on day 14. Blood samples were taken, clinical observations were made, and rectal temperatures were recorded for each animal at 0, 12, 24, 48, 72, 96, 120, and 138 hours after inoculation, and analyzed as repeated measures. Heifers fed MGA had greater levels of eosinophils and post-challenge levels of segmented neutrophils and white blood cells ($P < 0.01$) compared to controls, as well as elevated plasma protein, serum haptoglobin, and fibrinogen after MH challenge ($P < 0.01$). Heifers fed MGA had lower plasma glucose ($P < 0.01$), higher plasma urea nitrogen ($P = 0.02$), and elevated respiratory indices ($P < 0.01$) compared to controls. Necropsies performed on day 6 after inoculation suggested that MH challenge was relatively mild, as lesions were confined to a small portion of the lungs. On a 0 to 100 scale, lung lesion scores were 3.08 and 1.04 for MGA-fed and control groups, respectively ($P > 0.05$). Contrasting outcomes of this experiment and our previous study with naturally-exposed cattle challenges our hypotheses concerning immunomodulatory effects of MGA, suggesting that additional research is needed.

Key Words: Melengestrol Acetate, Mannheimia haemolytica, Heifers

554 Peripheral and core body temperature sensing using radio-frequency implants in steers challenged with lipopolysaccharide. E. D. Reid* and G. E. Dahl, University of Illinois, Urbana.

Early detection of disease can influence timely administration of treatments, alter the health status of animals and on a larger scale, prevent the spread of disease through a herd. Immune stimulation is often manifested as elevated core body temperature, as measured by rectal temperature. Injectable radio frequency implants (RFI) are now produced with the ability to remotely monitor temperature at the site of implantation, yet the fidelity of peripheral site values relative to core temperature is unknown. We hypothesized that in response to lipopolysaccharide (LPS), patterns at three peripheral implantation sites are similar to rectal (REC) temperature patterns in weaned steers (n=4; BW 77 +/- 2 kg). These three sites were 1)under the scutiform cartilage at the base of the left ear (EAR) 2)s.c. on the midline, posterior to the poll (POL) and 3)s.c. on the midline beneath the umbilical fold (UMB). Animals were housed in controlled temperature rooms (2/room) and fed ad libitum cubed alfalfa and water and 2 kg/d of pelleted grain. Room temperature and humidity were logged every 15 min. and REC, EAR, POL and UMB temperatures were collected every 8 h daily. On d 7, 21, 22, 36 and 37, temperatures were taken every 5 min for 6 h, every 15 min for 3 h and every 30 min for 15 h. On d7 steers were placed on either short day photoperiod (8 h light:16 h dark) or long day photoperiod (16 h light: 8 h dark) and photoperiod was switched on d22. To test the RFI during a simulated immune system challenge, 0.1 ug/kg of LPS (e. coli 055:B5) was injected i.v. at 1000 h on d 22 and 37. Mean basal temperatures (°C) were REC (38.7±0.3), EAR (36.7±1.3), POL (35.9±0.7), and UMB (36.1±1.4). REC temperature rose rapidly to 40.0±0.3°C after LPS injection, but EAR, POL and UMB declined in similar fashion. The drop in peripheral temperature was biphasic and consistent among sites. These data do not support the hypothesis that core and peripheral temperature move in synchrony after LPS challenge. However, RFI have potential for use in the early detection of diseases that alter basal temperature.

Key Words: RFID, Temperature

555 Including important traits with low heritability in workable dairy progeny tests in the US. R. Pearson* and B. Cassell, Virginia Polytechnic Institute and State University, Blacksburg.

Breeding companies make an investment in progeny testing that is recouped by selling semen primarily from these proven bulls. The purpose of progeny testing is to accurately predict the average genetic contribution of a bull to future progeny. Problems accentuated for traits with low heritability include: inaccurate identification, progeny group size, accurate data on progeny groups, and genotype x environment interaction. Accurate animal id is currently emphasized in relation to tracking animals. This will not reduce the problem of incorrect id, but may offer opportunities to obtain samples for parentage verification and keep the id permanent. Increasing progeny group size is mainly a financial question. Current evaluations are focused on increasing the spread of proofs and increased stability through more accurate genetic evaluations. Incentives for use of progeny testing are costly as are the cows bred to progeny test sires that are not candidates for the more profitable proven bull semen. Would this be a place where sexed semen could be a cost effective incentive to the breeder? Because of the added value, the semen may be more judiciously used and thus increase the output of daughters. The potential for sire x environment interactions continues to increase as the variation in the intensity, and/or specificity of the management system increases. Degree of use of BST, approaches to timed AI, variation in the pathogen loads, intensity of rations, and approaches to the dry period are just a few of the possible causes. Genetic evaluations have been from traits that producers were willing to pay for the data collection. AI units will need to find ways to increase the value of data on low heritability traits and recruit herds that already value the needed data. The opportunity of improving the selection of sires for progeny testing through DNA evaluation continues to be a hope for increasing the accuracy of selection. To this point, its overall impact has been minimal.

Key Words: Progeny Test, Low Heritability Traits, Dairy Cattle

556 Effect of herd by sire interaction variance on genetic evaluations. P. M. VanRaden and M. E. Tooker*, Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.

Records from multiple daughters of a bull in the same herd have had reduced weighting in USDA evaluations since 1967 by adjusting for herd by sire interaction. Interaction variance (c^2) defined as a percentage of phenotypic variance was initially estimated to be 14%. In 1997, c^2 was reduced to 10%, and heritability was increased from 25 to 30% in the animal model. Recent c^2 estimates have been lower, but higher c^2 limits differential management or fraud by individual herd owners. Official November 2004 predicted transmitting abilities (PTA) for Holstein protein yield with c^2 = 10% were compared with PTA computed with reduced c^2. Repeatability of protein yield was held constant at 0.55 by increasing permanent environmental variance as c^2 was decreased to 5 and 1%. Correlations of official PTA with PTA with reduced c^2 were high: 0.999 for c^2 = 5% and 0.993 for c^2 = 1% for active artificial-insemination (AI) bulls and 0.999 and 0.994, respectively, for cows born since 1998. Calculated reliability of PTA increased as c^2 decreased: 88.6% for c^2 = 10%, 89.2% for c^2 = 5%, and 90.0% for c^2 = 1% for bulls and 49.3, 49.4, and 49.4% for cows. Mean PTA decreased slightly: 18.4, 18.3, and 18.2 kg for bulls and 8.2, 8.1, and 8.0 kg for cows. Individual PTA changes were small for active bulls and moderate for non-AI bulls. Of the top 100 bulls for protein, 98 had no PTA change; only 2 bulls had changes of 1 kg when c^2 was reduced from 10 to 5%. When c^2 was reduced from 10 to 1%, 92 of the top 100 bulls had no PTA change; changes for the other 8 bulls were 1 or 2 kg. Of 2.3 million recent cows, PTA changed by >4 kg for only 20 cows when c^2 = 5% and 1256 cows when c^2 = 1%; those cows were sired by non-AI bulls with many daughters in one or a few herds. Use of a relationship matrix among herd by sire or herd by animal interactions could be helpful but was not tested. Reduction of c^2 to 5% would facilitate AI companies obtaining more daughters per herd in large cooperating herds. However, somewhat less protection would be provided against chance or fraud when sampling was limited to a few herds.

Key Words: Herd by Sire Interaction, Environmental Correlation, Animal Model

557 Quantifying the level of heat stress in a southeastern dairy using weather recording on- and off-farm. M. Freitas*[2], I. Misztal[1], J. Bohmanova[1], and J. West[1], [1]University of Georgia, Athens, [2]Universidade Federal de Vicosa, Vicosa, MG, Brazil.

The purpose of this study was to compare the effectiveness of on- and off-farm weather recording on capturing the effect of heat stress on production. Daily milk yield for 31 primiparous Holstein cows was collected at Tifton, GA, from June 2 to July 19, 1993. Air temperature and relative humidity were recorded on-farm by a portable unit placed immediately adjacent to the free stalls. Weather information was also available from public weather stations located in Georgia; the closest station was in Tifton, about 3 km from the farm. Maximum temperature-humidity index (THI) was calculated using maximum temperature and minimum relative humidity, and minimum THI was calculated using minimum temperature and maximum relative humidity. Analyses used the average of minimum and maximum THI. Based on on-farm weather information recorded the day of milking, the onset of heat stress was at THI = 74, and afterwards, the rate of decline averaged 0.77 kg of milk per degree of THI. Using a lag of 2 d for weather data increased the rate to 0.96 kg. With the data from the Tifton station, the onset of heat stress was at 71 THI, and the rate was 1.00, (1.14, 1.12, and 0.97) for no lag and (lags of 1 d, 2d, 3d). With data from stations in Macon, (Columbus, Atlanta, and Athens), the onset was at 73, (70, 71, and 71), and the rate was 0.85, (0.76, .88, and 0.89). A separate analysis included 1993-2003 test days from the same farm and the weather information from the Tifton station. The onset of heat stress was at 68 THI and the slope was 0.32. Using only data for 2000-2003 changed the onset to 75 and increased the rate to 0.74; the Tifton station was changed from manual to automatic weather recording in 1999. Records from nearby weather stations may be equal to or superior to those from on-farm recording. The quality of data from weather stations is a function of location and time.

Key Words: Heat Stress, Temperature-Humidity Index, Dairy Cattle

558 Test-day model that accounts for heat stress of Holsteins in the United States. J. Bohmanova*[1], I. Misztal[1], S. Tsuruta[1], D. Norman[2], and T. Lawlor[3], [1]University of Georgia, Athens, [2]Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD, [3]Holstein Association, Brattleboro, VT.

Genetic evaluations for heat tolerance of US Holsteins were developed with national data. Hourly temperature and relative humidity records were available from 202 public weather stations across the United States. Production data included 57,315,661 first-parity test-day records from 1993 through 2004 for 6,906,815 Holsteins. Herds were assigned by distance from the nearest weather station. Hourly temperature-humidity indexes (THI) were calculated as [1.8(°C) + 32] - [0.55 - 0.0055(relative humidity percentage)][1.8(°C) - 26]. A daily temperature-humidity index (THI24) was calculated as mean of hourly THI on recording day. The threshold for heat stress was assumed to be a THI of 72. The test-day model contained effects for interaction of herd with test day, days-in-milk classes, calving age, milking frequency, additive genetics, permanent environment, and random regressions on max(0, THI24-72), for additive genetic and permanent environmental effects. Breeding values were calculated by BLUP90IOD in 144 rounds and 8 hr. Breeding values for heat tolerance of sires ranged from -0.48 to 0.38 kg milk per THI unit above a THI24 of 72. Breeding values at higher THI24 would be (THI24 - 72) times greater. On average, the 50 most heat-tolerant bulls were 3 yr older than the 50 least tolerant. Compared to eight worst bulls for heat tolerance, the best eight bulls differed by -5 kg for

milk, -0.08 kg for fat, -0.12 kg for protein, -3.6 for dairy form, +2.2 for udder composite, +2.0 for body composite and +2.2 mo for productive life. Relative drop in protein and fat was lower than in milk. Heat tolerant bulls have daughters with lower milk production, lower water content in milk, larger body reserves, better udders and longer productive life. Heat stress effects may have been underestimated due to unequal quality of weather data. National genetic evaluation for heat tolerance is feasible.

Key Words: Heat Stress, Heat Tolerance, Test-Day Model

559 Reproduction data in USDA database. G. Wiggans*, Animal Improvement Programs Laboratory, Agricultural Research Service, Beltsville, MD.

The Animal Improvement Programs Laboratory began storing all breedings for cows and heifers in 2003. Some data back to 1997 also were stored. Reproduction data have been acquired for a high proportion of cows in recent years with most herds providing some data. Currently, two record processing centers supply breedings for heifers and up to nine types of reproductive events. The other centers supply the latest breeding each test day and pregnancy confirmation information for cows, but do not supply heifer data and additional reproductive events. Data from 2,336,621 calvings in 2003 and 304,183 heifers born in 2002 were analyzed to determine the portion of data with reproductive events reported. Usable service sire was reported for 89% of the breedings from the two centers with complete reporting, which had 53% of total breeding analyzed. Pregnancy confirmation was reported in 67% of the lactations, of these, 24% were confirmed not pregnant. Of the cows, 86% had at least 1 breeding reported and averaged 2.1 breedings. For heifers, the average number of breedings was 1.5 and breedings were reported for 82% of the heifers. Almost no estrus synchronization and very few cases of embryo transfer, either as a donor or recipient, have been reported. Of herds with 10 or more calvings, 70% had complete reporting and 24% more reported some breedings. Confirmations were reported for 81% of herds with 10 or more calvings. The reproduction data supports daughter pregnancy rate evaluations. For lactations without subsequent calving, pregnancy status is used to improve accuracy of estimates of days open. As pedigree information is added to the database, a calf's sire is checked against its dam's service sire and the provider notified when they differ. The calf's sire is not changed to the service sire because the service sire may be incorrect. This more extensive collection of reproduction information supports improved evaluations of daughter pregnancy rate, planned evaluation of male fertility and further research on fertility.

Key Words: Fertility, Days Open, Reproductive Events

560 Conception rates of Holsteins in New York and Georgia. C. Huang*[1], S. Tsuruta[1], I. Misztal[1], T. J. Lawlor[2], and J. S. Clay[3], [1]University of Georgia, Athens, [2]Holstein Association USA Inc., Brattleboro, VT, [3]Dairy Records Management Systems, Raleigh, NC.

The objective of this study was to estimate fixed effects that influenced conception rate of Holsteins in NY and GA. Data were obtained from DRMS, Raleigh, NC, and included production and service records on 417,910 cows in NY and 59,784 cows in GA from 2003 to 2004. After removing uncertainty and extreme records (without caving date or birth date, lactation ≥ 1, days to service after calving ≥ 365, service times ≤ 10, and without next calving record), those numbers dropped to 146,821 cows in NY and 11,465 cows in GA, respectively. Using SAS PROC GLM, for each state, the model included the effects of days after calving group, lactation number, milk production level, AI status, caving month, service month, age of cow, herd, calving year and those interactions. In NY (GA), least squares means for conception rate, as a function of days postpartum was 0.51 (0.55) at 50 d and increased to 0.68 (0.74) at 250 d for AI sires. The conception rate was about 0.2 (0.12) higher for natural service sires than for AI sires. The conception rate was the highest at 0.68 (0.82) in March and the lowest at 0.51 (0.53) in June, and decreased by 0.05 (0.07) as milk production increased from 30 to 45 kg/day. The calving and insemination were very seasonal in GA, with 3 times more cows calving in October than in June. Also, the proportion of natural bull services was very seasonal peaking at 25% in summer and dropping to 15% in winter. Conception rate increased with days postpartum and natural service bulls had significantly higher conception rate. Also, it is influenced by season especially in Georgia.

Key Words: Conception Rate, Fertility, Holstein

561 Genetic parameters for conception rate and days open in Holsteins. S. Tsuruta*[1], C. Huang[1], I. Misztal[1], T. J. Lawlor[2], and J. S. Clay[3], [1]University of Georgia, Athens, [2]Holstein Association Inc., Brattleboro, VT, [3]Dairy Records Management Systems, Raleigh, NC.

The goal of this study was to estimate genetic parameters for conception rate and days open in Holsteins. Data collected in NY from 2001 to 2003 were provided by the DRMS, Raleigh, NC. After editing, it included 89,271 first-parity service records for 43,344 cows. The first mixed linear model (bivariate analysis) was for conception rate at first service and for days open and included fixed effects of herd-year, age class, month of calving, AI status (natural service or AI), days to first service after calving (for conception rate only) and milk yield as a covariate, and random additive genetic and residual effects. Heritability estimates for conception rate at first service and days open were 1.4% and 2.5%, respectively. Genetic correlation between these traits was –0.92. The second model applied to conception rate with repeated records. It included the same fixed effects as the first model plus linear random regression as a function of days to service for the animal additive and permanent environmental effects. Heritability and repeatability estimates were 1.0-1.5% and 3.6-4.2%; they were approximately constant from 50 d to 250 d postpartum. The genetic correlations between the conception at 50 and (150, 250) d were 0.86 and 0.45, respectively. We also estimated genetic parameters for conception rate with threshold models as a binary trait. The heritability and repeatability estimates were about one and a half times higher than those from linear models. Days open is a good measure of fertility in NY. Conception rate may be a different trait at different days postpartum.

Key Words: Conception Rate, Heritability, Holstein

Companion Animals: Nutritional and Health Considerations for Companion Animals II

562 Effects of food and water intake on variation in ileal digesta viscosity among dogs fed a maintenance diet. C. Dikeman* and G. Fahey, Jr., University of Illinois, Urbana.

A two-period crossover design experiment was conducted to address effects of food and water intake on ileal digesta viscosity among dogs. Six ileal cannulated dogs, average weight of 26.0 kg (range, 19.5 to 29.6 kg), were fed during an initial 6-d adaptation phase up to individual energy requirements (ME = 145 kcal*kg BW $^{0.67}$). This phase preceded a 4-d collection of ileal digesta. The second 10-d period consisted of caloric/intake restriction by decreasing intake by one-half (ME = 72.5 kcal*kg BW $^{0.67}$). Dogs consumed an extruded diet that met or exceeded AAFCO recommendations for dogs at weight maintenance. Water was offered ad lib. Water intake was measured and recorded at 0800 and 2000 daily. Ileal digesta, for both periods, was collected for 1.5 h at 0900, 1300, and 1700 during the collection phase. Ileal digesta viscosity was measured, at multiple shear rates, using a Brookfield RV-DVII+ viscometer adapted with

vane spindle geometry. All viscosities exhibited shear-thinning behavior and are presented as area under the curve values (AUC). Data were analyzed using the mixed models procedure of SAS with a statistical model including the fixed effect of treatment and random effects of period and dog. In addition, linear regression analysis was used to determine the relationship between water intake and viscosity AUC. Daily water intake ranged from 310 to 1,159 ml. Food intake ranged from 137 to 186 g/d during the caloric restriction phase and 274 to 372 g/d when dogs consumed food to meet energy requirements. Digesta viscosity AUC values for dogs consuming food up to their energy requirement ranged from 6,978 to 59,866 cP·RPM. Digesta viscosity AUC values for dogs during the caloric restriction phase ranged from 4,930 to 24,352 cP·RPM. Viscosity AUC values were 39.6% ($P<0.01$) lower when dogs consumed less food. Water intake did not account for variability in viscosity AUC, indicated an $R^2 = 0.07$. These results indicate that food intake accounts for greater variation in gastrointestinal tract viscosity than water intake.

Key Words: Viscosity, Ileal Digesta, Dog

563 Canine diet matrices affect digesta viscosity in vitro and ileal viscosity in vivo. C. Dikeman* and G. Fahey, Jr, University of Illinois, Urbana.

Two experiments were conducted to determine the effects of canine diet matrix on ileal digesta and simulated digesta viscosity in vitro. Three canned diets containing either carageenan (C), guar gum (G), or soybean hulls + cellulose (SBC), and three dry extruded diets containing rice bran (RB), wheat bran (WB), or soybean hulls (SB), were fed to 6 ileal cannulated dogs in a 6 x 6 Latin square design. Dogs were fed either 1400 or 400 g/d of canned or dry diet, respectively, such that caloric intake of canned and dry diets was similar. Ileal digesta was collected 3 times daily on the final 2 d of each 7-d period. In the second experiment, all diets were subjected to a two-stage in vitro gastric and small intestinal digestion simulation model. Viscosity of in vitro solutions was measured every 2 or 3 h during gastric and small intestinal simulations, respectively. Viscosity of digesta and in vitro solutions was measured, at multiple shear rates, using a Brookfield RV-DVII+ viscometer. All viscosities exhibited shear-thinning behavior and are presented as area under the curve values (AUC). Viscosity AUC of digesta ranged from 3,116 to 128,469 cP·RPM, for canned C and SBC diets, respectively. Less variation in viscosity AUC was noted when dogs consumed dry diets (17,676 to 25,174 cP·RPM, for WB and RB diets, respectively). Digesta viscosity for dogs consuming SBC was much higher ($P<0.0001$) compared with all other dietary treatments. Digesta viscosity was lower ($P<0.0001$) when dogs consumed C compared with SB, RB, WB, or SBC. Digesta viscosity for dogs consuming G was numerically lower than for the three dry diets. During gastric in vitro simulation, viscosity AUC at 0 and 6 h ranged from 189 to 331 cP·RPM and 145 to 987 cP·RPM for C and WB and G and WB diets, respectively. Small intestinal in vitro solutions at 0 and 18 h ranged from 91 to 410 cP·RPM and 17 to 256 cP·RPM for RB and G and G and SBC diets, respectively. With the exception of the SBC diet, consumption of canned diets resulted in lower ileal digesta viscosity compared with digesta following consumption of dry extruded diets in vivo and in vitro.

Key Words: Digesta, Viscosity, Dog

564 Effect of body size and diet on total dietary fiber digestibility in dogs. D. Hernot*[1], H. Dumon[1], V. Biourge[2], L. Martin[1], and P. Nguyen[1], [1]National Veterinary School, Nantes, France, [2]Royal Canin Research Center, Aimargues, France.

We have previously reported that, fed a same dry diet, large and giant-breed dogs presented higher concentrations of fecal fermentation products and a higher digestibility of total dietary fiber (TDF) compared to small dogs. We have therefore hypothesized that large and small-breed dogs would have different fermentative capacity. The aim of the study was to test the effect of different dietary fiber contents on TDF digestibility in dogs varying in body size.

Twenty four dogs, varying from 4 to 59 kg body weight were used in the study: 6 Miniature Poodles (MP), 6 Standard Schnauzers (SS), 6 Giant Schnauzers (GS) and 6 Great Danes (GD). All dogs were fed 4 diets differing in fiber amount and fermentable-to-non-fermentable ratio (F:nF). Diets 1, 2, 3 and 4 contained a F:nF of 0.15, 0.15, 0.36 and 0.48 with 7.7, 9.7, 8.9 and 9.2 % TDF, respectively. TDF was measured in diets and lyophilized feces using AOAC (1984) methods.

For each diet, we found a higher TDF digestibility in large dogs compared to small ones (from 41.9±2.9% for MP to 62.9±5.6% for GD, with control diet). For each breed TDF digestibility increased with the dietary F:nF ratio, except for diet 4 with which TDF digestibility was the lowest (from 40.7±9.1% for MP to 55.7±7.1% for GD). In the same way, digested dietary fiber amount increased with body size and dietary F:nF ratio except with diet 4. For each breed, we indeed found no difference in digested TDF amount between diet 3 and diet 4 (respectively, 9.82±1.48 and 9.95±0.99 g/day for GD).

We confirmed the higher TDF digestibility in large dogs and showed an effect of body size whatever the diet. Results of digested fiber amount suggested that dogs could adapt their fermentation process to an increase in dietary fermentable fiber until an upper limit was reached. With diet 4, which presented the highest fermentable fiber rate, fermentation capacity seems, indeed, to be overwhelmed. So, we could hypothesize that diet 3 still contained the highest fiber amount our dogs could ferment.

Acknowledgements: The authors thank Samuel Ninet, Gerald Pondevie, Sophie Baziere and Therese Fregier for excellent technical asistance.

Key Words: Dog, Dietary Fiber, Fiber Digestibility

565 Effect of body size and dietary fiber level on fecal bacterial mass and fecal quality in dogs. D. Hernot*[1], V. Biourge[2], H. Dumon[1], L. Martin[1], and P. Nguyen[1], [1]National Veterinary School, Nantes, France, [2]Royal Canin Research Center, Aimargues, France.

Fed a same dry diet, large-breed dogs show higher fecal moisture and softer stools than small ones. We have reported a higher fermentation activity in large dogs. The aims of the study were 1/ to test the effect of different diets (varying in beet pulp and maize fiber content) on fecal bacterial mass and 2/ to determine whether diets and fecal bacterial mass correlated with fecal quality according to body size.

Dogs varying in body size were used in the study: 6 Miniature Poodles (MP), 6 Standard Schnauzers (SS), 6 Giant Schnauzers (GS) and 6 Great Danes (GD). All dogs were fed 4 diets differing in fiber amount and fermentable-to-non-fermentable ratio (F:nF). Diets 1, 2, 3 and 4 contained a F:nF of 0.15, 0.15, 0.36 and 0.48 with 7.7, 9.7, 8.9 and 9.2 % TDF, respectively. Fecal bacterial mass was estimated using diaminopimelic acid (DAPA) as a bacterial marker. Fecal moisture was measured and fecal consistency scored for two weeks.

For each diet large dogs presented a lower fecal consistency and higher fecal moisture than small ones. There was no effect of diet on fecal scores for MP and SS but diet 4 significantly decreased fecal scores in GS and GD (from 3.2ï,±0.3 with diet 1 to 3.0ï,±0.1 with diet 4, for GD). Neither diet nor body size had effect on fecal DAPA content. Including all dogs and diets, the mean fecal DAPA content was 0.49ï, ±0.08 mg/g DM.

Beet pulp is known to induce well formed stools and also increase feces moisture. Those effects were confirmed in this study especially with diet 4 which contained the highest beet pulp rate and F:nF ratio. Nevertheless, while the effect of body size persisted for each diet on fecal consistency, results showed that large dogs would be more sensitive to a modification in dietary fiber level than small ones. The influence of dietary fiber on fecal consistency, in large dogs, did not seem to be the consequence of an increase in fecal biomass. More fermentation parameters have to be studied to confirm a more beneficial effect of fermentation on fecal consistency in large than in small dogs.

Acknowledgements: The authors thank Samuel Ninet and Gerald Pondevie for excellent technical assistance.

Key Words: Dog, Fecal Quality, Diaminopimelic Acid

566 Effects of selected concentrations of DL-methionine and 2-hydroxy-4-(methylthio)-butanoic acid on nitrogen balance and nutrient digestibility in growing dogs. I. Middelbos*[1], L. Karr-Lilienthal[1], J. Folador[1], M. Vazquez-Anon[2], G. Yi[2], and G. Fahey Jr.[1], [1]University of Illinois, Urbana, [2]Novus International, Inc., St. Louis, MO.

The effects of DL-methionine (DLM) and 2-hydroxy-4-(methylthio)-butanoic acid (HMTBA; Alimet® Feed Supplement, Novus International, Inc.) on nitrogen balance and nutrient digestibility in growing dogs were evaluated. A basal diet (control) containing commercially available ingredients was formulated to contain minimal concentrations of methionine (0.4% of DM). Batches of basal diet were supplemented with 0.1 or 0.2% DLM or HMTBA. Thirty Pointer puppies (age = 72 ± 6 d; BW = 5.5 ± 1.0 kg) were assigned to one of the five diets for 15 d, using three blocks of ten puppies each. Dogs were fed 90% of the voluntary feed intake of the lowest consumer within treatment and block prior to collection. Total feces and urine were collected for 5 d. Contrasts were used to compare DLM vs. HMTBA and inclusion levels. Nitrogen balance did not differ between methionine sources or inclusion levels. Fat and total dietary fiber (TDF) digestibilities were not affected by methionine source or inclusion level, but variation in TDF concentration among diets led to higher TDF intake ($P < 0.05$) of diets supplemented with HMTBA. Higher TDF intake coincided with higher fecal TDF output ($P < 0.05$) and lower ($P < 0.05$) digestibilities for DM, OM, CP, and energy for diets supplemented with HMTBA. These data suggest no effect of inclusion level or methionine source on nitrogen balance in growing dogs. TDF concentration discrepancies among the diets have impacted nutrient digestibilities in this study.

Key Words: Dog, Methionine, Nitrogen Balance

567 Encapsulation to deliver a steady-state level of dietary lutein to an animal via dry pet food. L. Deffenbaugh*, Kemin Industries, Inc., Des Moines, IA.

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. The lutein esters are commercially obtained via a solvent extraction process from marigolds and are commonly used as a pigmenter 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 pet food, but, like most biological antioxidants, is difficult to deliver via the convenience of a dry diet because of poor stability. Unprotected lutein added to a petfood diet will lose >50% of its activity through the manufacturing process, and then deplete to <20% of the initial inclusion level within the first few months of shelf life. An encapsulation process has been developed that protects lutein through processing and shelf life, yet allows for bioavailability to the animal upon ingestion of the diet. Three extrusion tests have shown that >90% of encapsulated lutein survives the process. Shelf life studies further show that the encapsulated lutein survives up to two years in the diet with minimal (<10%) additional loss. Encapsulation of lutein allows for a guaranteed level of lutein to be delivered in a dry petfood diet throughout the shelf life of the diet. Consequently, a steady-state level of lutein will be ingested and absorbed by an animal absorbing the diet. The cost of delivering a biologically active level of lutein in a dry petfood diet has been optimized to be comparable to other "value-added" ingredients such as natural antioxidants and palatants. Further, this encapsulation matrix will also likely be viable for hosting other biological nutrients that are unstable in an unprotected form.

Key Words: Lutein, Encapsulation, Biological Antioxidants

568 Effect of rosemary extract ingestion on canine serum antioxidant levels. W. Gamble*, Kemin Nutrisurance, Des Moines, IA.

Because free radicals cause damage to cell walls, certain cell structures, and genetic material within cells, oxidative stress may play a role in diseases. Antioxidants work by binding to free radicals, transforming them into non-damaging compounds, or repairing cellular damage. Antioxidants can be important in maintaining immune responses and vaccine recognition in young cats and dogs and can counter-act decreases in immune-cell function for older animals. Therefore, it has been proposed that health might be improved by increased dietary intake of antioxidants. Plant derived antioxidants, such as rosemary extracts, have been proposed as dietary antioxidants. Phenolic diterpene antioxidants, such as carnosic acid, carnosol, rosmanol, and galdosol have been isolated from rosemary with carnosic acid present in the greatest abundance. For these reasons the effect of rosemary extract on the immune system of companion animals is of interest. In order to demonstrate an effect on immune system, it is necessary to first demonstrate bioavailability of the the active antioxidant molecules. A bolus canine feeding study was undertaken with 6 dogs using partially a purified rosemary extract at 10 mg carnosic acid/kg body weight. Serum samples were drawn over a time course of one to six hours post-dosing. These samples were analyzed for carnosic acid content directly by Liquid Chromatography/Mass Spectrometry and by a Malondialdehyde assay method to measure lipid peroxidation as an indicator of serum antioxidant status. The Liquid Chromatography/Mass Spectrometry results demonstrated the absorption of carnosic acid into the bloodstream with peak concentrations occuring from one to three hours post-dosing. The Malondialdehyde assay results were not as consistent, showing much more dog to dog variation. However, the Malondialdehyde assay results for each dog did exhibit consistency when a second feeding study was performed.

Key Words: Antioxidant, Rosemary, Serum

569 A multi-center clinical study of the effect of docosohexanoic acid (DHA) on joint inflammation and mobility in dogs with mild to moderate osteoarthritis. F. Buonomo*[1], D. Grohs[1], M. Conzemius[2], S. Johnston[3], and D. Millis[4], [1]Monsanto Company, Animal Science Division, St. Louis, MO, [2]Iowa State University, Ames, [3]VA-MD Regional College of Veterinary Medicine, Blacksburg, VA, [4]University of Tennessee, Knoxville.

DHA is a 22-carbon highly unsaturated derivative of α-linolenic acid and a member of the omega-3 family of essential fatty acids. Dietary DHA supplementation has been hypothesized to reduce the production of proinflammatory 2-series prostaglandins and 4-series leukotrienes, and increase the production of the less inflammatory 3-series prostaglandins and 5-series leukotrienes. The objective of this study was to determine if dietary DHA supplementation improves clinical lameness and range of motion assessments in dogs with mild to moderate osteoarthritis. This study included 35 client-owned dogs diagnosed with mild to moderate arthritis in at least one elbow, hip, or stifle joint according to a defined clinical scale provided to trained clinicians. Dogs were randomly assigned to a placebo (18 dogs) or DHA (17 dogs) treatment group. Alginate pellets containing 0 or 900mg DHA were administered orally once daily for 84 d. Clinical assessment scoring included determinations of lameness, weight-bearing status, joint mobility, pain and radiography. These were collected at two pretreatment time points, and on d 28, 56, and 84 of treatment. Kinetic gait evaluation was conducted on a subset of dogs (8 placebo, 7 DHA) at the same time points. Client efficacy evaluations were conducted weekly throughout the study. Blood and synovial fluid samples were collected for analysis of prostaglandin E_2, leukotriene B_4, osteocalcin, IGF-I and IGFBP-5. Dogs receiving DHA had significantly improved lameness, range of motion, subjective investigator efficacy and client efficacy scores. Kinetic gait evaluation indicated a significant improvement in peak vertical impulse in dogs with affected forelimbs following several weeks of DHA administration. Dogs receiving DHA had significantly lower circulating levels of PGE_2 and LTB_4, but significantly higher levels of IGF-I, IGFBP-5, and osteocalcin, as compared to those receiving the placebo. These data indicate that DHA supplementation may be beneficial in ameliorating aspects of osteoarthritis development in dogs.

Key Words: Docosohexanoic acid, Osteoarthritis, Canine

570 Effect of the pH on the microstructure, firmness and meltability of cultured Cream cheese. R. R. Monteiro[1], D. Q. Tavares[1], P. S. Kindstedt[2], and M. L. Gigante*[1], [1]State University of Campinas, Campinas, SP, Brazil, [2]University of Vermont, Burlington.

Previous studies demonstrated that the firmness and water holding capacity of cream cheese were highly pH-dependent and inversely related. These results suggested that higher pH in cream cheese promoted increased casein-water interactions, which in turn triggered changes in cheese structure that gave rise to softer texture and greater water holding capacity. The objectives of the present study were to evaluate the effect of the pH on the microstructure of Cream cheese and to compare pH-induced changes in microstructure with concomitant changes in cheese firmness and meltability. Cultured cream cheese was manufactured and analyzed for initial chemical composition. The cheeses were then sectioned into samples that were randomly assigned to seven different treatments. Three groups were exposed to ammonium vapor for 1, 3 and 5 min to increase the pH; three groups were exposed to acetic acid for 30, 60 and 90 min to decrease the pH, and one unexposed group served as the control. After equilibration at 4°C samples were analyzed for firmness, meltability and microstructure by scanning electron microscopy. The entire experiment was repeated three times and the relationships between pH and melting or firmness were analyzed by regression. Cheese microstructure changed dramatically with increasing pH from 4.2 to 6.8. The volume of the protein network surrounding the fat droplets increased markedly with increasing pH, presumably due to casein swelling. Concomitantly, cheese firmness decreased (R^2 = .95) and meltability increased (R^2= .98) in a linear manner. Consequently, firmness and meltability were strongly correlated (R^2= -.96). These data support the hypothesis that casein:water interactions increased as the cheese pH increased, which gave rise to progressive swelling of the casein network. Swelling, in turn, caused the mechanical resistance of cheese structure to decrease, resulting in softer texture and increased meltability.

Acknowledgements: FAPESP-SP/Brazil

Key Words: Cream Cheese, Microstructure, Firmness

571 Effect of the addition of potassium sorbate on the stability of cream cheese. A. S. Salles[1], A. A. Vitali[2], P. S. Kindstedt[3], and M. L. Gigante*[1], [1]State University of Campinas, Campinas,SP,Brazil, [2]Institute of Food Technology, Campinas,SP,Brazil, [3]University of Vermont, Burlington.

Previous studies showed that the syneresis potential of Cream cheese made with locust bean gum (LBG) stabilizer was influenced by the viscosity of the serum phase, which in turn was determined by the stabilizer. Furthermore, a direct relationship was observed between microbial growth and decreases in the viscosity of LBG in aqueous solution during storage. Thus, it is possible that decreased viscosity of the serum phase of Cream cheese during storage may be related to microbial growth. The objective of this study was to evaluate the effects of the addition of potassium sorbate, an antimicrobial agent, on the microbiological activity and the viscosity of the serum phase of cultured cream cheese made with LBG. Standardized milk was fermented with lactic culture. The curd was divided and cheeses were manufacture with and without potassium sorbate. The cheeses were divided into two batches and stored at 4 or 20^{0}C. Samples were taken at random after 4, 10, 17, 24, 31, 38, 45, 52 and 59 days of storage and analyzed for chemical composition, pH, amount of expressible serum, total microbial count and yeast and mold count. The expressible serum was evaluated for total solids and apparent viscosity. Results were evaluated by ANOVA according to a Split-Split-Plot design with three experimental replications. Cheese water holding capacity decreased significantly during storage in a temperature dependent manner, with faster decreases occurring at 20^{0}C. The total microbial and yeast and mold counts increased linearly and significantly during the storage. Furthermore, counts were higher in the cheeses manufactured without the addition of potassium sorbate and stored at 20^{0}C. As the microbial counts increased, both the apparent viscosity of the expressible serum and the water holding capacity of the cheese decreased. These results suggest that viscosity of the serum phase decreased as a result of microbial growth, thus leading to decreased water holding capacity and increased potential for syneresis and quality defects.

Acknowledgements: FAPESP-Fundação de Amparo à Pesquisa do Estado de São Paulo, SP/Brazil

Key Words: Cream Cheese, Syneresis, Locust Bean Gum

572 Textural properties of commercial cream cheese. T. Wang*, Y. Chan, M. Brighenti, S. Govindasamy-Lucey, and J. A. Lucey, University of Wisconsin, Madison.

There has only a limited amount of information published on the textural and rheological properties of cream cheese. Objective of this study were to characterize the textural properties of commercial cream cheese products. Nine types of commercial cream cheeses including full fat, (one-third) less fat and fat-free (one sample), were obtained from a local grocery store. Typical moisture contents of full fat, less and fat free cream cheeses are ~54, ~64, and ~73%, respectively. Texture properties were analyzed by penetration test. Dynamic rheological properties were measured by small amplitude oscillation during heating from 5 to 80°C at 1°C/min and cooling at the same rate. Parameters measured were storage modulus (SM) and loss tangent (LT). The penetration test clearly indicated that full fat cream cheese had greater hardness (mean values ranged from 308 to 588g) compared to less fat (50 to 236g) or fat free (182g) cheeses. SM values decreased rapidly as temperatures increased, which would help cream cheese become spreadable at room temperature. SM values at < 40°C were significantly higher in full fat cheese during heating or cooling sweeps. In full fat cream cheese, one maximum in the LT (value = 0.26-0.35) was observed at 24-30°C, while no clear maximum in LT were observed during cooling sweep but LT increased greatly at low temperature. In less fat cream cheeses, a smaller maximum in LT was observed at 20-25°C, while a second maximum in LT was observed at ~55°C, which was also observable during cooling. There was no noticeable maximum LT observed during either the heating or cooling sweeps of fat free cream cheese samples. The LT peak in full fat cream cheese was presumably due to structural changes to the network after melting of fat. In full fat cream cheese homogenization of the high fat milk resulted in greatly increased surface area of fat globules covered by protein (mostly casein). The increased protein surface area helped to re-enforce the acid-induced casein network and contributed to increased hardness and SM values at < 40°C of full fat cheese.

Key Words: Cream Cheese, Texture

573 Effect of somatic cell count on Prato cheese ripening. G. Mazal[1], M. V. Santos[2], and M. L. Gigante*[1], [1]State University of Campinas, Campinas, SP, Brazil, [2]University of Sao Paulo, Pirassununga, SP, Brasil.

The objective of this work was to evaluate the effect of somatic cell count (SCC) on proteolysis and firmness of Prato cheese during ripening. Initially, two groups of animals were selected to obtain milk with low (< 200,000 cell/ml) and with high (> 600,000 cell/ml) SCC. The milk was submitted to three treatments to obtain Prato cheese: (1) from milk with low SCC and clotting time of 35 minutes; (2) from milk with high SCC and clotting time of 35 minutes; and (3) from milk with high SCC and adjusted clotting time. The cheeses were evaluated after 5, 12, 19, 26, 33, and 40 days of ripening, according to pH, moisture, total nitrogen, soluble nitrogen at pH 4.6 and at 12% TCA, and texture and eletrophoretic profiles. The ratios of width (SNpH4.6/TN*100) and depth (SN-12%TCA/TN*100) of ripening were calculated. A randomized block design was used, with two factors: treatment (three levels) and storage time (six levels). The treatments affected significantly the pH, moisture and the ratios of

width and depth of ripening. The cheeses with high SCC showed the highest pH, moisture, and the most intense proteolysis, followed by the cheeses with high SCC and adjusted clotting time and lastly, those with low SCC. The ratios of width and depth of ripening increased significantly throughout storage time; however, they were not significantly affected by the interaction of the treatments and the storage time. The cheese with high SCC showed significantly less firmness than the cheese with low SCC and the cheese with the high SCC and adjusted clotting time; these last two did not differ between themselves. The firmness of all the cheeses decreased significantly throughout ripening. The cheeses with high SCC showed higher degradation of α_{S1}-casein. In short, the cheeses with high SCC, clotting time notwithstanding, showed higher pH and moisture, more intense proteolysis, and less firmness, which can compromise the typical sensorial quality of the product.

Acknowledgements: FAPESP-Fundação de Amparo à Pesquisa do Estado de São Paulo, SP, Brazil.

Key Words: Somatic Cell, Proteolysis, Firmness

574 Effect of mixing speed during manufacture and type and level of emulsifying salt used on the microstructure of process cheese. R. Kapoor*, S. K. Garimella Purna, and L. E. Metzger, University of Minnesota, St. Paul.

A 2 X 2 X 3 factorial design was used to manufacture twelve process cheese foods (PCF) utilizing 12 different factor-level combinations including two levels of mixing speed during manufacture (low and high) and three levels of trisodium citrate (TSC) (2, 2.5 and 3% respectively) and di-sodium phosphate (DSP) (1.5, 2 and 2.5% respectively). All 12 PCF treatments were manufactured using a rapid visco analyzer. Microstructural analysis of the PCF manufactured was performed using Cryo-Scanning Electron Microscopy (cryo-SEM). The PCF samples were mounted onto copper holders and plunged into a liquid nitrogen slush at -207°C. The frozen samples were then fractured under vacuum and the fractured surface was freeze dried at -80°C for 5 min followed by gold coating. The gold-coated samples were then transferred to the cold stage of the cryo-SEM at -140°C and imaging was performed. Cryo-SEM images were collected in triplicate for each PCF treatment and were evaluated for the diameter (D), number of fat globules / 100 sq microns PCF surface (N) and distribution in fat globule diameter (FD). Mixing speed showed a significant effect on N, D and FD, with PCF made using high mixing speed showing a significantly higher N and a significantly lower D with a more uniform FD when compared to PCF made using a low mixing speed for both TCS and DSP treatments. Increasing the level of TSC and DSP showed an increase in the N and a decrease in D with a more uniform FD for the high mixing treatments. When similar levels (2% and 2.5%) of TSC and DSP treatments were compared with each other at the two mixing speeds individually, there was no significant difference in N, D and FD of the PCF on the basis of the type of emulsifying salt. Consequently, cooking conditions such as the mixing speed at which a process cheese is manufactured as well as the level of the emulsifying salt used for process cheese manufacture have a significant effect on process cheese microstructure.

Key Words: Process Cheese, Cryo-Scanning Electron Microscopy

575 Nutraceutical components of Pecorino Toscano cheese. M. Antongiovanni*[1], S. Rapaccini[1], A. Buccioni[1], M. Mele[2], A. Serra[2], and F. Petacchi[1], [1]University of Florence, Firenze, Italy, [2]University of Pisa, Pisa, Italy.

The acidic composition of milk fat is characterized by the presence of acids such as vaccenic (VA) and conjugated linoleic acid isomers (CLA), very important nutraceuticals to human health.

Three large samples of Spring bulk milk were collected and divided into subsamples: 3 sub-samples of raw milk (RM); 3 of pasteurised milk (PM, 73° C for 15 sec); 3 of PM added with ferments (PF). Fifteen sub-samples were made cheese from PF (according to the Pecorino Toscano disciplinary directions). The added ferments were selected Lactobacilli. Three cheese samples were analysed on the very day of cheese making, 3 at day 30 of ageing, 3 at day 60, 3 at day 90 and the last 3 at day 120 of ageing.

The levels of palmitic acid (PA), oleic acid (OA), myristic acid (MA) and VA in RM samples were 23.4, 16.7, 10.5, 3.4 mg/100g total lipids, respectively. CLA was quite high (1.6 mg/100 g total lipids), due to the Spring pasture grazing. Both the pasteurisation and the addition of ferments did not alter the composition of milk as well as of fresh cheese samples. The ageing process led to a slight decrease of both MA and PA after day 90 and day 120, respectively. The differences resulted statistically significant ($p<0.05$), but indeed very small. Actually, the levels of these two harmful acids did not increase with ageing. The same may be said for OA, slightly decreased at day 90. VA, linoleic acid (LA) and CLA remained steady throughout the ageing period.

Since the analytical procedure (Christie, 1982) allows the determination of esterified acids only, the slight decrease with ageing of the most abundant acids MA, PA, and OA, could mean that the lipolysis and oxidation processes were not so pronounced.

In conclusion, it is confirmed that the milk fat from grazing ewes contains appreciable amounts of nutraceutical fatty acids, particularly of CLA, and that this beneficial characteristic is maintained during both cheese making and cheese ageing, with little lipolysis and oxidation processes.

Acknowledgements: Research funded by Fondazione Ente Cassa di Risparmio di Firenze

Key Words: Sheep Cheese, CLA

576 Changes in sensory properties of Ragusano cheese from cows raw milk at different level of pastures. S. Carpino*[1], G. Marino[1], and G. Licitra[1,2], [1]CoRFiLaC, Regione Siciliana, Ragusa, Italy, [2]D.A.C.P.A. Catania University, Catania, Italy.

Our objective was to determine the influence that different level of pastures had on the sensory properties of Ragusano cheese. Sensory properties were studied on 24 samples of Ragusano cheese in spring 2004. The cheese milk was from three groups of cows on a farm sited at mountain level (ML) in the Hyblean region of Sicily. One group was fed only Total Mixed Ration (TMR) (ML0).The second group was fed TMR supplemented with 30% Dry Matter (DM) of native pasture (ML30).The third group was fed TMR supplemented with 70% DM of native pasture (ML70).Milk was collected 4 times with 15 d interval.Two blocks (14 kg each) of cheese were made from each batch of milk.The experiment was repeated 4 times, with 24 experimental cheeses produced, eight for each level of pasture. Twelve cheeses were aged at 4 mo and 7 mo at CoRFiLaC aging center in ventilated rooms at 14 to 16°C. Twelve trained panelists tested all the cheeses. Quantitative Descriptive Analysis was used to describe the cheeses.A score card ranging from 1 to 15 was used.Repeated measures Anova was used to determine the effect of different treatment.The overall odor intensity and pungency, characteristics of typical Ragusano good quality cheese, were higher ($P<0.005$) for the 4 mo ML70 cheeses.The consistency and mouth feel attributes such as smooth/rough, oily, plasticity, and piquancy were also higher ($P<0.005$) for the 4 mo ML70 cheeses.Intensity of floral odor attribute was higher ($P<0.005$) for the 4 mo ML30 cheeses showing that an integration of 30% DM of pasture is sufficient to have a good perceptible grade of floral odor from panelist.Panelists graded hardness and bitterness significantly higher ($P<0.005$) for the 4 and 7 mo ML0 cheeses. The ML30 results were compared with other cheeses produced contemporary on another farm for one group of cows fed TMR supplemented with 30% of pasture at sea level (SL30).Breed, milk production levels, and days in milk were similar for the two groups of cows ML30 and SL30.Sensory attributes of ML30 were scored significantly higher ($P<0.005$) than cheeses from SL30 suggesting that a higher altitude of the farm may influence sensory properties in cheeses.

Key Words: Cheese, Sensory, Pastures

577 Foodborne illness and antibiotic resistance: Types, sources and extent of problem. M. P. Doyle*, University of Georgia, Griffin.

The leading bacterial causes of foodborne illness and several other significant foodborne pathogens are largely associated with livestock and/or poultry as primary asymptomic carriers. Included are Campylobacter, Salmonella and enterohemorrhagic E. coli O157:H7. Recent reports by the Centers for Disease Control and Prevention of risk factors of sporadic infections in the United States attribute chicken and nonpoultry meat prepared at restaurants to 45% of Campylobacter infections, chicken prepared outside the home to 27% of Salmonella Enteritidis infections, and eating pink hamburger, visiting a farm with cows and living on or visiting a farm to 31% of E. coli O157:H7 infections. Manure from livestock and poultry is a primary vehicle for transmitting these pathogens, with cell numbers of 10^2 to 10^8 cfu/g frequently present in feces. Trends in antibiotic sensitivity and resistance of foodborne pathogens as determined by the National Antibiotic Resistance Monitoring System for Enteric Bacteria indicate for Salmonella between 1996 and 2001 an increase in pansusceptible isolates from 63% to 72%; however, the percentage of isolates resistant to eight or more antibiotics has increased from 0.3% in 1996 to 4% in 2002, largely due to the spread of multi-drug resistant Salmonella Newport. For E. coli O157:H7, 79% of isolates were pansusceptible in 1996 compared to 91% in 2001. For Campylobacter, 48% of isolates were pansusceptible in 1997 compared to 50% in 2001; however, resistance to ciprofloxacin has increased from 9.4% in 1998 to 14.7% in 2003, although methods for testing changed and may have affected the results.

Key Words: Foodborne Ppathogens, Antimicrobial Resistance, Salmonella

578 Ethical issues surrounding food-borne illness: Who is responsible? B. Rollin*, Colorado State University, Fort Collins.

Food-borne bacterial illnesses affect more than an estimated 76 million Americans each year. Many of these illnesses can be traced directly or indirectly to animal sources. Yet because of the nature of modern animal production practices the direct responsibility for safeguarding the public from food-borne illness remains nebulous. Are farmers, dairymen, transporters, feedlot operators, packers, or processors responsible for food-borne illnesses? Or is the consumer ultimately responsible for their own safety through proper in-home handling preparation and thorough cooking? With the consolidation of meat distribution, what responsibility do the retailers bear? What about chain and local restaurants? In this session, we will discuss who bears the ethical responsibility and what the role of each participant in the production chain should be. We will also discuss how these different segments need to work together to improve the safety of our food supply.

Key Words: Food Safety, Bioethics

579 Pathogen control in the field. What can we do to reduce pathogens entering the abattoir? T. Edrington*, T. Callaway, K. Genovese, R. Anderson, and D. Nisbet, USDA-ARS-SPA, Food and Feed Safety Research Unit, College Station, TX.

While the meat processing industry has made significant improvements in the handling and processing of animals at slaughter and continues to produce one of the safest meat supplies in the world, the system is not 100% effective at eliminating contamination by pathogenic bacteria. Large scale meat recalls continue to exact a heavy economic toll on the industry. It has been said that "strategies that reduce specific foodborne pathogens entering the abattoir could produce the most significant reductions in human exposures to the organism and therefore in related illnesses and deaths." A substantial amount of research has been conducted and continues to focus on eliminating pathogenic bacteria in the animal before it is presented for slaughter. Diet manipulation, vaccines, competitive exclusion, various feed additives, and antibiotics have all been employed with varying levels of success. Research with chlorate and other similar compounds have yielded promising results. Recent research involving modulation of the innate immune system as a means of controlling pathogen populations is providing interesting data. New bacteriophage research has likewise yielded important information regarding E. coli O157:H7. Additionally, a new hypothesis regarding the seasonality of E. coli O157:H7 has generated research with intriguing results and will be discussed in addition to the above research areas.

Key Words: Foodborne Pathogens, Preharvest Food Safety, E. coli O157:H7

580 Pathogen control during processing: What we can do to reduce pathogens in the processing plant. J. Sofos*, Colorado State University, Fort Collins.

In efforts to meet regulatory criteria and commercial specifications by reducing the incidence of pathogens such as Escherichia coli O157:H7, the meat industry employs decontamination processes such as animal washing, spot-cleaning of carcasses by knife-trimming or steam-vacuuming, and spraying, rinsing, or deluging of carcasses pre-evisceration, and before and possibly after chilling, with chemical solutions (e.g., organic acids, acidified sodium chlorite, trisodium phosphate, etc.), hot water or steam; most processors employ more than one of these interventions in sequence. While E. coli O157:H7 is the pathogen of major concern in fresh meat, Listeria monocytogenes has become a major food safety issue in ready-to-eat meat and poultry products. This happened following some major listeriosis outbreaks, which caused hundreds of illnesses and many deaths, as well due to frequent and highly publicized recalls of potentially contaminated products. These developments have alerted the industry, regulators, public health authorities and researchers to develop and establish effective controls for the pathogen. Results of studies have shown that heat, steam, high pressure, or inclusion of antimicrobials (acetates, diacetates, lactates, benzoates, sorbates, glucono-delta-lactone, nisin and their combinations at reduced concentrations) in the formulation or their application as dipping solutions after product slicing and before packaging are effective L. monocytogenes controls in ready-to-eat meat products contaminated after cooking. These approaches may be useful to the industry in its efforts to select and employ alternative post-lethality controls as required by regulation. The overall microbiological status of products reaching consumers, either as raw meat or ready-to-eat items, depends on the extent of exposure to contamination and its control during all steps of the food production, processing, distribution, storage, retailing and preparation for consumption chain. Proper application of the processes described above will yield products that should be safe for consumption following proper cooking and serving.

Key Words: Meat, Safety, Pathogens

581 The economics of pathogen control in the meat industry: Who is going to foot the bill? R. Huffman*, American Meat Institute Foundation, Washington, DC.

The United States has one of the safest food supplies in the world. During recent decades, the safety of meat products has improved dramatically. Yet each year the 5 most common food-borne pathogenic bacteria cost the United States economy more than $6.9 billion according to the USDA Ã¢â‚¬â€œ Economic Research Service. Over the past 20 years, the beef industry has invested more than $2.5 billion in control strategies against E. coli O157:H7 alone. The implementation of mandatory Hazard Analysis Critical Control Point also came at a significant cost to the meat industry. These major investments in meat safety initiatives underscore the fact that the meat industry takes the issue of public health and safety very seriously. However because of the segmentation of the meat industry, it has been difficult to truly assess costs of pathogen control. To

date, in-plant strategies are the primary means used to achieve pathogen reduction in the supply chain, and these costs are borne almost entirely by the packing sector. As on-farm strategies for pathogen control are explored questions about cost have arisen. Who is going to pay for on farm, in feedlot, in transit, in lairage, or further intervention strategies? These are difficult questions to answer, but will be discussed in this session.

Key Words: Food Safety, Economics

Goat Species: Educational Resources and Field Experiences to Enhance and Promote Goat Production and Management

582 Fitness indicators among Boer, Kiko, and Spanish does managed on pasture in central Tennessee. R. Browning, Jr.*, T. Payton, B. Donnelly, P. Pandya, M. L. Leite-Browning, W. Hendrixson, S. Kebe, and M. Byars, IAgER-Tennessee State University, Nashville.

Boer (BR; n = 42), Kiko (KK; n = 38), and Spanish (SP; n = 47) straightbred does representing a broad base of within-breed genetic lines were managed together on pasture from September 2003 to August 2004. Three-quarters of each breed were mated in October and the remainder bred in December. Herd health records were analyzed by GLM or χ^2 for the 2003-2004 production year to begin assessing animal fitness under the prevailing production environment. Does were treated for hoof scald and hoof rot upon observed lameness. The herd was not vaccinated for hoof rot. Breeds differed ($P < 0.01$) for lameness cases treated during the year. Boer required more ($P < 0.01$) treatments for lameness (1.77 ± 0.22 cases/doe) than SP (0.60 ± 0.22 cases/doe) or KK (0.47 ± 0.24 cases/doe). A higher ($P < 0.01$) frequency of BR (52.3%) required multiple hoof treatments per year compared with SP (19.2%) or KK (10.5%). Does were dewormed as a group in January (ivermectin) and individually at parturition (moxidectin). Does kidding in March were also dewormed as a group in June (moxidectin). Individual does presenting clinical symptoms of internal parasitism during the year received additional moxidectin treatments. Breeds differed ($P < 0.01$) for extra anthelmintic treatment. Additional dewormings were more numerous for BR (0.53 ± 0.09 cases/doe) than for SP (0.11 ± 0.09 cases/doe) or KK (0.07 ± 0.10 cases/doe). A higher ($P < 0.01$) frequency of BR (40.5%) received extra dewormings during the year compared to SP (6.4%) or KK (2.6%). Fecal egg counts (FEC) were determined on a random subset of does (19 BR, 15 KK, 18 SP) across kidding groups as kids approached 3 mo of age (June and August). Breed affected ($P = 0.04$) log transformed FEC with values higher ($P < 0.04$) for BR than for SP. Geometric mean FEC for BR, KK and SP were 606 ± 19, 307 ± 12, and 237 ± 9 eggs/g, respectively. Lower frequencies ($P < 0.01$) of BR does weaned kids at 3 mo (76%) and survived though the production year (79%) compared with SP (96%, 98%) and KK does (100%, 100%). Preliminary results suggest a difference among meat goat breeds for fitness under southeastern US conditions.

Key Words: Meat Goats, Breeds, Fitness

583 Goat sales and price patterns in West Virginia. D Singh-Knights*[1], D Smith[1], and M Knights[2], [1]West Virginia University, Morgantown, [2]The University of the West Indies, St. Augustine, Trinidad.

Sales of goat meat (chevon) in the Northeast US have increased continuously since the early 1980s. The production of goats is therefore a potentially profitable option for full-time and part-time farmers in the Northeast region. However, inadequate year round supply, low and fluctuating prices, as well as inconsistencies in meeting specific consumer preferences are thought to be limiting growth of the industry. The present study was aimed at determining factors affecting regional variations in prices and number of goats sold. Analysis of variance using the Generalized Linear Model (GLM) procedure of SAS (SAS Inst., 1985, NC) was conducted on goat sales transactions for 1999-2003 from auction markets in West Virginia and neighboring markets in Virginia and Pennsylvania. Sales transactions were analyzed to determine the effects of year, month, location, market class (selling weight and body condition) and their interactions on price and number of goats sold. The number of goats sold during 1999-2003 varied with class of goat, month, year and class within months and years (Month, Class, Month X Class, Year, Year X Class, $P < 0.01$). There was a significant interaction between class of goat and month on prices received (Month X Class, $P < 0.01$) probably reflective of shifting consumer preferences throughout the year associated with specific ethnic holidays. Significant increases in sale of goats occurred over the period 1999-2003 driven by increasing prices and possibly increasing demand. It is suggested that the monthly variations in both prices and number of animals sold is probably reflective of both seasonal nature of reproduction and seasonal demands associated with ethnic holidays. The results of this study can be used by individual producers or extension educators to evaluate production and marketing options in an effort to enhance revenue generation by goat producers in West Virginia (WV) and surrounding areas.

Key Words: Goat, Prices, West Virginia

584 Formation of the Missouri Boer Goat Association. E. Walker*[1], S. Hamilton[2], and B. Watts[3], [1]Southwest Missouri State University, Springfield, [2]University of Missouri, Columbia, [3]Missouri Boer Goat Assocation, Springfield.

Over the past 20 years, the ethnic population living in Missouri has increased, which could be indicative of a growing potential market for goat meat. Missouri has a high potential for multiple-use land since pastures consist of a variety of grasses, forages, and browse. Missouri is centrally located in the United States and could provide goat carcasses to Midwestern cities possessing a growing cultural base of potential goat consumers. Missouri, with its diverse land, a growing interest in goat production by producers, and close proximity to several large cities, could prove to be a major goat producing state. Missouri goat producers face challenges that goat producers face nationally including: negative perceptions of other livestock producers, lack of farm supply stores which sell goat-related products, lack of information on goats, and lack of marketing strategies. For these reasons, Boer goat producers in Southwest Missouri came together to form The Missouri Boer Goat Association. While other goat associations do exist within the State, none exist specifically to promote the Boer Breed. The overall goal of the association is help producers with goat production challenges and educate people as to the potential benefits of raising either purebred Boers or raising goats which are Boer influenced. Over 70 people from all over the State attended the first open association meeting. Meetings will occur quarterly and meeting topics will relate to the current or projected needs of the industry. Our next meeting will coincide with a goat show and sale. Congruently, the association will also host a showmanship and selection workshop for 4-H and FFA members. We have also developed a PowerPoint presentation which is available to our members so that they may promote the Boer breed. A website will be hosted by the Missouri Boer Goat Association. The unofficial slogan of the Missouri Boer Goat Association is “Boer: the beef goat of the future”, as that is the image we wish to convey.

Key Words: Missouri, Boer, Goat

585 Using the internet to extend the reach of small ruminant extension programs in Maryland. S. Schoenian* and C. Fritz, University of Maryland Cooperative Extension, Keedysville.

According to the UCLA Internet Project, 71 percent of Americans used the Internet in 2002. Seventy percent ranked the Internet as their most important

source of information. The 2002 Census of Agriculture showed that 50 percent of farmers have Internet access. The Maryland Small Ruminant Page (sheepandgoat.com) was created in 1998 as an information portal for sheep and goat producers. In addition to containing a comprehensive library of links organized by subject matter, the web site highlights Maryland Extension programs and contains original newsletters, fact sheets, and images. One hundred percent of the respondents to a 2003 online survey (n=35) indicated that they found information on the Maryland Small Ruminant Page that helped them manage their sheep and goat enterprises; 95 percent of respondents credited the web page with saving them money or increasing their profits. The Maryland Sheep & Goat Directory (www.smallfarmsuccess.info/sheepandgoat.cfm) was created in 2003 to help sheep and goat producers sell their breeding and slaughter stock and other products and to help buyers locate the same. Many producers have credited the directory for helping them to make sales. Sheepgoatmarketing.info is being developed as a national resource for sheep and goat marketing. It replaces sheepgoatmarketing.org created by the Northeast Sheep & Goat Marketing program at Cornell University. The new site will maintain its focus on the ethnic/religious markets for sheep and goats. The Maryland Sheep & Goat Directory will be merged with the producer directory of sheepgoatmarketing.info to create a national database of sheep and goat producers. Sheep101.info debuted in 2004 as a user-friendly resource for 4-H and FFA members, students, teachers, and beginning shepherds. The site uses simple language and images to illustrate the various topics and is updated regularly with new information and pages. Information contained on the sheep101 web site has been used by 4-H clubs and in classes for beginning shepherds. These four web sites serve different needs and target audiences, but share a common goal of expanding the reach of the Maryland Small Ruminant Extension Program.

Key Words: Sheep, Goats, Internet

586 Extension and teaching goat production in Mexico. S. Arbiza[1], M. Perez[1], and M. Huerta*[2], [1]Facultad de Estudios Superiores Cuautitlan, UNAM, Cuautitlan Izcalli, Mexico, [2]Universidad Autonoma Chapingo, Chapingo, Mexico.

Goat production in Mexico has an important economical, social, and environmental impact; however, there are limitations in teaching, research, and extension efforts. Part of these limitations arise from goat-specific taboos related to their nutitional habits and producer stereotypes. In some Mexican institutions, formal teaching about goats is conducted within a sheep and goat course, while in others it may be taught as an optional course. However, there are some universities from the North and Central regions of Mexico that have specialized faculty with well-designed undergraduate- and graduate-level courses on goats. These programs resulted from faculty training in Mexican and international institutions. Besides teaching, these faculty conduct goat research, and have presented their findings in 18 annual meetings of the Mexican Society of Goat Production. This research has generated information on goat production systems, and nutritional, reproductive, and sanitary management of goats for almost all the regions of Mexico, and comprises the core of the material taught in the goat courses. Practical aspects of goat courses should include milking, feeding, and reproductive management. Advanced courses should include processing of meat and milk products. Successful goat programs should have a good-sized herd, a strong research program, and a continuous training of teachers and researchers. Several extension programs have been implemented in the past, but most of them have failed. Some causes were: 1) lack of research on social, economical, or technological limitations; 2) specific rather than holistic approaches; 3) minimum involvement of goat producers; and 4) training of personal. Nevertheless, the involvement of producers, educational and research institutions, and government agencies will allow the implementation of good extension education programs on goats.

Key Words: Goats, Teaching, Extension

587 University strategies to solve problems in goat production. A. S. Juarez-Reyes and M. A. Cerrillo-Soto*, Universidad Juarez del Estado de Durango, Durango, Dgo, Mexico.

Arid and semiarid regions in North Mexico are recognized as having important potential for goat production. Nevertheless, several constraints affect the goat industry, mainly nutritional, managerial and animal health. Institutional programs in universities located in North Mexico are currently focusing in developing goat production courses. The aims of these courses are for the students to obtain not only an adequate theoretical knowledge but also to get involved in practical experiences. These practical hands-on situations will provide the students with a unique academic experience by giving them direct exposure to animal production. In this way, the students will have the opportunity to develop skills to deal effectively with the demands of improving meat production and livestock utilization. Under advisory guidance, students will also be responsible for conducting research and retrieving data on various aspects of goat production that ultimately will lead to a thesis to obtain their DVM degree. Working toward a DVM degree and a thesis also enables researchers and students to attend national and international meetings and submit the information to peer reviewed journals. However, concepts relating to goat product fabrication (cheese, candies, meat and skin) and product marketing are not included in the academic program but these ought to be considered. Finally, a permanent evaluation has to be conducted to ensure the quality of goat production courses taught. This evaluation should determine if the knowledge acquired is appropriate to help solving regional necessities.

588 A college-level, team-taught course on small ruminant production: Reflections on the status and trend of the goat and sheep industry in Louisiana and the Gulf Coast region. J. M. Fernandez*, J. E. Miller, B. M. Olcott, T. L. Dumas, P. E. Humes, J. M. Gillespie, K. W. McMillin, and R. A. Godke, Louisiana State University, Baton Rouge.

Small ruminant production in Louisiana generates approximately $2.6 million (2003). Over the past 25 years, sheep were the predominant small ruminant in Louisiana, primarily supplying the club lamb industry. Interest in the meat goat industry arose early in the 1990s with the importation of Boer goats. Now goat interest and numbers have overtaken sheep! In 1998, there were 724 producers raising 11,300 ewes, and 470 producers raising 6,900 does, whereas the latest figures show 7,460 ewes (and 570 producers) and 12,629 does (and 836 producers). Historically, LSU offered "Sheep Production" (ANSC 4086) during alternate Springs as one of four senior-level animal production courses. In the mid-1990s the name was changed to "Small Ruminant Production" to better reflect the increased emphasis on goat topics and materials; presently, it is about 50:50. The 3-h credit course consists of lectures and laboratory exercises, and has been taught in traditional and non-traditional (distance education) formats. The labs are held at the LSU Ag Center farms 6 miles from LSU. Each student is required to submit a globalization marketing project. Enrollments have ranged anywhere between 8 to 22 students (1992-2005), and are composed of traditional and non-traditional students, including many county agents. Graduate credit is available. The course is taught in a manner that provides useful, practical lessons that can be readily applied under sheep and goat production conditions common to the state and region. Indeed, the objective of the course — as stated in the catalog description — is to teach, "the theory and practice of management, breeding, and feeding of sheep and goats for production under southern conditions." This is accomplished utilizing a congenial and successful team-teaching effort that employs expertise available from across various disciplines and university units.

Key Words: Goats, Sheep, Teaching

589 Animal genetic resources of Indian subcontinent, their unique features and conservation. S. P. S. Ahlawat* and S. C. Gupta, National Bureau of Animal Genetic Resources, Karnal, Haryana, India.

Traditionally, India has been a mega bio-diversity centre and rearing of domesticated animals was practiced since time immemorial. Almost all the major livestock species including cattle, buffalo, sheep, goats, pigs, camels, horses, donkeys, yak and mithun are found in India. Apart from poultry, domesticated species of avian such as ducks, geese, quail, turkey, pheasants and partridges also exist in India. There are over 140 domesticate species, well documented and defined breeds, whereas per FAO watch list there are about 220 breeds. The existence of wild ancestral species of sheep like Ovis musimon, O. vignis, O orientalis, O.amon, wild goats like Himalayan Ibex, Himalayan Tahr, Nilgiri Tahr and Markhors, Wild Yaks(Bos mutus), Gaur (Bos gaurus), Red Jungle Fowl and Snow Partridges in natural habitat, further make this subcontinent a treasure of farm animal biodiversity. Conservation of all forms of life has been the ethos of human society in India since ancient times. The major basis of maintaining such a large bio-diversity was through the sustainable management of resources and their ecosystem. Further, this livestock genetic resource diversity has been the integral component of Indian agriculture. It is well documented that Indigenous livestock breeds are disease resistant to many tropical diseases, The greater heat and water scarcity tolerance make them ideal germplasm for their wider use for production in hot and resource poor agroclimatic zones besides their rich gene pool for introgression in high producing breeds from developed countries. In this paper, an overview of all the available germplasm of farm livestock and poultry species and breeds available and sustaining Indian agriculture for centuries, their production, reproduction and disease profiles has been discussed.

Acknowledgements: Authors thank the Indian Council of Agricultural Research for funding of the project.

Key Words: Indigenous Lvestock, Disease Resistant, Conservation

590 Relationships between chemical composition and in vitro volatile fatty acid profile of the diet consumed by range sheep. A. Cerrillo-Soto*, K. Landa-Salas, G. Nevarez-Carrasco, R. Montoya-Escalante, and A. Juarez-Reyes, Universidad Juarez del Estado de Durango, Durango, Dgo. Mexico.

Samples from the diet consumed by sheep grazing in a semiarid region of North Mexico were used to study relationships between chemical composition and in vitro volatile fatty acid (VFA) profile. Dietary samples were collected using three esophageal fistulated sheep from a 100 head flock. The sampling was performed two days each month, from August 2002 to June 2003. The samples (200 mg DM) were incubated in calibrated 100 ml glass syringes using rumen fluid from two sheep fed alfalfa hay and concentrate (70:30) as inoculum. Incubations were terminated after 24 h for metabolizable energy (ME) and VFA estimations. The ME content was obtained as: ME (Mcal/kg) = 0.1456 (ml gas) + 0.07675 (CP %) + 0.162 (fat %) + 1.198. Volatile fatty acid determination was performed from syringe contents using gas chromatography. Data were analyzed by ANOVA according to a completely randomized design. Simple linear correlation coefficients between chemical composition and in vitro VFA production were computed by PROC REG (SAS). Mean values (% DM) for OM, CP, NDF, ADF, lignin, hemicellulose and cellulose were 80.0, 18.8, 54.0, 35.2, 13.7, 18.9 and 21.5, respectively and differed between months of sampling ($P<0.05$). The mean content of ME was 1.7 Mcal/kg. Concentrations of VFA were 37.5, 24.0, 6.1, 0.78, 4.02, 1.6 and 0.89 $mMol^{-1}$, for total VFA, acetate, propionate, butyrate, isobutyrate, valerate and isovalerate, respectively and were different among months ($P <0.05$). Negative correlations ($P <0.001$) were registered between lignin and total VFA ($r = -0.70$), acetate ($r = -0.67$), propionate ($r = -0.67$) and butyrate ($r = -0.75$). Negative correlations ($P <0.05$) were also recorded between FDA and total and individual VFA. Results indicated that the ME content of the diet selected by the animals did not meet their energy requirements most of the year. Negative correlations between cell wall constituents and total and individual VFA concentrations may indicate the negative effect these chemical compounds exert on the in vitro gas production.

Acknowledgements: Project financed by Fundacion Produce Durango, A.C. Support from PROADU (SEP-Mexico) is recognized

Key Words: Gas Production, Grazing, North Mexico

591 Meat production using crop residues from eight maize cultivars as feed for sheep. S. Fernandez-Rivera*[1] and S. Twumasi-Afriyie[2], [1]International Livestock Research Institute, Addis Ababa, Ethiopia, [2]International Maize and Wheat Improvement Center, Addis Ababa, Ethiopia.

Our hypotheses were: 1) maize cultivars differ in nutritive value of their stover as assessed by the amount of meat produced by sheep fed on these residues, and 2) the amount of meat produced by using maize stover as feed is not related to grain yield (GHA, kg/ha). Eight maize cultivars (four commercial hybrids and four open pollinated varieties) were planted in a randomized complete block design with three replicates. After grain harvest the stover (husk excluded) was evaluated as feed for sheep. Seventy-two male lambs (22.2±0.1 kg BW) were allotted by weight to cultivars and replicates and fed individually diets with 10.5% CP consisting of 80% stover and 20% supplement. After 90 d the sheep were slaughtered and the cold carcass (CC) weight was determined. The amount of meat produced per ha (MHA, kg CC/ha) was estimated from initial and final BW, ADG, CC dressing, stover DMI per animal and stover yield (SHA, kg DM/ha). Cultivars differed in GHA (1951-2798 kg/ha, SEM=240, $P\leq0.06$), SHA (1632-4442 kg DM/ha, SEM=404, $P\leq0.01$), stover NDF (599-684 g/kg DM, SEM=13, $P\leq0.01$), stover ADF (420-492 g/kg DM, SEM=10, $P\leq0.01$), stover DMI (44-54 g DM/kg $BW^{0.75}$, SEM=1.5, $P\leq0.03$), meat produced per lamb (8.8-10.3 kg CC/animal, SEM=0.3, $P\leq0.04$) and MHA (119-317 kg CC/ha, SEM=41, $P\leq0.07$). Ranking of varieties for CC did not correspond with that for MHA. GHA was correlated negatively with stover NDF ($r^2=0.17$, $P\leq0.05$), stover ADF ($r^2=0.14$, $P\leq0.07$) and meat produced per lamb ($r^2=0.17$, $P\leq0.05$). Stover DMI (g/kg $BW^{0.75}$) and stover ADF accounted ($P\leq0.01$) for 0.60 of the variation in ADG and 0.65 of the variation in meat produced per animal (kg CC). MHA was predicted from ADG (g/d) and SHA with the equation MHA = 2.991 (±0.683) ADG + 0.0341 (±0.0056) SHA, $R^2=0.95$, $P\leq0.01$. Developing dual-purpose (food and feed) maize cultivars needs to address potential tradeoffs between grain yield and stover nutritive value and exploit variation in stover nutritive value as well as in stover yield.

Key Words: Crop Residues, Maize, Sheep

592 Post tsunami disaster livestock development: Can the vulnerability be reduced? The case of Aceh, Indonesia. C. Wollny* and G. Tesfahun, Georg-August University, Goettingen, Germany.

The densely populated Indonesia's Aceh province was the most affected area with nearly 170,000 people reported dead and at least 1550 villages destroyed.

The magnitude of the devastations of the Tsunami is massive requiring international efforts to reconstruct and rebuild the livelihood base.

This paper is presents a conceptual framework to reestablish the livelihoods in Aceh with an investment on risk sensitive and quick return livestock production system. The frame conditions are characterised by large scale devastations of the infrastructure, chaotic short-term activities of all kind of aid organisations, political and economic instability and conflicting interests as well as a large number of traumatised people. Our fact findings missions showed that in the short-term immediate needs of the survivors such as building confidence and enterprise establishment are on focus whereas in the long-term agricultural systems development would be the main intervention.

Destruction of aquaculture and rice fields support a strong argument that livestock are among the few options for fast recovery. Poultry, cattle and goats among others were the most popular species before the quake. The paper is advocating a participatory approach and integration of the existing network of university alumni in Indonesia. The concept is build on the assumption that sustainable agricultural development requires well adapted livestock for re-stocking. Risk sensitive development of livestock production system is of key strategic importance and includes capacity building and training of farmers as well as stakeholder participation. The masterplan consists of a comprehensive 5-years plan of action ranging from introducing specific husbandry practices to reestablishing the livestock population through local breeds of the preferred species. The challenge offers opportunities for global partnerships.

Acknowledgements: The authors thank the postgraduate students of the Indonesian-German student association and the partners of the Faculty of Animal Science of IPB, Bogor, Indonesia for substantial input.

Key Words: Livestock Development, Disaster Management, Indonesia

Lactation Biology

593 Evidence of a role of prolactin in mediating photoperiodic effects during the dry period. H. M. Crawford*[1], J. L. Dauderman[1], D. E. Morin[1], T. B. McFadden[2], and G. E. Dahl[1], [1]University of Illinois, Urbana, [2]University of Vermont, Burlington.

Short day photoperiod (SDPP) during the dry period increases milk production in the subsequent lactation relative to long day photoperiod (LDPP). In addition we have observed that SDPP improves immune function during the transition compared with LDPP. Our hypothesis is that mammary and immune responses under SDPP result from increased prolactin (PRL) sensitivity. In the present study our objective was to determine if exogenous PRL administered to cows on a SDPP would cause production and immune responses to be similar to those of cows on LDPP. To test this we assigned 24 multiparous Holstein cows to one of three treatments during their dry period: LDPP (16L:8D), SDPP (8L:16D), and SDPP+PRL (SDPP and recombinant bovine PRL). In the SDPP+PRL group, 12mg/d of PRL was continuously delivered via subcutaneous osmotic minipump for the last 30 days of pregnancy to match circulating concentrations of the LDPP cows, yet maintain other photoperiod factors consistent with SDPP. During the dry period, weekly blood samples were taken to quantify PRL concentrations. Treatments ended at calving when all cows were moved to an ambient photoperiod and milked two times daily for the entire lactation. SDPP+PRL cows calved 5.5 d earlier than SDPP and LDPP cows ($P<0.11$), resulting in 21 d of PRL treatment prior to calving. DMI as a percentage of body weight did not differ between LDPP and SDPP for weeks -8 to -4, but for weeks -3 to 0 DMI was greater in SDPP cows than SDPP+PRL cows, but SDPP+PRL did not differ from LDPP. The periparturient PRL surge was 26.4, 29.5, and 36.3ng/mL for SDPP, SDPP+PRL, and LDPP. Milk production was inversely related to the periparturient PRL surge. Milk production through 120 d of lactation averaged 42.0, 39.5, and 35.8 kg/d for SDPP, SDPP+PRL and LDPP cows ($P<0.04$). There were no differences among groups in postpartum BW or DMI, or prepartum BW. These results support the concept that circulating PRL during the dry period is inversely related to subsequent milk yield.

Key Words: Dry Period, Prolactin, Photoperiod

594 Lactational effects of the dry off period in dairy goats. A. A. K. Salama, G. Caja*, X. Such, E. Albanell, and R. Casals, Universitat Autònoma de Barcelona, Bellaterra, Spain.

Seventeen Murciano-Granadina multiparous dairy goats, milked once daily throughout lactation, were used to study the effects of the dry off period on the following lactation. Goats were impregnated at 210 DIM and assigned to two experimental groups at 300 DIM. Treatments were: 1) D56, dried off for 56 d before the expected kidding (n = 9); and, 2) ND, not dried (n = 8). Milk yield was recorded weekly during the preceding (561 ± 22 L/goat) and the following lactation. Five goats (63%) in the ND group dried off spontaneously at d 27 ± 4 before kidding and were considered as a separate group (D27; n = 5). Kids were weighed at parturition and removed before sucking. Colostrum samples were taken for milk components and IgG analysis. Mammary biopsies were taken at 280 DIM in the preceding lactation, d 7 after drying off (D56 group only), and d 49 in the following lactation (all groups). Apoptotic and proliferating cells were detected immunohistochemically by TUNEL and PCNA assays, respectively. Litter size (2.25 kids/goat) did not vary between groups, but ND kids had lower birth weight (1.7 kg; $P < 0.05$) than D56 (2.1 kg) and D27 (2.2 kg). Colostrum of ND goats contained lower IgG (5.6 mg/ml; $P < 0.001$) than D56 (42.4 mg/mL) and D27 (32.9 mg/mL) goats. In the following lactation (210 DIM), ND goats produced less milk (1.66 L/d; $P < 0.05$) than D56 (2.32 L/d) and D27 (2.45 L/d) goats. Comparing d 280 (late lactation) with d 7 after dry off (involution) in D56 goats, an increase in apoptosis (0.51 to 1.75%; $P < 0.06$) and proliferation (2.09 to 7.12% $P < 0.05$) of the mammary tissue was observed. At d 49 of the following lactation there were no differences between groups in apoptosis (0.71, 0.68 and 0.65%) or proliferation indices (2.95, 1.37 and 2.48%) for D56, D27 and ND, respectively. These results indicate that the length of the dry off period (27 or 56 d) did not affect mammary cell turnover in the following lactation. Omitting the dry period reduced colostrum quality and milk yield in dairy goats. Goats which spontaneously dried off for approximately one month were as productive as the goats that dried off for approximately two months.

Key Words: Apoptosis, Mammary Involution, Milking Frequency

595 Effects of milking interval on hourly milk secretion rate in goats. G. Pulina*, S. Fancellu, G. Battacone, and A. Nudda, University of Sassari, Sassari, Italy.

The effects of milking interval on secretion rate of milk, fat, protein, casein, lactose and fatty acids (FA) in dairy goats were investigated. Twenty Saanen lactating goats in mid lactation were used in a 4x4 Latin Square experimental design with 5 replications. Goats were allocated in four milking interval treatments: 3, 6, 12 and 24 hours after receiving at the morning milking (0 hr), i.v injection of 1 IU of oxytocin to remove residual milk. The goats were machine milked and stripped by hand. Milk yields were recorded and milk samples were collected at each milking. A regular twice daily milking (12 hr interval) was restored between each experimental period. The hourly secretion rates of milk, fat, protein, casein, lactose and FA were calculated. The hourly secretion rates of milk and lactose decreased up to 3 hr ($P<0.05$). The fat content is the milk component mostly affected by prolonged milking interval, decreasing linearly as milking intervals increased. The hourly secretion rate of FA does not seem to have a defined trend.

Secretion rate (g/hr) with different milking intervals

Milking Interval (hr)	Milk	Fat	Protein	Casein	Lactose
3	99 a	3.5 a	2.8	1.9	4.5 a
6	84 b	3.2 ab	2.5	1.7	3.8 b
12	87 b	3.0 bc	2.5	1.8	4.0 ab
24	82 b	2.4 c	2.4	1.7	3.7 b
P	0.013	0.002	0.063	0.110	0.022
P	0.013	0.002	0.063	0.110	0.022

a,b,c P£0.05

Acknowledgements: Research funded by FISR project (MIUR and MIPAF).

Key Words: Dairy Goat, Milking Interval, Milk Secretion Rate

596 Induced lactation in 15-month-old heifers: production, health and survival. R. S. Kensinger*, A. L. Magliaro, R. Graboski, P. R. Tozer, M. L. O'Connor, and L. D. Muller, Pennsylvania State University, University Park.

The costs of raising replacement heifers are large and significantly impact dairy farm profitability. The present study determined the health and productivity of Holstein heifers (n = 31) induced into lactation at 15 mo of age (BW of 427 ± 41 kg), as well as their lactational response to treatment with somatotropin (bST). Heifers were given daily sc injections of estradiol-17B and progesterone (75 and 250 ug/kg/d, respectively) on treatment d 1-7, and milking commenced on d 18. On d 25 ± 7 of lactation heifers were randomly assigned to control or bST treatment groups, and milk production was compared over the next 70 d (d 25-94 of lactation). After d 94 all heifers were treated with bST. Milk yields increased gradually and peaked at 22.7 kg/d at d 175 of lactation. Milk protein, fat and lactose averaged 17.9, 1.2 and 2.3 % on day 1 of milking and changed to 3.6, 4.6 and 5.1 %, respectively, by day 21 of milking. Milk yield of heifers treated with bST (17.9 kg/d) was greater than that of controls (15.6 kg/d) from d 25-94, but composition was not affected. Heifers induced into lactation averaged 301 DIM and produced 5,329 kg milk with 3.68 % fat and 3.35 % protein while gaining an average of 0.7 kg BW/d. Induced heifers conceived with 1.81 services/conception, averaged 102 d open, and had their first calving at 27.9 mo of age. Induced heifers were compared to a similar aged peer group (n = 31) that was not induced. Induced animals were older at first calving than peers (24.5 mo). Body condition scores at calving and calving ease scores were similar between the groups, but % calf mortality was lower for induced heifers. Survival analysis after 76 mo indicated that induced heifers left the herd at an earlier age but had a similar productive life compared to peers. Young heifers induced into lactation were healthy, grew normally, produced reasonable amounts of milk with normal composition, had good reproductive performance, and had similar productive lives relative to conventionally raised heifers.

Key Words: Induced Lactation, bST, Heifer

597 Leptin alters albumin synthesis in the bovine mammary gland. Y Feuermann[1,2], S. J. Mabjeesh[2], and A Shamay*[1], [1]Agriculture Research Organisation The Volcani center, Bet Dagan Israel, [2]The Hebrew University of Jerusalem, Rehovot, Israel.

At the late 70th Phillippy and McCarthy had published a work named "Multi-origins of milk serum albumin in the lactating goat" this work showed the first evidence that albumin can be synthesized by the mammary gland in ruminants. Lately we have established the fact that albumin is synthesized in the bovine mammary gland by performing de novo synthesis of albumin in bovine mammary gland primary explants culture. We showed that albumin synthesis is altered by mastitis in the bovine mammary gland. Albumin is a 68-kDa multifunction protein that can regulate a number of physiological functions. Some publications demonstrated the anti-apoptotic effect of albumin in cell system such as human endothelial cell line and murine peritoneal macrophages. The extensive lactation performance of the "modern cow", due to advance genetic selection is accompanied with advanced apoptotic process. Resent studies in our lab established the ability of leptin to up regulate lactation performance in bovine. Our findings that albumin is synthesized by the mammary gland and the effect of leptin on the bovine mammary gland, led us to investigate the relationship between leptin, lactation and albumin. We found that leptin can up regulate mRNA expression of albumin in bovine mammary gland explants and we also demonstrated the same effect on albumin secretion (preformed by western blot). The results showed that leptin can up regulate the expression and secretion of albumin in the bovine mammary gland explants but the up regulation is more significant when leptin was introduced together with prolactin. Based on this finding we examined the effect of leptin combined with prolactin on proliferation and other cell maintenance parameters, the results showed the same trend.

Key Words: Leptin, Albumin, Mammary Gland

598 Effects of continuous milking (CM) and prostaglandin E_2 (PGE_2,) on mammary gene expression in dairy cows. E. L. Annen*[1], P. C. Gentry[1], R. Sprissler[1], D. L. Hadsell[2], A. V. Capuco[3], and R. J. Collier[1], [1]University of Arizona, Tucson, [2]Baylor College of Medicine, Huston, TX, [3]USDA-ARS, Beltsville, MD.

First and second lactation cows (n=8) were utilized in a half udder model in which one half was dry 60 d (CTL) and the other half CM. Udder halves (n=16) were assigned a postpartum (PT) treatment of + or - PGE_2 (875 μg) by intramammary infusion at calving and 72 h PT. Tissue samples were obtained at 3 and 7 d after milk stasis of the CTL udder half and at 2 and 4 d PT. In CTL halves, mammary epithelial cell (MEC) growth was greater at 7 d of milk stasis and apoptosis was elevated at 3 and 7 d of milk stasis. PT MEC growth was increased in CM halves, but apoptosis was similar in CM and CTL tissue. PT milk yield was reduced in CM halves. Milk yield and MEC turnover was unaffected by PGE_2. RNA pools were created for prepartum (PP) and PT timepoints for each udder half. We evaluated expression of adenosine 5′-triphosphate binding cassette 1 (ABC1, stem cell marker), α-lactalbumin (α-lac, lactose synthesis) bax (apoptosis), bcl_2 (survival), CCAT/enhancer binding protein-β (CEBP-β, mammary growth); insulin-like growth factor binding protein 5 (IGFBP5, apoptosis); kinase inhibitor protein p27 (p27, cell cycle arrest). The housekeeping gene, 18S, was not changed by any of the treatments or interactions. PGE_2 did not alter gene expression. Involution of PP CTL tissue was associated with decreased ($P < 0.02$) α-lac expression, and increased expression of bax ($P < 0.05$) and IGFBP5 ($P = 0.07$) compared to lactating CM tissue. ABC1, CEBP-β, cyclin D1, p27, and bcl_2 expression were not changed in CM vs. CTL tissue. In PT tissue, α-lac expression was similar in CM and CTL tissue and ABC1 and IGFBP5 expression were increased ($P < 0.05$) in CTL tissue compared to CM tissue. Results demonstrate MEC apoptosis during involution of CTL tissue was regulated by bax and IGFBP5. Results for PT expression of IGFBP5 and ABC1 warrant further investigation on the role of IGFBP5 in PP apoptosis in CTL tissue and the role of the dry period on ABC1 expression and mammary stem cell renewal.

Key Words: Continuous Milking, Gene Expression

599 Effects of continuous milking (CM) and bovine somatotropin (bST) on mammary gene expression in primiparous cows. E. L. Annen*[1], P. C. Gentry[1], R. Sprissler[1], D. L. Hadsell[2], A. V. Capuco[3], and R. J. Collier[1], [1]University of Arizona, Tucson, [2]Baylor College of Medicine, Huston, TX, [3]USDA-ARS, Beltsville, MD.

Primiparous cows (n=8) were used in a half udder model in which one half was dry 60 d (CTL) and the other half was CM. Cows were assigned to + (n=4) or - bST (n=4) treatment. Tissue was sampled at 20 and 8 d prepartum (PP) and 1, 7, and 20 d postpartum (PT). Mammary epithelial cell (MEC) proliferation was increased PP compared to PT timepoints, but was 50% lower in CM tissue vs. CTL tissue at d -8. MEC apoptosis was elevated through d 7 PP in CTL tissue, but only to d 1 in PP CM tissue. Milk yield was reduced 53% in CM halves.

MEC turnover and PP milk yield was not altered by bST. Real-time RT-PCR analysis of genes regulating cell turnover or milk synthesis included: adenosine 5′-triphosphate binding cassette 1 (ABC1, stem cell marker), α-lactalbumin (α-lac, lactose synthesis) bax (apoptosis), bcl_2 (survival), CCAT/enhancer binding protein-β (CEBP-β, mammary growth); insulin-like growth factor binding protein 5 (IGFBP5, apoptosis); kinase inhibitor protein p27 (p27, cell cycle arrest). RNA pools were created for PP and PT timepoints for each udder half. Expression of 18S (housekeeping gene) was not changed ($P > 0.10$) by dry period length (DP) or bST. We failed to detect an effect of bST on expression of any of the genes evaluated. PP α-lac expression was increased 27-fold in CM tissue compared to CTL. During the PT period, α-lac expression was similar between CM and CTL tissue. ABC1, p27, bax, and IGFBP5 were not affected ($P > 0.1$) by DP treatment (CTL vs. CM) or gestation status (PP vs. PT). Cyclin D1 and CEBP-β expression were greater ($P < 0.03$) during the PP period than PT period, but were not affected by DP length. Expression of bcl_2 was increased ($P < 0.05$) 2.6-fold in PP tissue compared to PT tissue. Results indicate that late-gestation mammary development may be regulated by CEBP-β, cyclin D1, and bcl_2. Differences in milk yield and morphology between CM and CTL tissue were not represented in expression of genes evaluated in this study.

Key Words: Continuous Milking, Gene Expression

600 Effects of heat stress on morphology and gene expression of bovine mammary epithelial cells (BMEC) in collagen gel culture. C. Stiening[1], J. Hoying[1], M. Ben Abdallah[1], P. Coussens[2], and R. Collier*[1], [1]University of Arizona, Tucson, [2]Michigan State University, East Lansing.

Primary BMEC embedded in collagen gels were cultured at 37C (thermal neutral: TN) for seven days in a serum-free medium; a subset were then exposed to thermal stress (TS) at 41.5C for up to 24 hr. Growth was estimated by fluorometric DNA quantification at -24, 0, 8, 16 and 24 hr relative to TS initiation. Over the 48 hr period, net growth was unchanged in TS cultures, compared to a 4-fold increase in TN cultures. Analysis of Hsp70 (inducible) gene expression by RT PCR over the first 24 hr was used to determine temporal pattern of the TS response. Relative Hsp70 transcript levels remained low at 0, 15, 30 and 60 minutes of TS. A dramatic up-regulation occurred between 1 and 2 hr, and peaked between 2 and 4 hr; expression levels returned to near baseline by 8 hr. Replicate samples were collected at 1, 2 and 4 hr from both TS and TN cultures for global gene expression analysis using the NBFGC bovine cDNA microarray from MSU. Over 400 genes were identified as differentially expressed in TS BMEC. Genes involved in trafficking (ligatin) and remodeling (cofilin), as well as TS-responsive genes (HSPs, CLK1, BAG3) were among the most significant up-regulated genes. Downregulated genes included those involved in glycolysis (PFKs), peptide metabolism (DNPEP), and cell morphology (S100A1 and utrophin). Also of interest were a large number of differentially expressed genes related to G-protein signaling. Confocal microscopy of collagen whole mounts stained with phalloidin and Hoechst dye 33258 indicated a dramatic reduction of the prominent, complex networks of stellate-like ductal structures in TN to small, spherical masses within 24 hr of TS. Together, these data suggest an acute shift in intracellular trafficking and gene expression, including a down-regulation of biosynthesis and up-regulation of stress-response genes, leading in part, to a dramatic remodeling of the cytoskeleton following TS.

Key Words: Heat Stress, Mammary, Microarray

601 A proteomic approach to evaluate the effects of body weight and plane of nutrition on protein expression profiles of mammary gland extracts from Holstein heifers. K. M. Daniels*[1], K. E. Webb, Jr.[1], M. L. McGilliard[1], M. J. Meyer[2], M. E. Van Amburgh[2], and R. M. Akers[1], [1]Virginia Polytechnic Institute and State University, Blacksburg, [2]Cornell University, Ithaca, NY.

Biochemical and cellular mechanisms governing alterations in heifer udder development are poorly understood relative to prepubertal feeding and animal performance. Mammary development in dairy heifers was characterized with the use of proteomics, which is the study of the complete set of translated proteins in a biological sample. A 2 x 2 factorial experiment generated two-dimensional protein maps of mammary tissue extracts from heifers (n = 24) that were reared on one of two dietary treatments (Moderate (M) 650 g/d or High (H) 950 g/d of daily gain) and slaughtered at one of two body weights (BW, 200 or 350 kg). Cytosolic mammary gland extracts were prepared from frozen mammary parenchyma and used in two-dimensional PAGE analysis. Proteome maps of extracts were constructed using PDQuest software. Densities of 820 total protein spots were analyzed using the Mixed Procedure of SAS. Selected individual proteins were identified by changes in profiles of expression in response to increased BW and/or dietary treatment. Dietary treatment differed the expression of 131 protein spots; the expression of 108 spots differed by heifer BW. The 22 most significant spots were excised and submitted for mass spectrometry analyses. Returned protein names and accession numbers were used in NCBI database searches to obtain information on the identified proteins. For example, one of the proteins that differed by dietary treatment, transferrin, a binding protein (BP) of insulin-like growth factor BP-3, was identified via these methods. Possible roles of this and other proteins in mammary development were described. Validation assays are ongoing. Proteomic approaches are effective for the identification of proteins involved in bovine mammary development.

Key Words: Heifer, Mammary, Proteome

602 Inhibitory activity of bovine milk fat globule membrane against sialic acid-dependent and -independent strains of rotavirus. K. Ochonicky*[1], S. Donovan[1], T. Kuhlenschmidt[1], R. Jimenez-Flores[2], and M. Kuhlenschmidt[1], [1]University of Illinois, Urbana, [2]Dairy Products Technology Center, San Luis Obispo, CA.

Milk fat is encapsulated in a milk fat globule membrane (MFGM) that has associated with it glycoproteins, complex carbohydrates and bioactive lipids. Rotavirus (RV) is the most common cause of diarrhea in human infants and also affects calves and piglets, with the greatest incidence at weaning. Anti-RV activity of human and bovine MFGM occurs in vitro and has been attributed primarily to its glycoprotein (lactadherin) and complex carbohydrate (MUC1) components. In the present study, the anti-RV activity of an organic extract of bovine MFGM was tested. MFGM enriched in polar lipids was prepared from buttermilk (MFGM-B) and cheese whey (MFGM-C) by microfiltration and supercritical fluid extraction and lipid extracted using the Svennerholm method. Whole MFGM and the organic extract were compared against sialic acid dependent (porcine OSU) and sialic acid independent (human Wa) RV strains in MA-104 cells using a virus focus forming infectivity (FFU) assay. Dose dependent anti-RV activity was observed for whole MFGM-B and MFGM-C against both Wa and OSU RV strains ($P<0.05$). The % inhibition of OSU was greater ($P<0.05$) than Wa for both MFGM-B (94 ± 7.6 vs. 50± 2.8) and MFGM-C (79 ± 8.5 vs. 67 ± 3.5). The primary mechanism of RV inhibition by whole MFGM may be related to its protein and carbohydrate components, as these differed between MFGM-B and MFGM-C. The MFGM lipid extracts from both sources inhibited infectivity of OSU RV to a similar degree and in a dose dependent manner dependent (53 - 87% inhibition) ($P<0.05$). In contrast, lipid extracts were less effective inhibitors of Wa strain RV. In summary, whole MFGM was more effective against sialic acid dependent RV and differed between buttermilk and cheese whey sources. MFGM lipid extracts inhibited sialic acid dependent RV independent of MFGM source. These data suggest that whole MFGM and lipids isolated from MFGM inhibit RV by different mechanisms.

Key Words: Milk, Fat Globule Membrane, Rotavirus

603 Inhibitory effects of human and porcine milk oligosaccharides on sialic acid dependent and sialic acid independent strains of rotavirus. K. Ochonicky*, S. Donovan, T. Kuhlenschmidt, and M. Kuhlenschmidt, University of Illinois, Urbana.

Milk oligosaccharides have been proposed to protect the neonate from intestinal pathogens. We have shown that porcine colostrum and milk contain 1.5 and

0.5 mg/ml of oligosaccharides (PMO), of which 50% is sialyllactose. Some strains for rotavirus (RV) require sialic acid for binding to enterocytes, thus we hypothesized that PMO would inhibit RV infectivity. To test this hypothesis, oligosaccharides were purified from defatted human milk (HMO), pig colostrum collected during parturition, and pig milk collected 3-10 days post-parturition by gel filtration. Samples were further subjected to protein A affinity chromatography to remove immunoglobulins. HMO and PMO were analyzed by HPAE chromatography on Dionex PA100 columns and found to yield distinctive oligosaccharide profiles. Purified HMO and PMO were assessed for their ability to inhibit infection of cultured MA-104 cells by human sialic acid independent RV (Wa strain) or porcine sialic acid dependent RV (OSU strain) using a focus forming unit assay. PMO and HMO were studied in a dose-dependent manner and data were expressed as the oligosaccharide dose required to inhibit RV infectivity by 50% compared to control. Approximately 1.32 mg/ml of purified HMO inhibited OSU strain RV infection by 50% ($P<0.05$), but did not inhibit infection by Wa strain RV. Similarly, 1.5 mg/ml of purified PMO from colostrum inhibited ($P<0.05$) infection by the OSU strain RV by 50%. In contrast, 2.5 mg/ml of purified PMO from mature milk was required to achieve a 50% inhibition ($P<0.05$) of OSU strain RV infectivity. No consistent inhibition of Wa strain RV by PMO was observed. In summary, a higher dose of mature milk PMO was required for an equivalent degree of RV inhibition obtained with HMO or colostral PMO. These data imply that changes in the PMO composition from colostrum to mature milk may confer differential protection from RV. Additional fractionation of PMO is ongoing and should yield isolated structures for further comparison.

Key Words: Milk, Oligosaccharides, Rotavirus

604 Glucose and histidine affect the phosphorylation state of translation initiation factor 2 in the bovine mammary gland in vivo. C. A. Toerien*, D. R. Trout, and J. P. Cant, University of Guelph, Guelph, ON, Canada.

In eukaryotic cells, nutrients activate the cell signalling cascades that regulate protein synthesis at the level of translation. Eukaryotic translation initiation factor (eIF) 2 is a major control point in translation initiation. Phosphorylation of the α subunit inactivates eIF2 and impairs ribosome loading onto mRNA. To identify nutrients that regulate eIF2 in the mammary gland, Holstein cows were fasted to decrease protein synthesis before re-supplying nutrients. In a 6x6 Latin Square design, cows (initial: 69±4 DIM; 43.4±0.5 kg milk/d) were subjected every 14 d to a 31-h fast. For the last 9 h of the fast, cows were infused iv with EAA+Glc (positive control), Glc, Met+Lys, His, Leu, or saline (Sal; negative control). Milk production response to infusion was calculated from milk produced in the front quarters between +1 and +7 h of the 9-h infusion. At +9 h, an approximately 1.5-g biopsy sample of mammary tissue was harvested from a hindquarter (HQ). In successive periods, HQs were alternated so that each HQ was allowed 28 d to recover. Relative to Sal, infusion of EAA+Glc and Glc increased ($P<0.05$) total protein yield by 40% and 36% respectively. The effect of His on protein yield equalled 52% of the effect of EAA+Glc, which is far greater than its 5% proportion in the EAA of the EAA+Glc infusate. The stimulatory effect of EAA+Glc, Glc and His on protein yield was accompanied by a dephosphorylation of eIF2α. Although infused in a smaller proportion of EAA+Glc, His elicited a similar level of eIF2α dephosphorylation to that of Glc. In conclusion, glucose and His, but not Met+Lys or Leu, regulate the phosphorylation state of eIF2α in the bovine mammary gland.

Phosphorylation of eIF2a

	Treatment (LSmeans±SE)					
Item	Sal	EAA+Glc	Glc	Met+Lys	His	Leu
Milk protein, g/6h	59^{a}±2.8	82^{b}±3.3	80^{bc}±3.2	67^{abc}±3.2	71^{abc}±3.2	61^{ac}±3
eIF2a(P), %*	99±11	73±10	49±12	95±12	51±11	84±12
eIF2a, %*	101±14	105±14	110±16	111±16	99.4±14	128±16
eIF2a(P), %†	22.6^{a}±2.4	11.5^{b}±2.4	8.6^{b}±2.7	13.4^{ab}±2.7	8.5^{b}±2.4	13.2^{ab}±2.7
Inclusion, %y			100	19.8	5	17.3

^{a,b,c} Significance ($P<0.05$); * of Sal when Sal was set to 100; † of total eIF2a; y of EAA+Glc infusate

Key Words: Milk Protein Regulation, Translation Initiation Factors, Nutrients

Physiology and Endocrinology: Effects of Maternal Nutrient Supply on Embryonic and Fetal Development and Postnatal Performance

605 Effects of maternal metabolic state and intra-uterine crowding on embryonic survival and fetal development in swine. G. Foxcroft*, J. Barry, W. Dixon, S. Novak, M. Vinsky, E. Putman, S. Town, G. Murdoch, A. Wellen, S. Terletski, and J. Patterson, University of Alberta, Edmonton, AB, Canada.

Maternal metabolic state has important effects on embryonic survival in the pig. A switch towards a less positive energy balance in the cyclic gilt, and increased tissue catabolism in the lactating and weaned sow, produce detrimental effects on embryonic survival. Endocrine and metabolic profiling during follicular development and use of in vitro maturation and fertilization techniques, suggest that both the follicle and the enclosed oocyte can be nutritionally imprinted. Inherent deficiencies in oocyte maturation are a primary cause of poor embryonic survival, increasing variability in fertilization rate and early embryonic development. Embryonic development is further confounded by adverse effects of metabolic state on steroid-dependent changes in secretory function of both the oviduct and uterus. Dynamic changes in the pattern of prenatal loss may also affect fetal development through naturally occurring intra-uterine crowding. Studies of commercial dam-line sows, suggest that selection for litter size has indirectly increased ovulation rates in higher parity females (>30 ovulations), and increased the number of conceptuses surviving to the post-implantation period. Increased uterine crowding around day 30 of gestation decreases placental size in all surviving conceptuses. In prolific Meishan sows, increased uterine crowding also reduces placental weight, but this is partly compensated by increased placental vascularity. In contrast, in white-line sows, such compensatory changers in placental efficiency are not evident and uterine crowding results in intra-uterine growth retardation (IUGR) and a decrease in the number of secondary muscle fibers in the fetus. Available evidence suggests that these effects on prenatal development will have significant negative effects on postnatal growth.

Key Words: Swine, Preantral Survival, Uterine Crowding

606 Pre-gestational ewe management systems alter the impacts of early maternal undernutrition on fetal growth and offspring quality. S. Ford*[1], M. Du[1], B. Hess[1], and P. Nathanielsz[2], [1]University of Wyoming, Laramie, [2]University of Texas, San Antonio.

This study investigated if the management system a ewe was selected under alters the impacts of maternal undernutrition on fetal growth and offspring quality. Range ewes normally experiencing limited nutrition from Baggs, WY (Baggs ewes) maintained normal fetal weights when subjected to nutrient restriction (50% NRC requirements; NR) from day 28 to 78 of gestation. In contrast, ewes of similar breeding from the University of Wyoming flock (UW ewes), selected to a sedentary lifestyle and above adequate nutrition, exhibited a 30% decrease in fetal weight, under the same NR. The growth restricted fetuses of UW ewes exhibited bilateral cardiac ventricular hypertrophy, reduced kidney nephron numbers, and fewer secondary myofibers and smaller fasciculi in skeletal muscle than fetuses from control fed (100% NRC requirements; CF) UW ewes. The ability of NR Baggs ewes to maintain normal fetal weights was linked to an early placentomal conversion from Type A to more efficient Types B, C, or D by

day 78 of gestation. When NR UW and Baggs ewes were re-alimented from day 79 to term, size, viability and birth weights were similar for lambs born to NR and CF ewes. At 2 months of age, lambs born to NR UW ewes exhibited increased levels of glucose and insulin, before and after an i.v. infusion of 250 mg/kg glucose. By 8 months of age, these same lambs exhibited elevated glucose and a reduced insulin release to the i.v. glucose infusion. Further, lambs from NR UW ewes ate more, grew faster, were fatter and had markedly higher blood pressures at 9 months of age than lambs from CF UW ewes. To date, we have observed no differences in postpartum growth rate, insulin sensitivity or pancreatic function between lambs from NR and CF Baggs ewes. The abnormalities exhibited by the lambs born to NR UW ewes are consistent with a predisposition to health problems later in life such as obesity, type II diabetes, hypertension, and cardiovascular disease.

Key Words: Maternal Undernutrition, Sheep, Offspring Quality

607 Timing of nutrient restriction and programming of fetal adipose tissue development. M. Symonds*, H. Budge, M. Gnanalingham, T. Stephenson, and D. Gardner, Centre for Reproduction and Early Life, Institute of Clinical Research, University Hospital, Nottingham, UK.

Timing of maternal nutrient restriction has pronounced effects on fat deposition and endocrine sensitivity in the growing fetus that primarily occur in the absence of any change in total fetal weight. Nutrient restriction targeted over the period of maximal placental growth in sheep, has no initial effect on fetal fat mass. However, at term after restoration of the maternal diet to the same level as controls, previously nutrient restricted offspring possess more fat with increased abundance of mRNA for insulin-like growth factors, the mitochondrial protein uncoupling protein 2, and peroxisome proliferator activated receptor γ. The sensitivity of this fat to glucocorticoids is also enhanced, as there is a parallel increase in mRNA abundance for the glucocorticoid receptor in conjunction with an increased capacity to synthesise cortisol and a reduced ability to inactivate it via 11-β-hydroxysteroid dehydrogenase types 1 and 2, respectively. These adaptations in cortisol sensitivity persist into later life and are paralleled by the large increase in fat growth that occurs after birth. Critically, fat deposition in offspring of nutrient restricted mothers is enhanced when they are maintained in an environment in which physical activity is significantly reduced. In contrast, maternal nutrient restriction in late gestation coincident with the period of maximal fetal growth results in reduced fat mass at term. These offspring, however, possess more fat at one year of age in conjunction with increased insulin receptor β subunit abundance and reduced glucose transporter-4 abundance. The maternal and therefore fetal nutritional environment has substantial effects on both immediate and later fat deposition that are mediated in part by changes in endocrine and metabolic sensitivity of adipose tissue. These adaptations can place the offspring at increased risk of excess fat deposition in later life, particularly when exposed to a sedentary lifestyle.

Key Words: Nutrient Restriction, Fetal Growth

608 Nutrient partitioning in the growing adolescent sheep: consequences for conceptus development. J. M. Wallace*, Rowett Research Institute, Aberdeen, UK.

When pregnancy coincides with the continued growth of the mother, the normal hierarchy of nutrient partitioning may be altered at the expense of the conceptus. Thus in human adolescents, the risks of spontaneous miscarriage, prematurity, low birth weight and neonatal death are particularly acute in young girls who are still growing at the time of conception. To investigate the underlying mechanisms and the consequences for the fetus we have nutritionally manipulated maternal growth in young pregnant sheep. Thus when singleton bearing adolescent sheep are overnourished to promote rapid maternal growth throughout pregnancy, growth of both the placenta and fetus is impaired relative to control-fed adolescents of equivalent age. Rapid maternal growth is also associated with increased spontaneous abortion rates in late gestation and, for ewes delivering live young, is characterised by a reduction in gestation length and in the quality and quantity of colostrum produced at parturition. Nutritionally- sensitive hormones of the maternal somatotrophic axis may orchestrate this alteration in nutrient partitioning. In rapidly growing adolescent dams, insulin and IGF-1 concentrations are high and promote a sustained anabolic drive to maternal tissue deposition (primarily of adipose tissue). In contrast, maternal GH concentrations are low and GH supplementation of overnourished dams alters maternal metabolism and enhances nutrient supply to the fetus in late pregnancy. By late pregnancy, placental mass in the rapidly growing versus the control dams is reduced by approximately 45%. These growth- restricted pregnancies are associated with major reductions in absolute uteroplacental blood flows and attenuated fetal nutrient uptakes. The resulting fetuses display asymmetric growth restriction and are hypoxic, hypoglycemic and hypoinsulinaemic. Counter-intuitively, indices of fetal adiposity are enhanced, while the ontogeny of prenatal reproductive development is perturbed in both sexes. These observations have implications for postnatal body composition and fertility respectively.

Acknowledgements: Funded by the Scottish Executive Environment and Rural Affairs Department.

Key Words: Pregnancy, Nutrition, Fetus

Ruminant Nutrition: Beef—Feedlot

609 Effect of cooked molasses block supplementation and flax on newly received calf performance. D. Larson*[1], M. Bauer[1], G. Lardy[1], and J. Stewart[2], [1]North Dakota State University, Fargo, [2]Tublicks, LLC, Wyndmere, ND.

One-hundred forty-four crossbred steers were used to evaluate the effect of supplemental cooked molasses blocks with and without flax on newly received calf health and subsequent performance. We hypothesized that calves would consume blocks, thereby, increase nutrient intake during periods of low feed intake which typically occur after weaning. Steers were assigned randomly to one of three treatments: control (C, no block), block without flax (WOF), and block including ground flax (WFA). Steers were assigned to pen (8 pens/treatment) as they exited the truck. Two-day weights were collected initially and every 2 weeks thereafter for 6 weeks. Calves were fed a diet consisting of dry rolled corn (48%), alfalfa/grass hay (30%), shredded beet pulp (20%), and a supplement (2%) formulated to contain a minimum of 12.5% CP, 0.60% Ca, and 0.30% P (DM basis). Steers were vaccinated for clostridial and viral diseases prior to arrival, given a viral booster, and given parasiticide upon arrival. Calves were allowed free access to their respective treatment blocks at all times. Block intake was determined by weighing the tub refusal upon replacement with a new tub. Data were analyzed using the MIXED procedure of SAS with treatment as the fixed effect. There were no differences ($P \geq 0.50$) attributed to treatment for the weights taken at arrival, days 14-15, 26-27, or at the conclusion of the trial. Nor was ADG (1.45±0.12 kg/day) different between treatments ($P = 0.70$). Daily DMI of the ration (7.93±0.43 kg/day) was not different among treatments ($P = 0.60$) and averaged 2.66% of body weight. Block intake (0.16±0.03 kg/day) was not different between WOF and WFA ($P = 0.32$). Gain to feed (0.18 ±0.01) was not different between treatments ($P = 0.56$). The number of calves treated per pen was not different among treatments ($P = .12$). For the calves used in this study, providing supplemental nutrients in the form of a cooked molasses block, with or without flax, did not improve animal performance or health.

Key Words: Flax, Beef Steers, Health

610 Effects of winter growing program on visceral organ mass and oxygen consumption in beef steers. M. McCurdy*[1], C. Krehbiel[1], G. Horn[1], and J. Wagner[2], [1]Oklahoma State University, Stillwater, [2]Continental Beef Research, Lamar, CO.

The purpose of this study was to investigate the effects of winter growing program on visceral organ mass and O2 consumption. A total of 46 steers were utilized for the experiment. Four steers were harvested at the beginning of the experiment. Remaining steers were allotted to one of four treatments: 1) ad libitum fed high-concentrate diet (CF); 2) grazed on wheat pasture (WP); 3) fed a sorghum silage-based growing diet (SF); or 4) program fed a high-concentrate diet (PF). Steers in the WP, SF, and PF groups were managed to achieve approximately equal rates of BW gain during a 112-d growing phase (1.07, 1.14, and 1.19 kg/d, respectively), and were then adapted to a high-concentrate finishing diet. At the end of the growing and finishing phases, six steers from each treatment group were randomly selected for harvest. Weights were collected on carcass and all individual noncarcass tissues. Tissue samples were collected from liver, rumen, and duodenum to determine in vitro O2 consumption. At the end of the growing phase, liver, kidney, and small intestine (SI) weights (g/kg EBW) were greatest ($P < 0.01$) for WP steers, whereas SF steers had the heaviest ($P < 0.05$) reticulo-rumen. Mesenteric and omental fat (MF) was greatest ($P < 0.01$) for PF, intermediate for SF, and lowest for WP steers. At final harvest, liver and large intestine (LI) weights were greatest (g/kg EBW; $P < 0.01$ and $P < 0.05$, respectively) for WP steers. There were no significant ($P < 0.10$) differences in O2 consumption ($\mu L \cdot min^{-1} \cdot g^{-1}$) due to treatment; O2 consumption by liver was generally related with tissue mass. The most dynamic changes in GIT mass occurred ($P = 0.07$) for steers grazing WP, with increases of liver, kidney, and SI mass occurring during the growing phase, and increases in reticulo-rumen, LI, and MF occurring during the finishing phase. Due to the considerable energy expenditure by splanchnic tissues, changes in organ mass during the growing phase might contribute to maintenance energy requirements, and therefore performance during the finishing phase.

Key Words: Beef Cattle, Visceral Organs, Oxygen Consumption

611 Influence of phase-feeding on performance of beef steers. J. Gleghorn[1], P. Defoor[1], M. L. Galyean[2], G. C. Duff[3], and N. A. Cole*[4], [1]New Mexico State University, Clayton, [2]Texas Tech University, Lubbock, [3]University of Arizona, Tucson, [4]USDA- Agricultural Research Service, Bushland, TX.

As cattle mature the dietary CP requirement, as a percentage of the diet, decreases. Thus, decreasing the dietary CP concentration during the latter part of the finishing period might decrease feed costs and N losses to the environment. This study evaluated the effect of phase-feeding of CP on performance of finishing beef cattle fed 90% (DM basis) concentrate, steam-flaked corn-based diets. Three hundred sixty medium-frame cross-bred steers (315 + 4.9 kg) were blocked by BW and randomly assigned to 36 feedlot pens (10/pen). Following a 21-day step-up period, the following dietary treatments (DM basis) were randomly assigned to pens within a weight block: 1) fed an 11.5% CP diet throughout; 2) fed a 13% CP diet throughout; 3) switched from an 11.5% to a 10% CP diet when approximately 56 d remained in the feeding period; 4) switched from a 13% to an 11.5% CP diet when 56 d remained; 5) switched from a 13% to a 10% CP diet when 56 d remained; and 6) switched from a 13% to an 11.5% CP diet when 28 d remained. Cattle were slaughtered by block when 60% of the cattle within a weight block were visually estimated to grade USDA Choice. On average, cattle were on feed for 182 d (161 d for Block 1, 183 d for Blocks 2 and 3, and 189 d for Blocks 4, 5, and 6. Cattle switched from 13% to 10% CP diets had lower ($P < 0.10$) ADG (1.14 vs. 1.52 kg) and G:F (186 vs. 192 g/kg) than steers fed a 13% CP diet throughout. Steers on the phase-feeding regimens had numerically lower ADG and lower ($P < 0.10$) DMI during the last 41 days on feed than steers fed 11.5 or 13% CP diets throughout. Carcass characteristics were not affected by dietary regimen. Performance by cattle fed a constant 11.5% CP diet was similar to those fed a 13% CP diet, although cattle fed the lower CP diet had numerically lower overall ADG (1.48 vs. 1.52 kg) and DMI (7.64 vs. 7.96 kg) during the feeding period. Results suggest that modest changes in dietary CP concentration in the latter portion of the feeding period may have modest effects on overall beef cattle performance, but that decreasing dietary CP to 10% would adversely affect performance of cattle fed high-concentrate, steam-flaked corn-based diets.

Key Words: Beef Cattle, Phase-Feeding, Protein

612 Relationship of residual feed intake with metabolic rate, methane production and energy partitioning in beef cattle. J. D. Nkrumah*[1], E. K. Okine[1], G. W. Mathison[1], K. Schmid[1], C. Li[1], J. A. Basarab[2], M. A. Price[1], Z. Wang[1], and S. S. Moore[1], [1]University of Alberta, Edmonton, Alberta, Canada, [2]Alberta Agriculture, Food and Rural Development, Lacombe, Alberta, Canada,.

The biological mechanisms underlying the variation in feed efficiency in animals with similar BW and growth rate are currently not well understood. This study was conducted to determine the associations of feedlot residual feed intake (RFI) with digestion, metabolic rate and energy partitioning using data from 27 beef steers. The steers were selected based on RFI following feedlot tests at the Kinsella Research Station of the University of Alberta. Selected steers were ranked into high-RFI (RFI is > 0.5 SD above the mean, n = 11), medium-RFI (RFI is 0.5 SD above and below the mean, n = 8) or low-RFI (RFI is < 0.5 SD below the mean, n = 8). The respective BW (SD) kg for the RFI groups were 495.6 (12.7), 529.1 (18.6) and 501.2 (15.5). Steers were fed a high grain diet (approximately 80% corn or barley based concentrate diet) at 2.5 times their estimated maintenance requirement. Mean DMI (SD) ($g/kg^{0.75}$) during the measurements for high, medium and low-RFI groups respectively, were 82.7 (2.0), 78.8 (2.6) and 81.8 (2.5) and did not differ ($P > 0.20$) among the groups. Residual feed intake was correlated with daily methane production ($r = 0.44$, $P < 0.05$). Methane production was 28% and 24% lower in low-RFI animals compared to high or medium-RFI animals, respectively. Residual feed intake tended to be associated ($P < 0.10$) with apparent digestibilities of DM ($r = -0.33$) and CP ($r = -0.34$). The RFI of steers was also correlated with DE ($r = -0.41$), ME ($r = -0.44$) ($P < 0.05$), heat production (HP) ($r = 0.68$) and retained energy (RE) ($r = -0.67$) ($P < 0.001$) (energy values are expressed in $kcal/kg^{0.75}$). With the exception of HP ($r = 0.37$, $P < 0.05$), FCR was unrelated to the traits considered in the study. Feeding duration was correlated with apparent digestibility of DM ($r = -0.55$) and CP ($r = -0.47$), methane production ($r = 0.51$), DE ($r = -0.52$), ME ($r = -0.55$), and RE ($r = -0.60$). These findings have practical implications for the selection of animals that eat less at a similar body weight and growth rate and for the environmental sustainability of beef cattle production.

Key Words: Beef Cattle, Feed Efficiency, Energy Partitioning, Methane Production

613 The relationship between mitochondrial DNA content, single nucleotide polymorphisms and feed efficiency in crossbred Angus steers. W. H. Kolath*, M. S. Kerley, and J. W. Golden, University of Missouri, Columbia.

The objective of this study was to examine the relationship between mitochondrial DNA (mtDNA) content, single nucleotide polymorphisms (SNP) of mtDNA and feed efficiency. Two hypotheses were formed; first that mtDNA SNP in the inefficient steers could affect mitochondrial function and second that increased mtDNA content in the efficient steers may allow for the greater flux of substrate that is observed. Crossbred Angus steers had their individual feed intakes recorded via the Growsafe® feed intake system over a three-month period. Intakes were used to calculate residual feed intake (RFI), a measure of efficiency. Steers were selected for further study based on their RFI values. Tissue samples were taken from the longissimus lumborum muscle from both the efficient (RFI -0.83; n = 9) and inefficient (RFI +0.78; n = 8) animals for the isolation of total cellular DNA. Quantitative polymerase chain reaction was performed to measure mtDNA content. Blood samples were taken from a second group of steers [efficient (RFI -1.564; n = 6) and inefficient (RFI 1.657; n = 6)] for the determination of mtDNA sequence. DNA was isolated via phenol/chloroform extraction, fragments were amplified with polymerase chain reaction, and sequenced with an automatic nucleotide sequencer. No difference ($P = 0.96$) in mtDNA content was found between the efficient and inefficient steers. On average 8.9

mutations were found per mtDNA genome for both the efficient and inefficient steers. None of those mutations were correlated to feed efficiency status. It appears that mtDNA sequence and content are not related to the differences observed in mitochondrial function between efficient and inefficient steers.

Key Words: Mitochondria, RFI, mtDNA

614 Evaluation of the effects of diatary antioxidant (Agrado®) on feedlot performance and carcass characteristics. M. Vazquez-Anon*[1], F. Scott[1], B. Miller[1], and T. Peters[2], [1]Novus International, St Louis, MO, [2]Dekalb Feeds, Rock Falls, IL.

Four performance studies were conducted using over 13,000 feedlot cattle to evaluate the effect of feeding the antioxidant 6-ethoxyl-1, 2, 2, 4-trimethylquinoline (Agrado® feed antioxidant). Study 1: At OSU, 75 crossbred steers (326 kg BW) were fed a ground corn diet with 0 or 135 PPM of Agrado (DM basis) the last 28 d prior to harvest. Cattle fed Agrado showed 5 and 10 % improvements in gain and feed conversion (FC), respectively, and greater lean maturity (153 vs. 142; P<0.02) and USDA yield grade (2.27 vs. 2.67; P <0.04). Study 2: At CRF, Lamar, CO, 128 crossbred yearling steers (350 kg BW) were fed a steam flaked corn diet with 0 or 150 PPM of Agrado (as-fed basis) for the last 123 d prior to harvest. Cattle fed Agrado showed 9 % (P <0.06) and 6 % improvement in gain and FC, respectively, and less variable feed intake. Study 3: At UAK, 80 mixed breed steer calves (264 kg BW) were fed 0 or 150 ppm of Agrado during the pre conditioning period and shipped to Texas AM where each group was split into two groups and fed a corn flaked diet with 0 or 150 ppm of Agrado for 182 d. Cattle fed Agrado in the finishing period had 11 % (1.46 vs. 1.62 kg/d; P <0.05) greater daily gain, hot carcass weight (293 vs. 348 kg; P < 0.05) and feed intake (7.26 vs. 8.61 kg/d) than control. In addition, serum vitamin E (2.23 vs. 2.36 ug/ml; P <0.04) and vitamin A (450 vs. 502 ng/ml; P < 0.04) increased with Agrado in the pre-condition and finishing period, respectively Study 4: Performance from 13,000 cattle housed in 11 feedlots fed daily with 0 or 150 ppm of Agrado for 143 ± 38 d prior to harvest was evaluated. Improvements in gain (6.2 %) and FC (9.6 %) and reduction in feed intake (-3.7 %) and feed cost (9 $/hd) were observed with Agrado across the 11 feedlots. From the summarized results of the four studies, it can be concluded that the addition of antioxidants such as Agrado to feedlot cattle diets improves gain, FC, carcass quality, and reduces feed cost.

Acknowledgements: Agrado is a trademark of Novus International

Key Words: Antioxidants, Agrado, Feedlot

615 Effects of dietary sunflower seeds (SS) and Tylosin phosphate on production parameters, carcass characteristics and liver abscess incidence in European crossbred steers. C. Ross, P. Mir*, and M. Shah, Agriculture And Agri- Food Canada, Lethbridge, AB, Canada.

A 2x2 factorial experiment with 12 animals per treatment was conducted to evaluate the effects of dietary SS and Tylosin phosphate on production parameters, carcass characteristics and liver abscess incidence. European crossbred steers were fed a control (Con) diet of 84.5% rolled barley and 14% barley silage (DM basis), or a SS diet where 15% of the barley was replaced with SS. Half the animals within each diet received Tylosin phosphate (T) top dressed at 11mg·kg^{-1}DM fed. The interaction of Tylosin and SS reduced daily DM intake from 10.1 kg (Con) to 8.9 and 8.7 kg for the Con-T and SS diets, respectively (P<0.02), while the SS diet intake was not significantly different from either diet with Tylosin. The same relationship was observed for final animal weight (P<0.05). Daily DM intake·kg$^{0.75}$ for Con was 0.096 and greater (P<0.02) than the average of 0.086 kg for all other treatments, which were not different from each other. Intake as a percentage of body weight was 2.04 (Con) and higher (P<0.05) than the average of 1.84% for all other treatments, which did not differ from each other. Average daily gain (ADG) was higher for Con versus all other treatments (1.44 vs 1.20 kg·d^{-1}, P<0.05). Feed to gain ratios were elevated in the SS diets (7.8 vs 7.1, P<0.02). Warm carcass weight decreased for SS and Con-T vs Con (P<0.05), while rib-eye average fat cover was 17.2 vs 12.9 mm (Con vs all other treatments, P=0.05). Dietary inclusion of SS effectively reduced liver abscesses (P<0.02), from 25% in control fed animals to 0% in SS fed animals, irrespective of dietary Tylosin. The interaction of Tylosin and SS affected a number of production parameters, resulting in reduced warm carcass weight and reduced fat cover over the rib-eye. SS in the diet reduced liver abscess incidence significantly and is a promising dietary ingredient for liver abscess control in steers.

Key Words: Sunflower Seeds, Tylosin, Liver Abscess

616 Effect of Bos Koolus on dry matter intake, rectal temperature and respiration rate of grain fed steers exposed to hot conditions. J. Gaughan*[1], R. van Barneveld[2], and D. Cadogan[3], [1]The University of Queensland, Gatton, Qld, Australia, [2]Becan Consultancy Group, South McLean, Qld, Australia, [3]Feedworks, Eagle Farm, Qld, Australia.

Grain-fed cattle exposed to hot conditions will reduce DMI resulting in reduced performance. Reducing the effects of heat stress will help to maintain performance and welfare. Feeding osmolytes (low molecular mass organic compounds) such as polyols (sugar free sweeteners), free amino acids, and combinations of urea and methylamines to cattle during summer may be beneficial. Osmolytes help maintain cellular water balance, protecting cells and tissues from dehydration and osmotic inactivation. A replicated randomized complete block study was undertaken using 8 Angus steers (mean 549.7 kg) to test the effect of adding Bos Koolus (BK), a mixture of heat stress alleviating compounds including osmolytes in a feedlot diet. The steers were housed for 11 d in stalls (3m x 1m) in a climate controlled unit and were exposed to 5 d of hot conditions (HOT) (32°C dry bulb temperature, 66% relative humidity). Prior to HOT the steers had 4 d exposure to thermoneutral conditions (TN) and following HOT a further 2 days of TN. Rectal temperature (RT) was measured at 5 min intervals. Respiration rate (RR) was measure hourly from 0600 h to 1800 h. Individual DMI was recorded daily. Climatic conditions (dry bulb, wet bulb and air pressure) were measured at 5 min intervals. Relative humidity was calculated from the measured climatic conditions. The steers fed the BK diet had lower (P<0.05) RT (39.5°C) compared to the control group (39.9°C). Mean RT of the BK fed steers during HOT was 39.6°C and for the control group the 40.1°C (P<0.001). The RR of the BK steers was lower (P <0.05) compared to the control group at 77.1 breaths per minute (bpm) and 80.9 bpm respectively. Mean RR were lower (P<0.05) for the BK fed steers on days 3 and 4 of HOT at 92.2 bpm and 101.9 bpm respectively. DMI of the BK fed steers was greater (P<0.001) than the control group at 5.74 and 4.93 kg/d respectively. These data suggests that steers fed Bos Koolus were better able to tolerate HOT.

Key Words: Osmolytes, Heat Tolerance, Beef Cattle

617 Feedlot performance response by steers to oral doses of polyclonal antibody preparations against Streptococcus bovis or Fusobacterium necrophorum. N. DiLorenzo*, C. R. Dahlen, A. DiCostanzo, and G. C. Lamb, University of Minnesota, St Paul.

We have demonstrated that feeding preparations of avian polyclonal antibodies (PAP) against Streptococcus bovis (PAPSb) or Fusobacterium necrophorum (PAPFn) were effective at reducing rumen counts of target bacteria, and had modulating effects on rumen pH. The objective of this study was to determine effects of these PAP on feedlot performance and carcass characteristics. During two consecutive years, 226 (year 1) or 192 (year 2) Angus and Angus crossbred steers in 16 (year 1) or 12 (year 2) pens were fed a high-grain diet in a 2 X 2 factorial arrangement of PAPSb and PAPFn. Diets (1.39 Mcal NE_g /kg DM, 12.5% CP, 0.7% Ca, and 0.35% P) were formulated with high-moisture corn and dry ground corn (50:50 mix, DM basis), corn silage, and a supplement containing laidlomycin propionate. Interaction term for feed efficiency (analyzed as BW gain-to-feed) was significant (P < 0.05). Steers receiving PAPSb were more efficient (P < 0.05) than those receiving no PAP. Steers receiving PAPFn tended (P = 0.06) to be more efficient than those receiving no PAP. Carcass-adjusted feed efficiency (analyzed as carcass-adjusted gain-to-feed)

tended to be greater (P < 0.10) for steers fed PAPSb than those fed both or no PAP (interaction P-value = 0.13). Fat depth was greater (P < 0.05) in steers fed PAPSb than in steers fed no PAP; however, when adjusted for hot carcass weight, this difference disappeared. Steers fed PAPFn had lower (P < 0.05) dressing percentage. Liver abscess incidence (data available only for yr 2) was lower (P < 0.05) in steers fed PAPFn and both PAP than in those fed no PAP or PAPSb. Results from the current study demonstrated these PAP were effective at enhancing feedlot performance. Taken together with results from previous studies, avian PAP remained viable in the rumen of steers fed high-grain diets, and had a positive effect on performance.

Key Words: Streptococcus bovis, Fusobacterium necrophorum, Antibodies

618 Effect of dietary vitamin A intake on marbling. M. A. Gorocica-Buenfil*, F. L. Fluharty, and S. C. Loerch, The Ohio State University, Wooster.

To evaluate the effect of low dietary vitamin A on carcass characteristics, 168 Angus-based steers (BW = 295 kg) were allotted to 24 pens (7 steers each). Four treatments were investigated. No supplemental vitamin A - No soybeans (NA-NS); No vitamin A - soybeans (NA-S); Supplemental vitamin A (2,700 IU/kg diet DM) - no soybeans (A-NS); Supplemental vitamin A - soybeans (A-S). Diets included high moisture corn (65-80%), 5% corn silage, 10-20% supplement, and 20% roasted soybeans in S treatments. Basal ingredients contained 900 to 1,300 IU of vitamin A /kg DM. According to NRC, feedlot cattle require 2,200 IU of vitamin A/kg DM. Roasted soybeans were included to evaluate their effect on CLA content of beef; these results are not reported. During d 1-84 feed intake was restricted to achieve 1.1 kg ADG. Steers were fed ad libitum from d 85 until harvest on d 168. Two steers per pen were bled every 28 d for serum vitamin A determination. Hot carcass weight, back fat thickness (BF), longissiumus muscle area, KPH, marbling, and quality and yield grade (YG) were determined. Carcass samples were taken (2 animals/pen) for composition analysis of the edible carcass (EC). Longissimus muscle samples were analyzed for moisture, CP and EE. No interactions between roasted soybean inclusion and vitamin A level were detected, therefore main effects are reported. Low vitamin A diets did not reduce (P >.05) ADG (1.64 vs. 1.69 kg/d), DMI (7.8 vs. 7.8 kg/d) and G/F (211 vs. 216 g/kg, for NA and A respectively). A tendency for greater quality grade (P =.07) was detected in NA steers. Marbling score and percent of choice carcasses were 10 % greater in NA steers although these trends were not significant (P = .11 and .13, respectively). BF and YG were not affected (P >.26) by vitamin A level. EC and longissimus muscle DM, OM, CP and EE did not differ (P >.05) between treatments. Serum retinol was reduced after d 56 (P <.05) and by d 168, it was 44% lower in NA steers (23.0 vs. 41.1 µg/dL, P < .01). These data suggests that marbling could be increased without affecting BF and YG when cattle are fed low vitamin A diets for at least 168 days.

Key Words: Beef, Marbling, Retinol

619 Effects of roughage level and Fibrozyme™ supplementation on performance and carcass characteristics of finishing beef steers. J. J. Cranston* and C. R. Krehbiel, Oklahoma State University, Stillwater.

The objective of this experiment was to determine the effects of roughage level and fibrolytic-enzyme supplementation on performance and carcass characteristics of finishing beef steers. One hundred eighty-four steers (initial BW = 343 ± 42.1 kg) were used in a randomized complete block design with a 2 x 2 factorial arrangement of treatments. Steers were fed dry rolled corn-based finishing diets; treatments (8 pens/treatment) included (DM basis): 1) 9.0% alfalfa hay without enzyme (9N); 2) 9.0% alfalfa hay with enzyme (10 g·steer^{-1}·d^{-1}) (9Y); 3) 4.5% alfalfa hay without enzyme (4N); 4) 4.5% alfalfa hay with enzyme (10 g·steer^{-1}·d^{-1}) (4Y). Steers were fed for an average of 151 d. Enzyme supplementation increased (P = 0.05) carcass-adjusted final BW. From d 0 to slaughter, neither DMI nor ADG was affected (P ≥ 0.13) by treatment; however, enzyme supplementation increased (P = 0.10) carcass-adjusted ADG. Roughage level x enzyme supplementation interactions were detected (P ≤ 0.08) for carcass-adjusted final BW, ADG, and G:F. These interactions resulted in steers being fed the 4Y diet having greater performance (P ≤ 0.07) than steers fed the 4N diet; no differences were observed (P ≥ 0.55) between steers fed the 9Y and 9N diets. An enzyme effect (P = 0.05) and roughage level x enzyme supplementation interaction (P = 0.08) were detected for HCW. Steers fed the 4Y diet had heavier (P = 0.01) HCW than those receiving the 4N diet; however, no difference was detected (P = 0.86) between steers fed the 9N and 9Y treatments. A roughage level x enzyme supplementation interaction was also detected (P = 0.06) for yield grade scores. Steers fed the 4N diets had lower (P = 0.04) yield grades than steers fed the 4Y diet; steers fed the 9N and 9Y diets did not differ (P = 0.53). No other carcass measurements were affected (P ≥ 0.17) by treatment. When dry rolled corn-based finishing diets were fed, Fibrozyme supplementation was more efficacious in diets containing 4.5% alfalfa hay compared with diets containing 9.0% alfalfa hay.

Key Words: Beef Cattle, Roughage Level, Fibrolytic Enzyme

620 Fatty acid composition of diets, metabolism and deposition in edible tissue of pasture-and feedlot-finished cattle. J. Guay*[1], J. Fontenot[1], W. Swecker[1], J. Neel[2], J. Herbein[1], W. Clapham[2], G. Scaglia[1], and A. Abaye[1], [1]Virginia Polytechnic Institute and State University, Blacksburg, [2]USDA/ARS, Beaver, WV.

A finishing study was conducted to determine the fatty acid (FA) composition of feeds and to evaluate FA metabolism in beef cattle. Twelve steers were finished on a high-concentrate diet in feedlot (individually fed) and 12 on pasture (initial BW = 302.9 ± 89.3 kg). The pasture treatment consisted of three replications. The high-concentrate diet consisted of cracked corn, corn silage, soybean meal, and mineral supplement. Subcutaneous adipose tissue biopsy samples were obtained initially, and on d 28, 84, and 140. Pasture forage and composited feedlot diet ingredient samples were collected every 14 d. Adipose tissue data were analyzed as a completely randomized design using the PROC MIXED procedure. The average FA composition of the high-concentrate diet consisted primarily of linoleic acid (16.17 to 28.0 mg/g DM, or 55.17 to 58.17 % of total FA). The FA composition of pasture forage samples consisted primarily of linolenic acid (9.81 to 47.71 mg/g DM, or 56.38 to 76.98 % of total FA). The conjugated linoleic acid (CLA) content of adipose tissue decreased (P < 0.05) in high-concentrate-fed steers and increased (P < 0.05) in pasture-finished steers. The pasture-finished steers had higher (P < 0.05) amounts of CLA in adipose tissue on d 24 (12.91 vs. 5.2 mg/g tissue), d 84 (10.50 vs. 2.11 mg/g tissue), and d 140 (10.01 vs. 2.12 mg/g tissue), than the high-concentrate finished steers. The pasture-finished steers had higher (P < 0.05) amounts of linolenic acid (an omega-3 FA) in adipose tissue on d 28 (6.82 vs. 2.77 mg/g tissue), d 84 (5.15 vs. 2.8 mg/g tissue), and d 140 (5.81 vs. 2.57 mg/g tissue), than the high-concentrate finished steers. An increase of CLA and omega-3 FA in beef products may be beneficial to consumer health.

Key Words: Fatty Acid, Conjugated Linoleic Acid, Pasture-Finished Beef

621 Fatty acid composition in rumen bacteria isolated from ruminal and duodenal digesta. B. Vlaeminck[1], R. J. Dewhurst[2], and V. Fievez*[1], [1]Laboratory for Animal Nutrition and Animal Product Quality, Ghent University, Ghent, Belgium, [2]Institute of Grassland and Environmental Research, Aberystwyth, UK.

The objective of this study was to compare the fatty acid (FA) composition in rumen bacteria isolated from the liquid (LAB) and solid (SAB) phase of the rumen and duodenal digesta (DB) from dairy cows fed diets varying in forage:concentrate (F:C). In a 4 × 4 Latin square experiment, 4 dairy cows were fed ryegrass silage and a standard dairy concentrate with F:C of 35:65, 50:50, 65:35 and 80:20. Differential centrifugation was used to separate SAB and LAB from rumen contents, collected four hours after the morning feeding and duodenal bacteria from a reconstituted duodenal sample, collected over 24h. Bacterial samples were freeze-dried prior to fatty acid analysis by GLC. Results were tested by ANOVA with orthogonal contrasts and the significance of linear effects is given. Total FA content of SAB (124 mg/g) was higher compared with LAB (58 mg/g) and decreased with increasing F:C (104, 90, 89, 80 mg/g DM; SEM=4.6; P=0.016). Diet showed no effect on proportions of the two major FA, C16:0 and C18:0. The latter was enriched in SAB (55.7 vs. 34.2% of total FA; SEM=0.94; P<0.001), whereas C16:0 was more abundant in LAB (25.9 vs. 18.0%, SEM=0.26, P<0.001). Increasing F:C decreased bacterial content of trans-10 C18:1 (1.74, 1.12, 0.62, 0.47%; SEM= 0.196; P<0.001), C18:2 (n-6) (3.31, 3.28, 2.53, 2.12%; SEM= 0.264; P=0.015) and cis-9,trans-11 C18:2 (0.36, 0.31, 0.24, 0.22%; SEM= 0.037; P=0.045). In contrast, C18:3 (n-3) increased with increasing F:C (0.82, 0.87, 1.06, 1.27%; SEM= 0.088; P=0.011) whereas trans-11 C18:1 remained constant (3.96%). No differences were found between SAB and LAB in C18:3 (n-3) (1.00%) whereas LAB were enriched in trans-10 C18:1 (1.19% vs. 0.78%, SEM=0.139, P=0.074) and C18:2 (n-6) (3.53% vs. 2.09%, SEM=0.187, P=0.004) and SAB in trans-11 C18:1 (4.93% vs. 2.98%, SEM=0.108, P<0.001) and cis-9,trans-11 C18:2 (0.43% vs. 0.14%, SEM=0.026, P=0.026). Dietary effects on the fatty acid content and composition of DB were generally in agreement with effects observed in LAB and SAB.

Key Words: Rumen Bacteria, Fatty Acid, Dairy Cow

622 Proportions of solid- (SAB) and liquid-associated (LAB) rumen bacteria in duodenal content as estimated by bacterial odd and branched-chain fatty acids. B. Vlaeminck[1], R. J. Dewhurst[2], and V. Fievez*[1], [1]Laboratory for Animal Nutrition and Animal Product Quality, Ghent University, Ghent, Belgium, [2]Institute of Grassland and Environmental Research, Aberystwyth, UK.

The objective of this study was to estimate the proportions of LAB and SAB in duodenal content and their contribution to duodenal flow of N and fatty acids (FA). In a 4 × 4 Latin square experiment, 4 dairy cows were fed ryegrass silage and a standard dairy concentrate with forage:concentrate (F:C) ratios of 35:65, 50:50, 65:35 and 80:20. Differential centrifugation was used to separate SAB and LAB from rumen contents, collected four hours after the morning feeding and duodenal bacteria from a reconstituted duodenal sample, collected over 24h. Bacterial samples and duodenal contents were freeze-dried prior to FA analysis by GLC. LAB were enriched in iso C15:0 (1.37 vs. 1.12 mg/g DM; SEM=0.020; P=0.007), anteiso C15:0 (4.22 vs. 1.87 mg/g DM; SEM=0.108; P=0.001) and C15:0 (2.55 vs. 2.30 mg/g DM; SEM=0.069; P=0.026) whereas SAB contained higher proportions of iso C17:0 (0.413 vs 0.331 mg/g DM; SEM=0.018; P=0.059) and C17:0 (0.795 vs. 0.551 mg/g DM; SEM=0.018; P=0.001). Variation in odd and branched-chain fatty acids (OBCFA) between SAB and LAB were used to estimate their relative proportions in duodenal bacteria by means of linear programming. Proportions of SAB increased with increasing F:C (64.7, 70.7, 73.8 and 74.8%; SEM = 1.78; P = 0.026) which might reflect the increased attachment to forage particles or a decreased growth rate of LAB. The latter was illustrated by a decrease in LAB of cytosine:N - a proxy for growth rate in bacteria (0.071, 0.060, 0.057 and 0.055 g/g; SEM=0.003; P=0.020) with increasing F:C. Proportion of duodenal N from LAB and SAB increased with increasing F:C (21.5, 18.0, 23.8 and 25.1%; SEM=1.58; P=0.059 and 32.0, 40.3, 38.4 and 40.6; SEM=2.18; P=0.050 for LAB and SAB, respectively) whereas no dietary effects were observed on contribution to duodenal FA of LAB (11.5%) and SAB (52.5%). In conclusion, variation in OBCFA can be used to estimate proportions of SAB and LAB in duodenal contents and their contribution to duodenal flow of nutrients.

Key Words: Odd and Branched Chain Fatty Acids, Rumen Bacteria, Dairy Cow

623 Development of an in vitro method to estimate fat digestibility in the small intestine of ruminants. T. Glindemann[1], K.-H. Suedekum*[1,2], and E. Wisker[1], [1]University of Kiel, Kiel, Germany, [2]University of Bonn, Bonn, Germany.

Supplementation of dairy cow diets with rumen-protected fat (RPF) has consistently increased yields of milk and milk fat, and may also improve reproductive performance of ruminants. Although one important feature of the effects of RPF is digestibility in the small intestine, this variable is only very infrequently reported. The objective of the current study was therefore to develop an in vitro method to estimate the digestibility of fats in the small intestine of ruminants by closely mimicking the chemical and physical conditions within the small intestine. First, the fat is blended with an aqueous solution of gum arabic as emulsifier and thickener. The blend is intensively stirred in a mixer under continuous cooling to prevent segregation between the aqueous solution and the fat. Second, taurocholic acid (bile salt) and lecithin (phospholipid) are added and brought to 37°C under continuous stirring to further support development of an emulsion. Calcium as a co-factor for lipase action is added as $CaCl_2$ and the pH is adjusted at 8.8. Third, pancreatin is added, which contains lipase and colipase. The pH is maintained at 8.8 by immediate titration of free fatty acids (FA) with NaOH (0.1 M) and digestion is usually stopped after 75 min. Release of FA from triglycerides is calculated from the amount of NaOH that was titrated during digestion. Because lipase can cleave only the two external ester bonds of a triglyceride and monoglycerides also can be absorbed from the small intestine, digestibility of fat was considered to be 100%, when two thirds of the FA were released from the fat. In in vitro digestibility experiments using the above procedure, conventional fat sources (olive oil, coconut fat, cod-liver oil, and butter fat) had very high fat digestibilities of almost 100%, whereas a crystalline vegetable RPF product (Bergafat T-300) had a digestibility of only 80%. The coefficient of variation of four repeated digestibility estimates on each single fat source was smaller than 5% in all cases. This indicates that the method can produce repeatable and robust estimates of fat digestibility in the small intestine.

Key Words: Fat Digestion, Ruminant, Small Intestine

624 Conversion of oleic acid to 10-hydroxy and 10-keto stearic acids in vitro and their accumulation in milk of cows fed added fat. T. C. Jenkins*, A. A. AbuGhazaleh, E. J. Thies, and M. B. Riley, Clemson University, Clemson, SC.

Previously, 10-hydroxy stearic acid (HSA) and 10-keto stearic acid (KSA) were present in continuous cultures of mixed ruminal microorganisms at 6-12% of total fatty acids, and were shown to arise primarily from oleic acid based on tracer studies using a pulse dose of ^{13}C-labelled oleic acid. Additional in vitro and in vivo studies were conducted aimed at two objectives; 1) to determine if HSA and KSA originated directly from oleic acid or if they originated from an intermediate of oleic acid biohydrogenation and 2) to determine if HSA and KSA could be detected in rumen and milk samples. When 20, 30, or 40 mg of oleic acid were added to batch cultures of ruminal microorganisms, there were linear ($P \leq 0.05$) net gains in KSA (0.40, 0.60, and 0.75 mg/flask) and HSA (0.43, 0.53, and 0.97 mg/flask) over 24 h of incubation. When the same amounts

of a trans monoene were added to cultures, no increases in HSA or KSA were detected. Batch cultures were then run with 17 mg 12-HSA added per flask. After 24 h of incubation, HSA concentration dropped 4.2 mg with a 5.9 mg net increase in KSA. The yields of stearic acid and trans monoene did not change. Four Holstein cows were then fed 0, 1, 2, or 3% free fatty acids (65.5% linoleic, 19.5% oleic, and 10.5% linolenic acid) in a 4 x 4 Latin square with 2-week periods. The HSA concentrations in ruminal samples increased ($P \leq 0.01$) linearly from 0.70 to 1.98 % of total fatty acids as fatty acids in the diet increased from 0 to 3%. In milk, the HSA concentration increased ($P \leq 0.05$) linearly (0.01, 0.22, 0.46, and 0.65% of total fatty acids) for diets containing 0, 1, 2, and 3% added fatty acids, respectively. These results show that HSA in ruminal contents originates directly from oleic acid and is subsequently converted to KSA. The HSA concentration in ruminal contents and milk are linearly related to fatty acid intake by cows.

Acknowledgements: This project was supported by National Research Initiative Competitive Grant No. 2003-35206-12835 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Biohydrogenation, Rumen, Oleic Acid

625 Effect of feeding supplemental palmitic acid (C 16:0) on performance of lactating dairy cows under summer heat. J. L. Warntjes*[1], P. H. Robinson[1], E. Galo[2], E. J. DePeters[1], and D. Howes[3], [1]University of California, Davis, [2]Dairy Consulting Services of California, Inc., Madera, CA, [3]Howes Consulting Inc., Nampa, ID.

The objective was to determine performance changes of early lactation high producing dairy cows under summer heat, by adding a supplemental fat (99% total lipid (DM); Energizer-RP10, IFFCO, Johor, Maylasia) which analyzed as 85.6% C 16:0 (of total fatty acids), to the total mixed ration (TMR). Early lactation multiparous Holstein cows on a commercial dairy near Madera (CA), in two pens of 99 and 115, were used in a 2 * 2 Latin Square design with 35 day periods. The study occurred from July through September (2004) when high and low temperatures averaged 34.3°C and 15.9°C, and there were no rain events. The TMR was 66.1% DM and contained 16.3% (DM) corn silage, 6.5% alfalfa haylage, 19.2% alfalfa hay and 58.0% premix which contained 1.7% (DM) Energizer-RP10, 38.2% corn grain, 1.3% molasses, 7.6% soybean hulls, 7.3% wheat middlings, 13.9% corn distillers dried grains, 6.6% canola meal, 15.6% whole upland cottonseed and 7.8% of a mineral/protein premix. The Control TMR was formulated for 17.6% CP (DM), 26.5% soluble CP (of CP), 27% NDF (DM), 6.7% total lipid (DM) and 1.74 Mcal/kg NEl (DM). The TMR was the same for each group, except that the vitamin/mineral/protein premix had no added RP10 (Control; C) or added RP10 at a level designed to deliver approximately 450 g/cow/d of Energizer-RP 10, if cows consumed 26.5 kg/d of DM. Parameters measured included yield (kg/d) of milk, fat and protein, as well as milk components (i.e., fat %, protein %, and somatic cell count (SCC)). Cows were scored for body condition (BCS) and locomotion (BLS) at the beginning and end of each period by two scorers. Milk fat % decreased with RP10 feeding (3.75 vs. 3.60; $P = 0.02$), but protein % and SCC were not affected. There was a tendency ($P = 0.10$) to an increase in milk yield (36.7 vs. 38.0 kg/d), as well as milk protein yield (1.08 vs. 1.13 kg/d; $P = 0.06$) with RP10. Milk fat yields was unaffected, as were BCS (mean = 2.95) and BLS (mean = 1.21), as well as changes in BCS and BLS. Supplemental palmitic acid changed milk composition, and tended to increase yield of milk and milk protein in dairy cows under summer heat.

Key Words: Palmitic Acid, Milk Production, Dairy Cows

626 Effect of different levels of nonfiber carbohydrates with and without spplemental fat on production and composition of Holstein dairy cows. M. Bashtani, A. A. Naserian*, and R. Valizadeh, Ferdowsi University of Mashhad, Mashhad, Khorasan, Iran.

The effect of inclusion of different levels of nonfiber carbohydrates (NFC) with and without supplemental fat on performance of Holstein dairy cows was investigated using a change over design with four treatments and four periods. Eight multiparous Holstein dairy cows were used with mean milk production and days in milking of 36 ± 5 kg and 46 ± 8 days.The experimental diets were 1) high nonfiber carbohydrates, no added fat; 2) high nonfibe carbohydrates, 2.5% fat; 3) low nonfiber carbohydrates, no added fat and 4) low nonfiber carbohydrates, 2.5% added fat. The DMI, milk production and composition were not affected by supplemental fat or nonfiber carbohydrates. The digestibility of fiber components were higher ($P < 0.05$) for diets with low nonfiber carbohydrates.Ruminal pH values were not affected by the experimental diets, but ruminal ammonia-N, BUN and MUN were significantly increased ($P < 0.05$) by decreasing the level of nonfiber carbohydrates.Glucose and cholestrol of plasma were significantly increased ($P < 0.05$) by increasing nonfiber carbohydrates and adding fat respectively. Activity chewing were not affected by nonfiber carbohydrates or fat. It appeared that response of dairy cows to adding fat was better in low fermentable carbohydrate diets.

Key Words: Fat, Nonfiber Carbohydrate, Dairy Cow

627 Milk fat trans-10 C18:1, trans-10 cis-12 CLA and trans-9 cis-11 CLA: association with fish oil-induced milk fat depression. M. A. S. Gama[1], J. M. Griinari[2], P. C. Garnsworthy[3], P. H. M. Rodrigues[4], P. R. Leme[4], L. W. O. Souza[4], and D. P. D. Lanna*[1], [1]ESALQ-USP, Piracicaba, SP, Brazil, [2]University of Hensinki, Finland, [3]University of Nottingham, UK, [4]FZEA-USP, Pirassununga, Brazil.

Trans-10, cis-12 CLA is currently the only conjugated linoleic acid (CLA) isomer unequivocally shown to inhibit milk fat synthesis. Increased formation of this isomer occurs when low fiber diets are fed to induce milk fat depression (MFD). Fish oil (FO)-induced MFD is a notable exception as many studies have observed minimal or no increase in milk fat trans-10, cis-12 CLA. In contrast, increased levels of milk fat trans-10 C18:1 have been observed in all types of diet-induced MFD. This study was conducted in two periods: 1) Baseline: cows (n=12) received high fiber diet (HF) without FO (baseline diet) for 12 d; 2) Supplementation: cows (n=4) received three treatments for 21 d: a) Low fiber diet (LF) b) HF+FO and c) LF+FO. NDF content for HF and LF were 40 and 25%, respectively. Roughage was corn silage and FO was included at 1.6% DM. Milk fat content and yield were reduced by FO treatments ($P<0.05$), but diet fiber level had no effect. Concentration of trans-10, cis-12 CLA in milk fat was lower (different superscripts, $P<0.05$) in LF diet than in HF+FO and LF+FO diets (0.002^{a}vs. $0.014^{b}$and 0.016^{b}% of total fatty acids, respectively). Values of trans-10 C18:1 and trans-9, cis-11 CLA in milk fat were 3.76^{a}, 2.57^{ab}, $0.65^{b}$and 0.05^{a}, 0.03^{ab}, 0.01^{b}, respectively for LF+FO, HF+FO and LF treatments. Concentrations of trans-10 C18:1 and trans-9, cis-11 CLA in milk fat were closely correlated (R^2= 0.97) and both fatty acids also showed independently a close inverse relationship with the degree of MFD (R^2= 0.68 and R^2= 0.55, respectively). In contrast, the association between trans-10, cis-12 CLA in milk fat and MFD was very poor (R^2= 0.02). Close correlation between trans-9, cis-11 CLA and MFD can be interpreted in two ways: trans-9, cis-11 CLA is an inhibitor of milk fat synthesis or it is a product associated with the formation of a yet unidentified inhibitor.

Acknowledgements: FAPESP

Key Words: Milk Fatty Acids, Dairy Cow, Milk Fat Depression

628 Source and amount of pelleted cottonseed influences fat digestibility and milk fat composition through ruminal metabolism of fatty acids in lactating cows. C. Reveneau*, M. L. Eastridge, and J. L. Firkins, The Ohio State University, Columbus.

Pelleting cottonseed (CS) improves handling characteristics for dairy operations. Our objectives were to determine if increasing the particle size of the CS pellet or dilution of a smaller pellet with delinted CS would limit the rate of CS oil release to optimize digestibility of fatty acids (FA) and fiber while maintaining milk fat production. In Trial 1, dietary treatments were 1) whole CS (WCS) control, 2) larger pelleted fuzzy CS (LFZ), and a blend of 1/2 small fuzzy pellets

(SFZ) plus 1/2 partially delinted CS fed at 3) 100% (SFC100) or 4) 90% of WCS (SFC90). Sixty cows averaging 105 DIM were fed the WCS diet for 2 wk and then assigned to one of the 4 diets for 12 wk. In a 5 x 5 Latin square with 3-wk periods (Trial 2), 5 rumen-cannulated cows were fed: 1) control with CS hulls and CS meal plus tallow and Ca soaps of FA, 2) WCS, 3) SFZ, 4) LFZ, or 5) SFC100. Diets contained 39.6% concentrate, 14.4% CS, and 46% forage (40:60, alfalfa hay:corn silage) on a DM basis. Unless stated, P≤0.05. For Trial 1, milk production trended to progressively increase for SFC100 and SFC90 than WCS or LFZ (diet x time, P=0.07). Milk fat was lower for LFZ (2.74%) and SFC90 (2.85%) than WCS or SFC100 (3.07 and 3.08%). 3.5%FCM was lower for LFZ than WCS, SFC100, and SFC90 (31.2, 35.0, 37.3, and 34.5 kg/d). In trial 2, NDF digestibility was unaffected, but N digestibility was lowest for SFC. FA digestibility was higher for WCS, SFZ, and LFZ (81.1, 82.6, and 82.3%) than control or SFC treatments (78.8 and 75.3%). The 18:1 trans-11 in milk from cows fed SFZ and LFZ (7.10 and 6.73%) was greater than control, WCS, and SFC (1.65, 4.13, and 3.78%). The % 18:1 trans-10 in milk from control (.36), SFZ (.27), and LFZ (.36) were higher than those in WCS and SFC (.04, .05). Based on estimated passage rates from NRC, fat disappearance in situ was 27.8, 65.7, 52.6, and 44.7% for WCS, SFZ, LFZ, and SFC. Although having a lower FA digestibility, SFC100 appeared to minimize negative effects of free oil in the rumen from SFZ, explaining higher DMI and milk production than WCS or LFZ.

Key Words: Cottonseed, Fatty Acid, Lactating Dairy Cows

629 Effect of feeding whole fuzzy cottonseed with elevated concentrations of free fatty acids on production of lactating dairy cows. K. M. Cooke* and J. K. Bernard, The University of Georgia, Tifton.

Twenty-four lactating Holstein cows were used in an 8 wk randomized block trial to examine the effects of feeding whole cottonseed (WCS) with elevated concentrations of free fatty acids in the oil (FFA) on intake and performance. Treatments included a control WCS with normal concentrations of FFA (6.8%) and two lots of WCS with elevated FFA; HFFA1 (24.1%) or HFFA2 (22.3%). Compared with control and HFFA1, the HFFA2 contained slightly more moisture (9.4, 10.6, and 11.9 %, respectively) and less oil (18.4, 17.1, and 15.9 %, respectively) and were visibly discolored. There were no differences in concentrations of ADF, NDF, or minerals among WCS treatments. Cows were trained to eat behind Calan doors and individually fed once daily. The WCS composed 14% of the total DM of the ration. Dry matter intake was highest (P = 0.06) for cows fed HFFA2 (23.5 kg/d) compared with control and HFFA1 (21.6 and 22.0 kg/d, respectively). No differences in milk yield (average 34.7 kg/d) were observed among treatments. Milk fat percent was lower (P = 0.007) for HFFA1 (3.64%) and HFFA2 (3.58 %) compared with control (4.22%). Percentage of milk protein, lactose, and SNF was similar among treatments. No differences were observed in concentrations of MUN although values were numerically higher (P = 0.15) for diets containing WCS with elevated FFA. While molar proportions of butyrate and isobutyrate were higher for HFFA1 and HFFA2 compared with control (P = 0.08 and P = 0.0004, respectively), no differences were observed in concentrations of acetate or propionate. Results of this trial indicate that feeding WCS with high concentrations of FFA may slightly increase DMI and decreases milk fat percentage but does not alter milk yield. The decrease in milk fat percentage is apparently not due to changes in proportions of individual VFA.

Key Words: Cottonseed, Free Fatty Acids

Animal Behavior and Well-being: Dairy Cattle Housing, Management, and Stress

630 The use of animal-based measures to evaluate tie stall design on dairy farms in Ontario. K. Zurbrigg*[1], D. Kelton[2], N. Anderson[1], and S. Millman[2], [1]Ontario Ministry of Agriculture and Food, Fergus, Ontario, Canada, [2]University of Guelph, Guelph, Ontario, Canada.

Poor tie stall design can cause injury, lameness and mastitis. These problems affect cattle welfare and increase the probability of premature culling, lost production and negative public attitudes toward the dairy industry. The objective of this study was to describe the prevalence of animal-based measures of cow comfort and associations among measures of cow comfort, tie stall dimensions, milk production and milk quality.

All lactating cows on 317 randomly selected tie stall dairy farms across Ontario were included in this cross sectional study. Each cow was scored for the presence of the animal measures listed in Table 1. Using multivariate negative binomial regression techniques, these measures were analyzed for their associations with stall length, stall width, tie rail height, chain length and the presence of an electric trainer. The proportion of the herd affected with each problem and the farms tie stall dimensions were also analyzed for associations with the volume of milk shipped and bulk tank somatic cell count (BTSCC). The prevalence of open hock wounds was 36% greater for cows housed in stalls with electric trainers compared to stalls without (p=0.05). For each inch increase in tie chain length there is a 1.4% decrease in the prevalence of cows with dirty hind limbs (p=0.05). A 1% increase in the percent dirty cows was associated with an increase in BTSCC, of 1100 cells per ml (p=0.003).

Benchmarking the prevalence of lameness, cleanliness and injuries allows individual farms to assess their own herd scores and thereby to determine their farms strengths and weaknesses.

Table 1. The proportion of cows affected with each animal measure ranked from the lowest to highest scoring farms in each category.

Variable	Best 20% (%)	2nd Best 20% (%)	Middle 20% (%)	2nd Worst 20% (%)	Worst 20% (%)
Swollen hocks	0-4	5-9	10-15	16-26	27-61
Hock hair loss	0-15	16-27	28-42	43-53	54-81
Hock wounds	0-1	2-3	4-7	8-12	13-100
Neck lesions	0	0	0-1	2-4	5-48
Broken tails	0	0	0-1	2-5	6-50
Rotated hind claws	0-7	8-15	16-22	23-34	35-74
Arched backs	0	0-1	2-3	4-6	7-21
Dirty udders	0	0-1	2-3	4-7	8-48
Dirty hind limbs	0-3	4-9	10-18	19-36	37-94

Acknowledgements: Ontario Minsitry of Agriculture and Food, University of Guelph, Dairy Farmers of Ontairo

Key Words: Tie-Stall, Injuries, Dairy Cows

631 The comparison between cow behavior to free stall and straw bedding system. S. Ghasemi* and A. A. Naserian, Ferdowsi University, Mashhad, Khorasan, Iran.

Free stall systems are increasing on dairy farms in Iran as an alternative to straw bedding. The objective of this study was to compare cows' responses to free stall and straw bedding systems, in different seasons. This experiment was conducted during 2004, in a dairy farm in north of Iran near the Caspian sea, with humid and hot weather in summer, annual rain fall of 450mm and minimum

and maximum of annual temperature and humidity of -3 to 42 C°, 30 to 100%, respectively. The herd size was 800 head with 300 cows milked daily and producing about 9 ton over the experiment. Two open sheds (60m x 32m) were used with 80 dairy cows in each. The average milk production of each barn was 36±1.5 Kg and average days in milk were 105±5. In one barn there were 80 free stalls and whilst the other was an open system with a concrete floor covered with wheat straw up to 10cm depth. Over 12 months, the location, posture and behavior of cows in each barn were considered at different times of day(4 AM, 9 AM, 2 PM and 8 PM). Data were analyzed using General Linear Models procedure of SAS V6.12 for ANOVA to evaluate differences among experimental groups, the design was split plot in time, means compared with Duncan test. In four seasons, the number of cows that were lying and eating in the straw bedding system was more than free stall system and the differences were significant ($p \leq 0.05$). So, data showed that cows prefer straw bedding in comparison with free stall system.

The effect of season on cow preference

	Lying in straw (%)	Lying in free stall (%	SEM
spring	35.96[a]	14.03[b]	0.013
summer	33[a]	14[b]	0.006
autumn	46.72[a]	15.88[b]	0.0001
winter	51.82[a]	35.88[b]	0.002
	Eating in straw (%)	Eating in free stall (%)	SEM
spring	31.57[a]	18.42[b]	0.011
summer	27[a]	26[b]	0.009
autumn	18.69	18.69	0.005
winter	7.4[a]	5.5[b]	0.05

Key Words: Free Stall, Straw Bedding, Dairy Cows

632 Immune function and oxidative stress vary by management and lactation stage for dairy cows in pasture-based production systems. K. Saker*[1], J. Fike[1], S. Washburn[2], and A. Meir[3], [1]Virginia Polytechnic Institute and State University, Blacksburg, [2]North Carolina State University, Raleigh,, [3]Center for Environmental Farming Systems, Goldsboro, NC.

This research focused on immune response to management and lactation stage in grazing dairy cows. Fall-calving first lactation and multiparous mixed breed dairy cattle (n=64) were maintained on pasture year-round. Pastures were a mix of cool- and warm-season perennial and annual grasses. Experimental treatments were high (3.7 cows/ha; HSR) vs. low (2.47 cow/ha; LSR) stocking rate management. A corn-cottonseed-based supplement was fed to both groups but at a greater rate for HSR cows (11 vs. 7 kg·cow d^{-1}). Stocking and supplementation rates were intentionally linked (confounding) to compare animal immune responses to differences in system management. Average milk production between the groups was similar (6100 kg/lactation), suggesting additional supplement adequately offset lower forage availability for HSR cows. Select immune function and oxidative stress measures were assessed 5 times per production year: calving (C), early lactation (EL), peak lactation/breeding (PL/B), summer heat stress (SHS), and late gestation (LG). In general, cows had lowest innate immune response during the PL/B and C periods, in that order. Phagocytic cell activity (% cells responding) of HSR cows was significantly lower than LSR cows during C (9.4 vs. 14.7%; $P < 0.01$), PL/B (9.3 vs. 18.6%; $P = 0.01$), and SHS (25.1 vs. 33.8%; $P < 0.01$) periods. Antioxidant activity in all cows closely paralleled phagocytic activity during specific times of physiological and environmental stress. Activity was lowest when oxidative stress was most pronounced. Cows at the LSR appeared to have greater protection against oxidative stress based on lower lipid hydroperoxide production (64.3 vs. 104.6 μM; $P < 0.01$) and higher antioxidant (SOD/GSH-Px) activities (36.0 vs. 15.5 and 94.4 vs. 81.2 mU/mg protein, respectively; $P < 0.05$). Somatic cell score of HSR cows were higher compared to the LSR group (3.5 vs. 2.5; $P = 0.05$). Stocking rate along with associated supplement:forage ratios in pasture-based dairy systems can influence immunological and physiological responses to management and environmental stressors.

Key Words: Antioxidant Activity, Immune Function

633 Infrared thermography as a non-invasive measure of stress in dairy cows. M. Stewart*[1], J. Webster[1], G. Verkerk[2], J. Colyn[3], and A. Schaefer[3], [1]AgResearch, Hamilton, New Zealand, [2]Dexcel, Hamilton, New Zealand, [3]Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada.

Infrared thermography of the eye (ET), to detect heat produced by stress, may be a useful non-invasive way to measure the welfare impact of husbandry practices on domestic livestock. This study examined the ET of dairy cows during stimulation of the stress axis by intravenous hormonal administration or social isolation. Six cows, acclimated to handling, were each given six treatments in a random Latin-square design: 1) 5ml saline 2) ACTH (0.05 mg Synacthen) 3) bCRH (20 μg) 4) bCRH (40 μg) 5) epinephrine (1.4 μg /kg liveweight) and 6) isolation (I). Treatments were administered at time 0 and blood was sampled via jugular catheter while standing beside each cow at -30, -15, 0, 5, 10, 15, 20, 30, 40, 50, 60, 75, 90, 120, 180 and 240 min except for epinephrine which was sampled at -30, -15, -10, -5, 0, 2, 5, 10, 15, 20, 30, 45, 60, 90 and 120 min. Body temperature was recorded every 10 min and ET was recorded approximately every 2 min from 30 min pre-treatment (ThermaCam S60). Plasma samples were assayed for ACTH, cortisol and non-esterified fatty acids (NEFA). ACTH increased after bCRH, and cortisol increased after ACTH and bCRH ($P<0.001$). Neither cortisol nor ACTH changed after epinephrine or I. NEFA increased after epinephrine ($P<0.01$). ET increased prior to treatment in many cases. Compared to pre-treatment, ET was higher 30 and 60 min after saline and ACTH ($P<0.001$), but not after other treatments. ET tended to drop rapidly by the first sample after I ($P=0.057$) and then increase again (by 30 min, $P<0.001$). Body temperature was not affected by any treatment. Increases in cortisol, ACTH and NEFA confirmed stress axis activation. Pre-treatment increases in ET, possibly due to prior activity or handling stress, confounded post-treatment effects. The changes in ET found after I are novel, suggestive of an acute sympathetic response and may reflect psychological stress which was unique to social isolation.

Key Words: Infrared Thermography, Stress, Welfare

Animal Behavior and Well-being: Cattle, Pain Stress and Welfare

634 Does ketoprofen alleviate acute pain during dehorning? S. Millman*, T. Duffield, K. Lissemore, S. James, and L. Misch, University of Guelph, Guelph, ON, Canada.

Research shows that dehorning is painful to calves and that local anaesthetic, such as a lidocaine block, alleviates acute pain responses. Currently, the vast majority of dairy producers in North America dehorn their own calves, and rarely use lidocaine for this procedure. Effective in reducing post-surgical pain from dehorning, we examined if ketoprofen, an over-the-counter non-steroidal anti-inflammatory drug, is effective in alleviating pain when calves are dehorned at very young ages. Dairy calves (n=27) were dehorned when less than one month of age. All calves received corneal (IC) and intramuscular (IM) injections immediately prior to the dehorning procedure, with calves randomized among three treatments: L (lidocaine IC, saline IM), K (saline IM, ketoprofen IM) or C (saline IC, saline IM). Persons dehorning and collecting data were blind to the treatments. Behaviour data was collected during dehorning. Physiologic data was collected immediately prior to and following dehorning. Analysis of variance was used to analyse heart rate, respiratory rate, stamping and

avoidance. Contrasts between treatments were constructed using simple t-tests. All other observations were collapsed into dichotomous variables and analyzed using Fishers exact test. Both K and C calves performed more foot stamping (P=0.001) and avoidance (P=0.0004) than L calves. Tail hanging, a relaxed posture, was more frequently observed in L than K or C calves (P=0.005). Episodes of falling, kicking, rearing and vocalization were analysed collectively, and were performed significantly more often by K and C calves (0/9, 7/9, 5/9 respectively). Similarly, K and C calves displayed significantly greater changes in heart rate (P=0.001) and respiratory rate (P=0.001) than L calves. There were no significant difference between K and C calves for any of the variables measured. In conclusion, behavioural and physiological responses indicate that ketoprofen is not an acceptable alternative to local anaesthetic when managing pain associated with dehorning, even when conducted at young ages.

Acknowledgements: The authors thank Divya Viswanathan for technical assistance, and funding from OMAF and Merial.

Key Words: Dehorning, Animal Welfare, Pain Management

635 Effect of neck injections and use of a blind on behavior and flight speed in cattle. R. Müller*[1], M. A. G. von Keyserlingk[1], and K. S. Schwartzkopf-Genswein[2], [1]Animal Welfare Program, University of British Columbia, Vancouver, BC, Canada, [2]Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.

The use of the neck region as injection site in cattle is becoming routine. Use of a blind may reduce aversive behavior caused by the presence of the person administering the injection. To evaluate whether cattle react to the proximity of the stockperson or to the subcutaneous injection (5 ml 0.9 % NaCl solution), 120, 10 mo old, Angus steers weighing 298 ± 28 kg (mean ± SD) were assigned to one of four treatment groups using a crossover design (neck/sham injection × blind/no blind) replicated over 2 d (3 d apart). Cattle were restrained for a total of 60 s in a squeeze chute with treatment being administered 20 s after entry. Squeeze activity (SA) was rated (scale: 5 levels from calm (1) to highly agitated (5)) for three 20 s intervals (initial 20 s baseline, middle 20 s including treatment, and final 20 s post treatment). Flight speed (m/s) was used as a measure of aversion to treatments and was taken upon release from the chute. No treatment or day effect on flight speed (2.67 vs. 2.58 m/s, ns, ANOVA) was observed; however, correlation between days ($r = 0.74$, $P \leq 0.001$) was significant. Animals receiving an injection were more agitated during the middle interval compared to animals receiving a sham injection (SA d 1, d 2: 1.90 vs. 1.58, 1.86 vs. 1.63; $P \leq 0.05$, $P \leq 0.1$; respectively). Although use of a blind had no effect on SA within d 1, animals exposed to the blind on d 1 were more agitated on d 2 (SA: 1.87 vs. 1.53; $P \leq 0.01$). Moreover, steers exposed to the blind on d 2 had higher reactivity scores during the baseline (SA: 1.87 vs. 1.53; $P \leq 0.01$) and post treatment intervals (SA: 2.17 vs. 1.67; $P \leq 0.001$) compared to animals without a blind. Flight speed may not be a useful measure of aversion when treatment differences are small, but appears to be repeatable. The results suggest that use of a blind does not reduce aversive responses by cattle to human presence or injection but appears to increase reactivity over time.

Key Words: Cattle Behavior, Injection Site, Flight Speed

636 A comparison of cattle temperament scores by breed type using different types of temperament scoring. J. Baszczak*, T. Grandin, S. Gruber, T. Engles, and J. Tatum, Colorado State University, Fort Collins.

The objective was to study beef cattle temperament during handling through a squeeze chute using several different numerical scoring systems. Four hundred and twenty 6 to 9 month old steers were grouped into 42 pens by breed type: Brahman crossbreds (n = 140), British (n = 140), and Continental crossbreds (n = 140). Temperament was evaluated on all cattle twice, approximately 28 days apart during standard weighing and processing. A four-point scoring system was used to assess the force required to induce the animal to enter the squeeze chute: none, tap on rear, one electric prod and multiple electric prods. A three-point scale of walk, trot, or canter was used for entering and exiting speed into and out of squeeze chute. Temperament within the squeeze chute was assessed with a four-point scale. Vocalization and defecation were measured by the number of occurrences while being held in the squeeze chute. Brahmans crossbreds (x = 2.06) needed the least amount of force to enter the squeeze chute compared to British (x = 2.35) or Continental crossbreds (x = 2.83) at P = 0.001. Entry speed scores were not significant at P = 0.23. Squeeze chute temperament scores were also not significant among the breed types at P = 0.79. Vocalization and defecation were not significant (P = 0.38 and 0.07). Exit speed scores were found to be significant at P = 0.005. Upon exiting the squeeze chute, Brahman crossbreds (x = 2.06) would trot, and Continentals crossbreds (x =1.87) were more likely walk to trot, and British steers (x = 1.50) would walk. Cattle forced entry and exit speed scores are probably a more sensitive way for determining differences in temperament by breed type. The data was analyzed using a repeated measures model by pen in SAS 9.1.

Acknowledgements: I would like to thank Elanco for supporting this project.

Key Words: Cattle, Temperament, Breed Type

Thursday, July 28, 2005

SYMPOSIA AND ORAL SESSIONS

Animal Behavior and Well-being: Attitudes Toward Animal Welfare and Human Animal-Interaction

637 Human and animal interaction and welfare issues at the farm level. P. Hemsworth*, *University of Melbourne*, *Werribee, Vic, Australia*.

While the importance of the stockperson in relation to animal welfare is generally acknowledged in industry care guidelines, codes of practice and quality assurance programs for animal welfare, it is debatable whether this sentiment has been fully accepted or adopted by the livestock industries and others. The major human characteristics affecting animal welfare are the stockperson's attitudes and behaviours. There are accumulating international data in a number of livestock industries that show that a negative attitude by stockpeople towards interacting with pigs, dairy cows and to a lesser extent poultry, is correlated with increased levels of fear of humans by farm animals and, in turn, reduced animal productivity and welfare. In addition to stockperson attitudes and behavior, there are other stockperson characteristics that will affect the welfare of livestock such as technical skills and knowledge, job motivation and commitment, job satisfaction and personality of the stockperson. This paper will review the impact of the stockperson on farm animal welfare and consider the opportunities for cognitive-behavioural training of stockpeople to improve animal welfare and other tools to assist in either selecting appropriate stockpeople or in identifying their training needs. While both housing and stockperson factors are important determinants of animal welfare, the focus to date has been on the former. Irrespective of their relative importance, considerably more resources need to be focused on the critical role of the stockperson in protecting the welfare of farmed animals. Indeed, it is likely in the near future that both the livestock industries and the general community will place an increasing emphasis on ensuring the competency of stockpeople to manage the welfare of farm animals. Appropriate strategies to recruit, train and retain stockpeople in the livestock industries will be integral in safeguarding the welfare of commercial livestock.

Key Words: Stockperson, Behaviour, Personality

638 Assessment of student attitudes about companion and food animal welfare. J. Osborne*[1], C. Gasser[1], S. Boyles[1], J. Kinder[1], and P. Hemsworth[2], [1]*The Ohio State University*, *Columbus*, [2]*Animal Welfare Centre*, *Victoria, Australia*.

Societal concern about welfare of animals has increased over the past several years. We assessed student attitudes toward animal welfare as part of a larger project involving development and incorporation of animal welfare teaching modules into the Animal Sciences curriculum at OSU. The specific objective was to assess how course level (within the Animal Sciences major) and career interest area (as determined by major course of study) affect student perceptions about animal welfare. Animal Sciences students from Introductory (L, n=315) and Capstone (H, n=123) courses were surveyed about a variety of animal welfare topics. Significant differences were observed in only a few responses, notably whether non-farmers are concerned about animal welfare (1: "not at all", 5: "very much"; H=3.52±0.09, L=3.18±0.05, $p<0.001$) and whether the welfare of laying hens is generally good (1: "agree very strongly", 5: "disagree very strongly"; H=3.14±0.09, L=2.92±0.06, $p<0.05$). Students surveyed in a senior level Social Issues course in Animal Sciences represented the University population and were divided into three groups, Non-agricultural majors (NonAG, n=286), Agriculture/non-Animal Sciences majors (AG, n=134) and Animal Sciences majors (AN, n=114). In almost all cases, differences were observed between responses provided by NonAG and AG, but relatively few differences were noted between AG and AN. Interestingly, no differences were noted among these groups regarding the state of the welfare of companion animals (dogs, cats, pleasure horses), with all groups agreeing that the welfare of these species was generally good (1: "agree very strongly", 5: "disagree very strongly"; mean responses ranged from 1.76±0.08 to 2.10±0.11). We conclude that the current curriculum in the Animal Sciences major is not impacting attitudes regarding animal welfare to a great extent, however there are significant differences in attitudes regarding animal welfare of food animal species in students with agricultural majors compared with non-agricultural majors.

Key Words: Animal Welfare, Survey, Social Issues

639 Attitudes to farm animal welfare: Survey results of US animal science and veterinary college faculty. C. Heleski*[1], A. Mertig[2], and A. Zanella[1], [1]*Michigan State University*, *East Lansing*, [2]*Middle Tennessee State University*, *Murfreesboro*.

The implementation of new technology or the acceptance of new research findings is at least partially dependent on the attitudes of stakeholders. Regarding farm animal welfare, a great deal of scientific work has been done, but uptake of the information has been slow. We decided to assess the attitudes toward farm animal welfare of two fundamentally invested stakeholder groups: animal science faculty (ANS) and veterinary college faculty with a large animal/food animal emphasis (VCF). We used e-mail surveys to contact ANS from 58 US animal science departments and VCF from 27 US veterinary colleges. Our response rate for ANS was 44% (n = 446) and for VCF was 35% (n = 157).

When presented with theoretical aspects of animal welfare, our respondents were generally concerned (e.g. 71% VCF and 70% ANS agreed with the statement, I believe in using animals for the greater human good, but we have an obligation to provide for the majority of their physiological and behavioral needs.) However, when presented with more specific examples, concern was considerably lower (e.g. 38% of ANS agreed that they are concerned with castration without anesthetic). Several background variables showed significant relationships with calculated attitude scale scores: females were more concerned about farm animal welfare than were males ($P < 0.01$), those with liberal political views were more concerned than those with conservative views ($P < 0.01$); and those citing higher religiosity had less concern than those with lower religiosity ($P < 0.05$).

When asked to identify obstacles to enhancing farm animal welfare (if they felt enhancements were necessary), over 60% of our respondents chose to provide an open-ended (qualitative) answer. The five most common themes mentioned were economics, lack of consumer willingness to pay, tradition, producer attitudes, and inadequate welfare science research.

These survey-based studies represent an important step in understanding attitudes toward farm animal welfare of stakeholders who are heavily invested in animal agriculture.

Key Words: Animal Welfare, Attitudes, Survey

640 Development of a web-based course in animal welfare. C. Wickens*, J. Siegford, and A. Zanella, *Michigan State University*, *East Lansing*.

Animal welfare is a complex issue of growing national and international importance, thus it is imperative to train personnel in scientific welfare assessment. Animal welfare instruction requires a multidisciplinary approach, which is not easily achieved in programs at single institutions. A university-wide collaboration of faculty at Michigan State University is developing a web-based animal welfare assessment course, using interactive media and software, to teach graduate and veterinary students scientific principles needed to assess animal welfare. Students will learn animal welfare concepts through a series of modules including: welfare ethics and law; economics of welfare; physiological indicators of welfare; welfare and suffering, including pain; and welfare standards among other relevant topics. To enhance quality and offer global diversity of content, modules will be created by international animal welfare experts. Web-based interaction between students and instructors from multiple institutions will provide opportunities for dialogue and collaboration. Real and science-based information has been compiled to form hypothetical scenarios, depicting various production or other animal-related situations. Students will use information on behavioral biology, physiology, husbandry, nutrition, veterinary care, housing, indicators of stress, and stockmanship to assess animal welfare by reviewing the information and rating each area, as well as the overall scenario. The scenarios contain links which allow students to access pertinent articles and animal welfare resources for additional information before making an assessment. A standardized answer key for each scenario allows students to compare their assessment to that of a panel of animal welfare scientists. The course will be evaluated to assess information acquisition, impact on knowledge of and attitudes toward welfare, and main criteria used to assess welfare. Future directions might include packaging course materials into CD-ROM format for professional use and licensing the course to other universities.

Key Words: Education, Welfare Assessment, Web-Based Instruction

Alpharma Symposium: Animal Health—Acidosis in Dairy Cattle

641 Ruminal acidosis: beyond the rumen. M. B. Hall*, *U. S. Dairy Forage Research Center, USDA-ARS*, *Madison, WI*.

Although the main focus in ruminal acidosis has been on the rumen, it might be more accurate to consider this nutritional disorder as a syndrome that can affect systems beyond the rumen and outside of the gastrointestinal tract. Notwithstanding that ruminal acidosis is by definition related to low ruminal pH and damage to that compartment of the gut, damage and impairment of function associated with ruminal acidosis has been reported for diverse systems. Among the signs associated with ruminal acidosis, mucin casts shed in feces are indicative of destruction of epithelium in the large intestine. Apparently similar to damage caused by grain overload in equines, it may offer a link between the species for routes by which laminitis may be induced. It also suggests that excessive fermentation in other portions of the gastrointestinal tract may be involved in the syndrome of ruminal acidosis. The damage and changes reported with induced acute ruminal acidosis offer indication of the array of systems that may be compromised: reduced oxidative metabolism of neutrophils, pneumonia, liver abscesses, laminitis, damage to various organ systems, gastroenteritis, fungal invasion of damaged tissues, and reduced saliva secretion. The study of ruminal acidosis has focused largely on the rumen. A broader view of tissues and functions affected might offer a better sense of the impact of this disorder on the animal and of appropriate treatments.

Key Words: Ruminants, Health, Nutrition

642 Regulation of ruminal pH: interaction of dietary and animal factors. M. S. Allen*, *Michigan State University*, *East Lansing*.

Ruminal pH is determined by the balance between the production of fermentation acids by microbes in the rumen and the absorption, passage, neutralization, and buffering of those acids. The production rate of fermentation acids is highly variable across diets. Identification of intrinsic characteristics of individual feeds have been identified that affect relative rates of digestion in vitro. However, absolute rates of digestion and passage of feed fractions in vivo are required to predict fermentation acid production. Absolute rates can be determined using the pool and flux method with ruminally and duodenally cannulated cows. Recent experiments using this method show great variation in fractional rates of passage of starch by source and indicate that rate of starch digestion in the rumen is a second order process and highly affected by concentration/activity of enzymes. Lack of information for absolute rates of digestion and passage of feed fractions from the rumen as well as microbial efficiency, which affects the yield of fermentation acid produced per unit of organic matter fermented, limit our ability to accurately predict fermentation acid production. Fermentation acid absorption is the primary route of hydrogen ion removal from the rumen and the concentration gradient across the ruminal epithelium is likely the major factor affecting their rate of absorption. Concentration gradient is likely affected by milk yield, which has been shown to be positively related to rate of fermentation acid absorption, as well as the strength and frequency of ruminal contractions, which affect mixing and blood flow. Coarse forage fiber retains digesta in the rumen, providing buffering capacity inherent in feedstuffs, increases salivary buffer flow through stimulation of rumination, and increases the concentration gradient through stimulation of ruminal motility. The importance of coarse forage fiber to maintain ruminal pH likely increases with the fermentability of diets.

Key Words: Ruminal pH, Concentration gradient, Rumen motility

643 Applied aspects of ruminal acidosis induction and prevention. G. R. Oetzel*, *University of Wisconsin*, *Madison*.

Recent information is improving our understanding of subacute ruminal acidosis (SARA) in dairy cows. Herds with SARA can be identified by measuring pH of ruminal fluid collected by rumenocentesis from a subsample of cows in the herd. Approximately 23% of herds evaluated as part of the clinical service provided by the Food Animal Production Medicine Section at the School of Veterinary Medicine, University of Wisconsin-Madison, were classified as having SARA problems. In herds feeding TMR, risk for low ruminal pH was higher in cows between 80 and 150 days in milk compared to cows less than 80 days in milk. Apparent risk factors for SARA, based on clinical and experimental data, include high dry matter intake, low dietary fiber content, inadequate dietary buffering, lack of long fiber particles, offering concentrate feeds separate from forage, sorting of feed ingredients within a TMR, intake of large meals at irregular intervals, and feed ingredients with unexpectedly high carbohydrate fermentability. Experimentally-induced SARA in lactating cows causes dry matter intake depression, decreased milk yield, increased ruminal concentrations of volatile fatty acids, transient spikes in ruminal lactate, the appearance of unusual fermentation products in ruminal fluid, and increased blood haptoglobin concentrations. SARA does not reliably cause milk fat depression, and short-term SARA challenges have no effect on milk fat content. SARA is more difficult to prevent in high-yielding cows with high dry matter intakes. Future prevention of SARA will likely require extremely consistent delivery of diets with minimal variation in composition; allowing cows adequate access to feed so that meals are small and regular; carefully formulating diets to optimize total intake of fermentable carbohydrate, fiber effectiveness, and buffering capacity; including (as needed) feed additives that help prevent low ruminal pH; and early detection of low ruminal pH - before long-term problems in cow health appear.

Key Words: Dairy cows, Subacute ruminal acidosis induction, Subacute ruminal acidosis prevention

Breeding and Genetics: Dairy Cattle Breeding for Production and Non-Production Traits

644 Productive life including all lactations, longer lactations, and calf value. P. M. VanRaden* and M. E. Tooker, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.*

Longer lactations are more profitable than in the past, and daughter pregnancy rate evaluations now allow separate selection for cow fertility and longevity. Measures of productive life were compared, and updated life expectancy factors were derived to replace those estimated in 1993. Extra credits for lactations longer than 10 mo and beyond 84 mo of age are proposed, and also for each calf produced so that an extremely long lactation will not receive more credit than multiple shorter lactations with dry periods between. Maximum credits per lactation of 10 mo, 12 mo, and unlimited were compared; the latter either included or excluded a calf value equal to 2 mo of production. Days in milk beyond 305 had not been stored in early data but were estimated from the subsequent calving date assuming a 60-d dry period. Heritabilities and genetic correlations were estimated by multi-trait REML for longevity censored at various ages and for yield traits and somatic cell score in first parity. Data included records from 1,098,329 Holsteins born from 1994 through 1997 from 5109 sires, and a relationship matrix among sires was included in the model. Cows that were still alive in 2005 received credit for predicted remaining months of productive life. Lactations beyond 84 mo added little information. Heritability of productive life was 0.073 with 10-mo, 0.069 with 12-mo, and 0.067 with unlimited lactation credits. The latter increased slightly to 0.068 with calf credit included. Corresponding genetic correlations of productive life with protein yield were 0.00, 0.03, 0.12, and 0.11, all much lower than the 0.46 estimated in 1993. Phenotypic correlations and life expectancy factors were similar to 1993 estimates. Productive life censored at 36 mo is genetically correlated by only 0.87 with final productive life and is influenced more by yield traits (those correlations ranged from 0.14 to 0.27). Adjustments for yield could make correlations more consistent across time and across censoring ages. Stable properties and high economic value are desired while retaining simple interpretation.

Key Words: Longevity, Productive Life, Lactation Length

645 Effect of inbreeding on functional longevity in Canadian dairy breeds. A. Sewalem*[1,2], G. Kistemaker[2], F. Miglior[1,2], and B. Van Doormaal[2], [1]*Agriculture and Agri-Food Canada, Guelph, ON, Canada,*, [2]*Canadian Dairy Network, Guelph, ON, Canada.*

The aim of this study was to assess the level of inbreeding and its relationship to the functional survival of Canadian dairy breeds using a Weibull proportional hazard model. Data consisted of 72,385 cows in 1,505 herds from 2,499 sires for Jersey, 112,723 cows in 1,482 herds from 2,926 sires for Ayrshire and 1,977,311 cows in 17,182 herds from 8261 sires for Holstein. Functional longevity was defined as the number of days from the first calving to culling or death or censoring. Inbreeding coefficients (F) were grouped in to seven classes. The statistical model included the effects of stage of lactation, season of production, the annual change in herd size, type of milk recording supervision, age at first calving, effects of milk, fat and protein yields calculated as within herd-year-parity deviations, herd-year-season of calving, inbreeding and sire. The relative culling rate was calculated for animals in each class after accounting for the above-mentioned effects. The result showed that in all breeds there is a slight trend toward higher risk of culling among more inbred animals. The relative risk ratio for cows with inbreeding coefficients up to 12.5% were from 1.19, 1.16 and 1.14 times the risk ratios for non-inbred cows (F=0) for Jersey, Ayrshire and Holstein cows, respectively. There was minimal difference on the relative risk ratios among the three lowest classes of inbreeding relative to the non-inbred cows. The difference, however, was greater when the inbreeding coefficient increased beyond 12.5%.

Key Words: Functional Longevity, Inbreeding, Canadian Dairy Breeds

646 Relationship between somatic cell count and functional longevity in Canadian dairy breeds. A. Sewalem*[1,2], G. Kistemaker[2], and B. Van Doormaal[2], [1]*Agriculture and Agri-Food Canada, Guelph, ON, Canada.*, [2]*Canadian Dairy Network, Guelph, ON, Canada.*

The aim of this study was to examine the impact of somatic cell count (SCC) on the functional survival of Canadian dairy cattle using a Weibull proportional hazard model. Data consisted of 72,385 cows in 1,505 herds from 2,499 sires for Jersey, 112,723 cows in 1,482 herds from 2,926 sires for Ayrshire and 1,977,311 cows in 17,182 herds from 8,261 sires for Holstein. Functional longevity was defined as the number of days from the first calving to culling or death or censoring. Test day SCC were averaged within each lactation. Average SCCs were grouped into 11 classes with equal number of records in each class. The statistical model included the effects of stage of lactation, season of production, the annual change in herd size, type of milk recording supervision, age at first calving, effects of milk, fat and protein yields calculated as within herd-year-parity deviations, herd-year-season of calving, SCC class and sire. The relative culling rate was calculated for animals in each class after accounting for the above-mentioned effects. The overall average SCC for Jersey breed was 185,250 with standard deviation of 59,700. The corresponding figures for Ayrshire were 213,880 and 71,200 and for Holstein 280,150 and 86,290. In all breeds there are no appreciable differences in the relative risk of culling among classes of mean SCC up to nearly breed average. However, as the mean SCC increased beyond breed average, the relative risk of cows being culled increased. For instance, cows with the highest mean classes of SCC had a risk of being culled that was 2.73, 3.27 and 2.58 times that for cows extremely low SCC for Jersey, Ayrshire and Holstein, respectively.

Key Words: Functional Longevity, Somatic Cell Count, Risk of Culling

647 Detection and confirmation of quantitative trait loci affecting traits of lifetime profit index on 23 chromosomes in Canadian Holstein cattle. Y. Pan*[1,2], J. P. Chesnais[1,2], N. Bissonnette[3], N. Caron[1], G. B. Jansen[4], Y. Plante[5], and E. B. Burnside[1,2], [1]*The Semex Alliance, Saint-Hyacinthe, Quebec, Canada*, [2]*L'Alliance Boviteq, Saint-Hyacinthe, Quebec, Canada*, [3]*Dairy and Swine Research and Development Centre, AAFC, Lennoxville, Quebec, Canada*, [4]*CGIL, Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada*, [5]*Saskatchewan Research Council, Saskatoon, Saskatchewan, Canada.*

Marker assisted selection (**MAS**) can be used to increase the accuracy of young bull selection prior to progeny testing, leading to increased rates of annual genetic gain or decreased costs for young bull selection or both. The dairy cattle population structure, whereby elite bulls have many sons, themselves proven through a large number of daughters, lends itself to the application of a granddaughter design (**GDD**) to detect quantitative trait loci (**QTL**) prior to MAS. In this study, a total of 617 young bulls with Canadian genetic evaluations, originating from six sire families, were genotyped for 143 microsatellite markers distributed on 23 chromosomes, at an average interval of 11.6 cM. The traits under scrutiny were these in the Lifetime Profit Index (**LPI**), i.e. protein yield, fat yield, somatic cell score, capacity, feet and legs, milking speed, mammary system and herd life. A weighted least squares method in the program QTL EXPRESS and the FORTRAN program (Knott et al. 1996) was used to detect QTL affecting these traits. Chromosome-wise thresholds for reporting statistically significant QTL were determined by permutation tests. False discovery rates (**FDR**) were used to determine thresholds for genome-wide significance. Approximately 50 QTL detected in this study ($P < 0.10$ and $FDR < 0.20$ for the across family analysis or $P < 0.05$ and $FDR < 0.20$ for the within family analysis) had already been found in other studies. In addition, 12 new QTL were discovered affecting LPI traits at significance levels of $P < 0.05$ and $FDR < 0.20$.

Key Words: Quantitative Trait Loci (QTL), Lifetime Profit Traits (LPI), Holstein Cattle

648 Identification of a missense mutation in the gene responsible for the QTL on BTA6 affecting milk yield and composition in dairy cattle. M. Cohen-Zinder[1], E. Seroussi[1], D. Larkin[2], J. Loor[2], A. Everts-van der Wind[2], J. Lee[2], J. Drackley[2], M. Band[2], M. Shani[1], H. Lewin[2], J. Weller*[1], and M. Ron[1], [1]*Agricultural Research Organization, The Volcani Center*, *Bet Dagan, Israel*, [2]*University of Illinois*, *Urbana*.

We previously localized a quantitative trait locus (QTL) on chromosome 6 affecting milk fat and protein concentration to a 4 cM confidence centered on the microsatellite BM143. We characterized the genes and sequence variation in this region, and identified common haplotypes spanning five polymorphic sites in the genes IBSP, SPP1, PKD2, and ABCG2 for two sires segregating for this QTL. Expression of SPP1 and ABCG2 in the bovine mammary gland increased during lactation. SPP1 was fully sequenced, and all the coding exons of ABCG2 and PKD2 were sequenced for these two sires. Only the single nucleotide change capable of encoding a substitution of tyrosine to serine (Y→S) corresponded to the segregation status of all three heterozygous and 15 homozygous sires for the QTL in the Israeli and US Holstein populations (P = 0.00008). The allele substitution fixed effects on the genetic evaluations of 335 Israeli sires were -340 kg milk, +0.15% fat, and +0.13% protein (F-value = 200). None of the other polymorphisms gave significant effects for fat and protein concentration in models that also included Y→S. The allele substitution effects on the genetic evaluations of 670 cows, daughters of the two heterozygous sires, were -226 kg milk, 0.09% fat, and 0.08% protein (F-value = 394), with partial dominance towards the S homozygotes. We therefore propose that this Y→S polymorphism is the causative site for this QTL.

Acknowledgements: This research was supported by a grant from the Israel Milk Marketing Board and the US-Israel Binational Agricultural Research and Development fund (BARD). The authors thank B. Kinghorn and I. Misztal for use of their programs and Mr. Efraim Ezra for his help in data retrieval from the Israeli herd-book.

Key Words: Quantitative Trait Locus, BTA6, Milk Protein Concentration

649 Genetic gains in milk, fat and protein yields of the Holstein breed in Brazil. C. N. Costa*[1], N. M. Teixeira[1], A. F. Freitas[1], J. A. Cobuci[1], and K. Haguihara[2], [1]*Embrapa Gado de Leite*, *Juiz de Fora-MG, Brazil*, [2]*Brazilian Holstein Association-ABCBRH*, *São Paulo-SP, Brazil*.

Traditionally Brazilian Holstein breeders are users of semen imported from North America and Europe. Choice of semen is generally based on sire proofs from the exporting countries. Estimates of genetic gain indicate effectiveness of imports to promote genetic progress locally. First lactation 305-day records of up to 88,449 Holstein cows calving between 1984 and 2003 in a total of 1808 herds in different States of Brazil were used to estimate breeding values and genetic gains for milk, fat and protein yields. Univariate analyses were used with a model including herd-year, season, age at calving, genetic composition of the cow and genetic group of sires as fixed effects and sire by herd interaction, animal and residual as random effects. Genetic variances for milk, fat and protein yields were respectively 333,869.2; 372.3 and 258.3 kg ^{2}. Genetic trends were estimated for sires and cows by regression of the Predicted Transmitting Ability (PTA) on birth year. Estimated weighted and unweighted average annual genetic gains (kg/year) were 13,8 and 10,1 for milk, 0.32 and 0.33 for fat, respectively, for sires born from 1968 to 1996 and 0.39 and 0.29 for protein for sires born from 1976 to 1995. Genetic gains were 8.3 for milk and 0.26 for fat for cows born from 1981 to 2000 and 0.29 for protein for cows born from 1989 to 2000. Annual weighted genetic gains for sires were 0.23, 0.16 and 0.18 % of the average population for milk, fat and protein, respectively. Except for fat yield, trends from weighted PTAs were slightly larger than those from unweighted PTAs indicating breeders have used more intensively sires with larger than average genetic potential for milk and fat production. Genetic gains in the last ten-year periods were lower than those from earlier periods suggesting the population has progressed at a decreasing pace. These rates of genetic progress suggest genotype by environment interaction and that breeders have been considering traits other than production when selecting sires for breeding.

Acknowledgements: ABCBRH for providing the data and Prodetab for financial support.

Key Words: Selection, Breeding Values, Genetic Progress

650 A phenotypic study of test-day yields recorded on Holstein-Friesian cows under Tunisian conditions. A. Ben Gara*, B. Rekik, M. Mrad, and B. Khouildi, *Ecole Supérieure d'Agriculture de Mateur*, *Mateur, Bizerte, Tunisia*.

Milk, fat, and protein yields and fat and protein percentages recoded in test-days and milk, fat, and protein yields in 305 days were studied on Holstein-Friesian cows under Tunisian conditions to determine important sources of variation and fit lactation curves.

Data included 330480 test-day records. These were of 23021 lactation records of which 6398 were first lactations. Data were collected in 136 herds from 1992 to 2002. The effects of environmental (year and season of calving), management (herd), and physiological (rank of lactation, calving age, and days in milk) factors on milk production were tested by a general linear model. Residuals were used to compute linear correlation coefficients among milk traits. Curves of test-day records and least square solutions of days in milk (DIM) from a test-day model were fitted by the incomplete gamma function.

Mean yields in 305 days were 6083 kg, 211 kg, and 190 kg for milk, fat, and protein yields, respectively, and contents were 3.42% and 3.04% for fat and protein. Milk productions varied with calving age ($p<0.01$), herd (0.01), rank of lactation (0.01), and DIM ($p<0.01$). Coefficients of determination of fitted curves ranged from 86 to 98%. The highest coefficients were obtained for protein percentage using non linear regression. DIM least square solutions improved fitting curves of only milk yield. First lactation cows started production averaging 16.7 kg, 0.64 kg, and 0.52 kg for the yields of milk, fat, and protein, respectively. They had lower peak yields but greater persistencies than multiparous cows. Correlation coefficients ranged from 0.58 to 0.88 among yield traits and from -0.31 to -0.28 between milk yield and fat and protein percentages, respectively.

Acknowledgements: Authors are thankful to CNAG, Sidi Thabet, Tunis, for providing the data.

Key Words: Test-Day Records, Lactation Curves, Dairy Cows

651 Genetic evaluation and best prediction of lactation persistency. J. Cole* and P. VanRaden, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*.

Cows with high persistency tend to milk less than expected at the beginning of lactation and more than expected at the end. Persistency was calculated as a function of a trait-specific standard lactation curve and the linear regression of a cow's test day deviations on days in milk. The objectives of this study were to calculate (co)variance components and breeding values for best predictions of persistency of milk (M), fat (F), protein (P), and SCS in Jerseys (Table 1). Heritabilities represent the additive genetic variance of persistency that is independent of yield and defined to have variance of 1. Data included 574,929 records for 252,669 Jersey cows calving since 1997. 3,193 AI sires received evaluations for persistency. Sire EBV for M, F, and P were similar and ranged from -0.70 to 0.75 for M; EBV for SCS ranged from -0.37 to 0.28. Regressions of sire EBV on birth year were near zero (< 0.003) but in favorable directions for all traits. Genetic correlations of M, F, and P with SCS were moderate and favorable, indicating that increasing SCS decreases yield traits, as expected. Genetic correlations among yield and persistency were low to moderate and ranged from -0.09 (SCS) to 0.18 (F). This definition of persistency is more desirable than those used in test-day models, which are often correlated with yield. A measure that is not confounded with yield may provide for simpler understanding of persistency. Routine genetic evaluations for persistency are feasible and may allow for improved predictions of yield traits.

Persistency (co)variance components

Trait	M[1]	F	P	SCS
M	0.17	0.76	0.89	-0.19
F	0.79	0.13	0.81	-0.14
P	0.90	0.80	0.13	-0.16
SCS	-0.44	-0.50	-0.43	0.05

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

Key Words: Best Prediction, Persistency, Test Day Model

652 Genetic evaluation of calving traits across Dairy and Beef breeds of cattle in Ireland. V. Olori*[1], A. Cromie[1], P. Donnellan[1], P. Amer[2], and R. Veerkamp[3], [1]*Irish Cattle Breeding Federation*, *Bandon, Co. Cork, Ireland*, [2]*Abacus Biotech Ltd.*, *Dunedin, New Zealand*, [3]*Animal Sciences Group*, *Lelystad, The Netherlands*.

Dairy and beef production systems are inter-twined in Ireland. Beef bulls are used extensively in dairy herds to produce crossbred calves for fattening and as beef suckler dams. With seasonal breeding and extensive grazing, farm profits are reduced by difficult calving and prolonged gestation. These traits should thus be in the dairy and beef breeding objectives. The aim of this study was to investigate the suitability of available data and estimate genetic parameters to facilitate genetic evaluation of these traits across breeds. Records were available from AI centres (AI), pedigree herd books (HB) and an Animal Events recording system (AE). Calving difficulty (CD) was transformed to a linear scale from scores on a 4 or 5 point categorical scale depending on source. GL was derived from the latest insemination date and restricted to ±10 days of the expected GL which was computed as the direct breed effect from sire and dam plus the maternal breed effect from dam. Genetic parameters were estimated with a sire-maternal grandsire model for the direct effect and simultaneously maternal grandsire for the maternal effect. Incidence of CD and genetic parameters varied significantly between data sources. Genetic correlation between AI and AE data was 0.45 for CD and 0.67 for GL but these were not correlated with corresponding traits in the HB data. The HB data was thus excluded from further analysis. Direct and maternal h^2 for CD were highest in the AE data and were 22% and 5% respectively with r_g of -0.77. Corresponding values for GL were 25%, 5% and -0.14. The AE data was used for breeding value estimation with the AI data incorporated as predictors. Sire PTAs for AI bulls across breeds ranged from -7% to 12% serious difficulty for direct CD, from -3% to 4% for Maternal CD and from -8 to 4 days for GL

Key Words: Calving Traits, Genetic Parameters, Across Breed Evaluation

653 Effect of the bovine solute carrier/sulfate transporter (SLC26a2) gene on foot and leg traits in newborn calves. A. M. Scholz*[1], S. Nueske[1], I. Medugorac[2], D. Seichter[3], J. Hampe[1], and M. Foerster[2,1], [1]*Experimental Farm of the Veterinary Faculty, University Munich*, *Oberschleissheim, Germany*, [2]*Institute of Animal Breeding of the Veterinary Faculty, University Munich*, *Munich, Germany*, [3]*Animal Breeding Research Munich e.V.*, *Poing, Germany*.

Foot and leg problems are of concern for cattle breeders. In this study, different foot and leg traits of newborn calves (age 5-8 days) measured linearly or by dual energy x-ray absorptiometry (DXA) were compared between the homozygous 'normal' (AA, n=114) and the heterozygous genotype (AB, n=58) of the bovine SLC26a2 gene (BTA 7q23-q24). Due to a relatively low frequency of the B allele (q=.18), the homozygous 'mutated' genotype (BB, n=1) was not included in the analysis. A T1559/G1559 mutation in the SLC26a2 gene results in an isoleucine to serine amino acid exchange at position 520. Comparable mutations in humans are responsible for bone and cartilage deformations caused by decreased transmembrane sulfate transportation. Purebred and crossbred calves originating from German Holsteins and Fleckvieh underwent a DXA scan under light sedation using a GE LUNAR DPX-IQ scanner. The medial and lateral claws of the fore and hind legs (including the pedal, distal sesamoid, short pastern, long pastern bones) were analyzed using the 'small animal whole body' scan mode for bone mineral density (BMD, g/cm^2), bone mineral content (BMC, g), and amount of fat tissue (g) within the region of interest. In addition, linear parameters as shown in the table were measured. A generalized linear model with the fixed effects SLC26a2 genotype, breeding line, gender, claw, SLC26a2×claw, and gender×claw was used for statistical analysis.

AA calves have significantly higher BMD, BMC, a larger wall diagonal, and heel angle than AB calves. But AA have a smaller sole width and heel height.

It is not exactly known yet, if a higher claw (bone) mineralization combined with a larger fat cushion, wall diagonal, and heel angle would be of an advantage for the foot health in the future life cycle of the calves. However, a DNA test for the SLC26a2 genotypes combined with exact phenotyping could provide a future tool to select for secondary traits, especially related to foot and leg health in cattle.

Least squares means ± standard errors of estimation for foot and leg traits measured by DXA and linearly

SLC26a2 Genotype	BMD	BMC	Fat Tissue	Wall Diagonal	Sole Width	Heel Height	Heel Length	Heel Angle
	g/cm^2	g	g	cm	cm	cm	cm	°
AA	.610±.003^a	10.38±.08^a	16.76±.28	6.14±.014^a	2.60±.008^a	3.18±.013^a	3.33±.020	113.7±.26^a
AB	.596±.004^b	10.02±.11^b	16.16±.38	6.07±.019^b	2.65±.010^b	3.24±.018^b	3.27±.027	112.5±.35^b

Different superscripts characterize significance (p£.05).

Acknowledgements: The DNA test for the bovine SLC26a2 gene has been patented under DE10155999C2 (BRENIG et al., 2003).

Key Words: Sulfate Transporter Gene, Foot and Leg Health, Dual Energy X-Ray Absorptiometry

654 Inheritance of hair whorl characteristics in Holstein cattle. A. VanCise*, T. Grandin, D. Garrick, and R. Enns, *Colorado State University*, *Fort Collins*.

A hair whorl is a follicular hair pattern on the forehead of most cattle. There are conflicting opinions as to whether hair whorl characteristics, such as height and asymmetry, are associated with scrotal circumference and spermatozoal characteristics such as motility and morphology. It has been hypothesized that an association between hair whorl characteristics and spermatozoal characteristics exists due to the fact that hair follicle pattern and testicular development occur at approximately the same time during fetal development. Hair whorls are visible from birth and if correlated with spermatozoal characteristics may be used as a selection criterion in cattle. Due to this possible relationship it was of interest to determine if hair whorl characteristics have a genetic basis. Using whorl characteristic data on Holstein bulls (n=414), whorl height and asymmetry were analyzed together to determine their heritabilities. MTDFREML was used to estimate the genetic correlation (r_g=0.10) between the two traits and their individual heritabilities. Both whorl height and asymmetry were found to be highly heritable (0.42±0.17 and 0.51±0.15, respectively). This high heritability would indicate that genes have a larger effect on whorl characteristics than environmental factors. If it were proven that a genetic correlation exists between hair whorl and spermatozoal traits, this would contradict the idea that the relationship between hair whorl and spermatozoal characteristics is due to an environmental correlation. If a genetic correlation were determined through further research, the high level of heritability in whorl height and asymmetry would make facial hair whorls a beneficial indicator trait on which to select young bulls to increase fertility.

Key Words: Hair Whorls, Heritability, Spermatozoal Characteristics

Companion Animals: New Advances in Pet Health, Nutrition and Reproductive Management

655 Maximizing conception rates using fresh cooled or frozen canine semen. R. Hutchison*, *Animal Clinic Northview, Inc.*, *North Ridgeville, OH*.

Since the American Kennel Club's recognition of litters conceived from frozen semen in 1981 and the subsequent acceptance and fresh chilled semen, practioners are being asked more frequently to assist clients with maximizing conception rates using these breeding techniques. The gratification one feels when successful is one of the great rewards in veterinary medicine.

The basis of fresh chilling and freezing semen is energy conservation within the sperm cell so that the semen can be shipped or used at a later date. The drawback to these methods is that even though some energy is conserved, enough energy is used to shorten the sperm cell's life.

Fresh semen is thought to easily live 4-6 days in utero. Some papers have reported live sperm found in the uterus 11 days post-breeding. The nautral sperm length of life allows for successful breeding when the bitch first exhibits standing and acceptance of the male, even though in many cases the timing is 4-6 days before the prime fertilization period of the mature ova.

Fresh chilled semen uses energy as it is cooled to 40 f (4 c) and eventually rewarmed to body temperature. The life in utero of a spermatozoa having experienced the chilling and subsequent warming process is 24 to 72 hours, necessitating a more precise manner of ovulation timing and breeding.

Key Words: Reproduction, Canine, Semen

656 Improving puppy trainability through nutrition. R. Kelley*, *The Iams Company - Research & Development*, *Lewisburg, OH*.

Nutrition is seldom discussed as influencing an animal's trainability. However it is becoming increasing clear that key nutrients can dramatically impact various physiological systems, especially during critical developmental windows. The present study was undertaken to examine the effect of dietary omega-3 fatty acids (n-3 FA) on trainability, particularly docosahexaenoic acid (DHA), during pre- and post-weaning puppy development. Beagle purpose-bred bitches (27) were selected based on estrous date and randomly assigned across 3 dietary treatment (TRT) groups that varied in n-3 FA content (High, Med and Low). Puppies were maintained on the respective maternal diet following weaning. Puppies were socialized (weeks 7-8) and then received 5 days of pretraining/acclimation in a Two-Arm T-Maze. Following pretraining, all puppies were tested by a Win-Stay, Lose-Shift format using 2 distinct symbols, a cube or a sphere. Briefly, puppies were trained to associate a symbol with a direction in the maze. Correct choices were rewarded with a highly palatable treat, with no treat given for an incorrect choice. Each puppy received 2 testing sessions (10 trials per session) per day until a puppy correctly responded 8 out 10 trials for 2 consecutive sessions (defined as a success criterion). Findings from this study demonstrate that both the maternal and puppy DHA status were sensitive to TRT. High-DHA reared puppies had significantly higher DHA content in the red blood cell membranes at days 14, 28 and 42 (weaning) as well as at 7, 11 and 15 week of age compared to the Med- and Low-DHA groups. Success in the maze testing was also found to dose-dependant relative to dietary DHA content. High-DHA reared puppies achieved at least 1 success criterion with greater ($P < 0.02$) frequency compared to Low-DHA reared puppies, with Med-DHA puppies not differing from either group (68% vs 42% vs 30% respective to DHA level). These data suggest that DHA is a critical nutrient during pre- and post-weaning development of puppies and that improved nutrient status can improve canine trainability.

Key Words: Canine, Docosahexaenoic Acid, Trainability

657 Research advances in carotenoid nutrition and immunology of dogs and cats. B. Chew* and J. S. Park, *Washington State University*, *Pullman, WA*.

Carotenoids occur in abundance in nature. Early reports have generally considered domestic dogs and cats as poor absorbers of carotenoids. Recently, we showed that both dogs and cats absorb significant amounts of β-carotene, lutein, astaxanthin and bixin across their intestinal mucosa. Furthermore, these carotenoids are taken up by subcellular organelles of circulating leukocytes. In both dogs and cats, the mitochondria take up the largest fraction of total carotenoids. Because the mitochondria consume most of the oxygen during ATP production, they too contribute most of the harmful oxygen radicals found. In addition, domestic dogs and cats are exposed to the same ionizing radiation, environmental toxins and atmospheric pollutants as their owners. These oxidative and nitrosative stressors have been blamed for the development of chronic diseases. Carotenoids, by nature of their antioxidant activity, serve to quench these harmful oxygen species to maintain a favorable oxidant:antioxidant balance for optimal immune function. Only until recently have studies become available to examine the possible role of antioxidants on immune response and health in dogs and cats. We conducted several studies on the immune-modulating, antioxidative and anti-inflammatory action of dietary carotenoids (β-carotene, lutein, astaxanthin, and bixin) in domestic dogs and cats. Overall, results consistently showed that these carotenoids enhanced both cell-mediated and humoral immune responses in both species. Differences occurred in the specific immune measure affected by the different carotenoids; also, the effective dose of each carotenoid differs for a given immune response. Studies have reported greater immune-enhancing action of carotenoids in geriatric dogs than in younger dogs. Besides immunity, dietary carotenoids generally reduced oxidative biomarkers including DNA damage, protein oxidation, lipid peroxidation, and inflammation; the latter are positively associated with the development of cancer and other chronic diseases. Therefore, carotenoids can improve the oxidant:antioxidant balance of dogs and cats, and consequently enhance their immune function.

Key Words: Antioxidants, Immunity, Carotenoids

658 Critical issues in aging and cancer: Implications for effective cancer prevention. D. Waters*[1,2], [1]*Purdue University Center on Aging and the Life Course*, *West Lafayette, IN*, [2]*Gerald P. Murphy Cancer Foundation*, *West Lafayette, IN*.

Cancer is one of the most prevalent and life-threatening age-related diseases affecting pet dogs. The purposes of this paper are: (1) to explore the possible mechanisms and extent to which aging influences cancer risk; and (2) to consider prevailing principles of disease prevention that must be exploited to develop practical cancer prevention strategies. This discussion is intended to provide a conceptual framework for designing studies that will determine whether nutritional intervention during the life course can significantly reduce cancer incidence and mortality.

Key Words: Cancer, Aging, Nutrition

Extension Education: Current Topics in Dairy Management—Transition Cows

659 Manipulating the transition udder: Where dairy management meets mammary gland biology. T. B. McFadden*, *University of Vermont*, *Burlington*.

The fundamental unit responsible for milk synthesis and secretion is the mammary alveolus, a hollow, spherical structure comprised of individual mammary secretory epithelial cells. These cells function by taking up nutrients from the bloodstream, synthesizing them into milk components, packaging them, and ultimately secreting them into the alveolar lumen. Thus, it follows that the key points of regulation of milk production involve mammary development, to establish the population of secretory cells; lactogenesis, to stimulate these cells to produce milk; and galactopoiesis, or maintenance/enhancement of their activity. Each of these processes depends on hormones and nutrients provided via the mammary blood supply. During the transition period, all of these functions play a key role, hence management strategies must effectively target one or more of them. Novel management approaches for the transition cow include manipulation of photoperiod during the dry period, frequent milking during early lactation, and reducing the length of the dry period. Recent evidence suggests that all of these strategies work through effects on the number or activity of secretory cells in the udder. The purpose of this paper is to review the regulation of mammary function and explore the biological basis for improving function through management. Through better understanding of the underlying factors, it may be possible to optimize current protocols and develop new approaches to managing the transition cow to enhance milk production efficiency.

Key Words: Transition Cow, Management, Mammary Gland Biology

660 Effects of modified dry periods on milk yield, milk composition and mammary development in dairy cows. E. L. Annen* and R. J. Collier, *University of Arizona*, *Tuscon*.

Recent research reports equal milk yield in bST-supplemented, continuously milked (CM) and 60-d dry (CTL) multiparous (MULTI) cows, but lower milk yield in CM cows not treated with bST and primiparous (PRIMI) cows treated with bST. In PRIMI cows, mammary development requirements demand a dry period longer than 30 days. We evaluated effects of CM and hormonal treatments on mammary epithelial cell (MEC) turnover during late gestation (LG) and early lactation (EL) and milk yield in CM, PRIMI cows. MEC growth is decreased in CM glands during most of LG. Assessment of MEC turnover in involuting CTL glands and lactating CM glands revealed a marked reduction in the MEC turnover process that occurs in the early dry period. When compared to CM tissue, MEC apoptosis in CTL tissue was increased 5-fold at 3 d of milk stasis and MEC growth was increased 3-fold at d 7 of milk stasis. In the last 20 d of gestation, MEC growth remained reduced in CM glands. By the last week of gestation, MEC growth was 50% less in CM tissue vs. CTL tissue. MEC apoptosis was unaffected by CM during the last 20 d of gestation, but a premature decrease in EL apoptosis occurred in CM glands at 7 d postpartum. Since CM and CTL glands contain equal MEC numbers, this decrease in apoptosis may allow CM glands to maintain MEC numbers following reduced prepartum MEC growth. In CTL glands, EL apoptosis likely sheds old and dormant MEC while permitting newer cells generated during LG to differentiate. Ultrastructure of CM tissue revealed large populations of resting or involuting alveoli by d 20 postpartum, whereas CTL glands had a homogenous population of secretory alveoli. Collectively, these data suggest that a 40-53% reduction in milk yield in CM glands is caused by reductions in MEC renewal and reduced secretory capacity. Treatments (bST, increased milking frequency, prostaglandin E_2) to stimulate milk synthesis or MEC growth in CM PRIMI glands have been unsuccessful. In conclusion, PRIMI cows continue to require a 60-d dry period, but MULTI cows are good candidates for short dry periods, and potentially no dry period.

Key Words: Modified Dry Period

661 Photoperiodic effects on the transition dairy cow. G. E. Dahl*, H. M. Crawford, and E. D. Reid, *University of Illinois*, *Urbana*.

Whereas photoperiodic effects on lactating cows are well characterized, the impact of light exposure on cows as they move through the transition from the dry period into lactation has been the subject of recent studies. In contrast to lactating cows, dry cows and pregnant heifers exposed to a reduced photoperiod (PP), that is short days (8L:16D; SDPP) have greater milk yield in the subsequent lactation relative to cows exposed to long days (16L:8D; LDPP), and that is associated with greater mammary growth. Dry cows on SDPP have higher DMI relative to LDPP. Relative to LDPP, exposure to SDPP improves immune measures in dry cows as they transition into lactation. Mammary and immune responses appear to be mediated through changes in prolactin (PRL) sensitivity, with SDPP causing a decrease in circulating PRL yet increased PRL-receptor mRNA expression compared with LDPP. Because reduced PRL concentrations in dry cows are associated with higher subsequent milk yield, other stressors that may elevate PRL should be limited. Responses to SDPP are consistent with 60 d of treatment, but shorter duration exposure is more variable, perhaps due to seasonal shifts in photoperiod under ambient conditions. With regard to application, any enclosed facility that is well ventilated is appropriate for housing. Cows can be exposed to natural light but that should be limited to 8 hrs/d. Observation can be facilitated, especially as parturition approaches, by the use of dim red lighting during periods of darkness. Following parturition, cows returning to ambient photoperiodic conditions from SDPP respond with higher milk yields than those on LDPP when dry. In summary, photoperiod manipulation of dry cows offers a non-invasive, easily implemented management approach to improve performance and health during the transition into lactation.

Key Words: Short Days, Milk Yield, Health

662 Impact of increased milking frequency during early lactation. M. VanBaale*, D. Ledwith, J. Thompson, R. Collier, and L. Baumgard, *University of Arizona*, *Tucson*.

Multiparous cows (n=300) were assigned to one of 2 increased milking frequency (IMF) treatments (trts) at parturition to investigate IMF (6X vs. 3X) effects during early lactation and subsequent lactation persistency with or without rbST. Treatments were 6X milking for 0 (control; milked 3X) or the first 7, 14 or 21 DIM (all 4 trts initiated rbST at 63 DIM), or 6X for the first 21 DIM (no rbST administration during the entire lactation and all cows returned to 3X milking after their respective trt ended). Cows milked 3X tended to produce more milk 43.2 vs. 41.5 and 41.0 kg/d during the first nine wks of lactation compared to cows milked 6X for 7 or 21 DIM, respectively. Milk yield did not differ among IMF trts (38.3 kg/d) after wk 9. Percentages of milk fat (3.80) and protein (2.90) did not differ between trts during the first nine wks after calving. Plasma NEFA concentration from a subset of cows assigned to the 3X and 6X 21 DIM trts were similar (477 μeq/L). Cows administered rbST and milked 6X for 21 DIM produced more milk (38.1 vs. 34.6 kg/d) compared to cows milked 6X for 21 DIM and not provided rbST. Percentages of milk fat and protein were not effected by rbST, however yields of fat (1.37 vs. 1.26 kg/d) and protein (1.12 vs. 1.00 kg/d) were higher for cows administered rbST and milked 6X for 21 DIM compared to cows not receiving rbST. Milk somatic cells (528 vs. 252 x 10^3 cell/ml) increased and BCS decreased (3.53 vs. 3.56) with rbST administration. The percentage of cows pregnant (37%) within 65 d of the voluntary waiting period, average DIM at pregnancy (126) and average service per conception (2.28) did not differ between treatments (X^2 = 0. 96). The number of cows that were sent to the hospital during the 305 d trial for mastitis (60), digestive disorders (9), respiratory issues (5), lameness (14), and/or retained placenta (10), were not affected by treatments (X^2 = 0.49). IMF (6x vs. 3X) in early lactation did not increase milk synthesis or improve lactation persistency.

Acknowledgements: We thank United Dairymen of Arizona for funding, Monsanto for Posilac™, Tom Thompson of Stotz Dairy and Arnaldo Burgos of Dairy Nutrition Services.

Key Words: Milking Frequency, Early Lactation, Somatotropin

Forages and Pastures: Composition and Quality

663 Ruminal and post ruminal crude protein digestion of halophyte forages (*Kochia scoparia*, *Atriplex domorphostegia*) determined by various procedures. A. Riasi*[1], M. Stern[2], M. Danesh Mesgaran[1], and M. Ruiz Moreno[2], [1]*University of Mashhad*, *Mashhad, Khorasan, Iran*, [2]*University of Minnesota*, *St. Paul*.

Ruminal, post-ruminal and total tract crude protein (CP) digestion of two low-quality forages originating from central Iranian deserts (*Kochia scoparia*, *Atriplex domorphostegia*) were evaluated using in situ, three-step and Daisy^{II} incubator procedures. These forages are halophytic plants typically grown on salty land that are a significant part of the local flora in central Iran. During unfavorable environmental conditions, these forages can provide supplemental or emergency feed for ruminants. Linear regression equations were used between the three-step and Daisy^{II} incubator procedures to determine if there was a relationship between procedures. Results showed that ruminal CP disappearance of Kochia was lower ($P < 0.05$) than Atriplex after 12 h incubation in the rumen, but there was no difference ($P > 0.05$) between forages after 16 h incubation. Post-ruminal CP digestion was not different between Kochia and Atriplex when using the three-step procedure (33.0 and 35.0 %, respectively) or the Daisy^{II} procedure (58.0 and 60.0, respectively). Total tract CP digestion of Kochia (86.6 %) tended ($P < 0.1$) to be lower than Atriplex (88.6 %) when using the three-step procedure, while total tract CP digestion of Kochia (88.4%) and Atriplex (91.3%) differed ($P < 0.05$) when using the Daisy^{II} procedure. Coefficients of determination (r^2) for the relationship of ruminal, post-ruminal and total tract CP digestion between the three-step and Daisy^{II} procedures were 0.70, 0.65 and 0.80, respectively. Results showed that there was a good relationship between the procedures for evaluating CP digestion of halophyte forages.

Acknowledgements: This work was conducted with the financial support of University of Minnesota, USA.

Key Words: Low-Quality Forages, Three-Sstep, Daisy^{II} Incubator

664 Factors affecting the quality of corn silage grown in hot, humid areas 1: Effect of delayed sealing, simulated rainfall and ensiling temperature. A. Adesogan*[1] and S. Kim[1,2], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *South Korea*.

This study aimed to determine how simulated rainfall, delayed sealing and high ensiling temperatures affect the fermentation and aerobic stability of corn silage. Half of each of four, replicated, 6 x 1.5 m plots of a corn hybrid were harvested at 350 g DM /kg. The remaining half was harvested after it was sprinkled with sufficient water to simulate 4 mm of rainfall. The forage samples were either ensiled (2 kg) immediately in a plastic bag in quadruplicate, or after a 3 h wilt. Half of the bags were stored in a 30°C incubator and the other half in a 40°C, air conditioned room. After 82 d, of ensiling, the bag silos were opened and the silages were chemically characterized. A 2 (moisture treatments) x 2 (sealing times) x 2 (ensiling temperatures) arrangements of treatments was used for the study. Wetting the corn silage increased (P<0.05) concentrations of NH3-N. Ensiling the corn at 40°C instead of 30°C increased (P<0.001) the pH (4.23 vs. 3.76) and NH3-N concentration, and reduced (P<0.05) lactate, acetate and propionate concentrations. Delaying sealing for 3 h reduced NH3N (P<0.05) concentration. Yeast counts were reduced (P<0.05) by wetting the corn, ensiling at the higher temperature and delaying sealing, while mould counts tended (P<0.1) to be reduced by delaying sealing. There were no interactions (P>0.05) between the treatments for the measurements except for aerobic stability, which was greater in the corn silage that was watered, ensiled at 40°C and sealed after a 3 h delay than in the other treatments. None of the treatments affected the lactic to acetic acid ratio. This study suggests that high temperatures during ensiling adversely affect the quality of corn silage. The simulated rainfall increased proteolysis, but delaying sealing for 3 h reduced proteolysis.

Key Words: Corn Silage, Moisture and Temperature, Delayed Sealing

665 Factors affecting the quality of corn silage grown in hot, humid areas 2: Effect of applying two dual-purpose inoculants or molasses. A. Adesogan*[1], M. Huisden[1], K. Arriola[1], S. Kim[1,2], and J. Foster[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, South Korea*.

This study determined how applying molasses or two proprietary inoculants affects the fermentation and aerobic stability of corn silage. A corn hybrid grown in four replicated plots was harvested at 400 g/kg DM and ensiled (15 kg) in quadruplicate in 20 l mini-silos. Treatments applied included Control, molasses (50 g/kg DM; Mol), BB inoculant (containing *Pediococcus pentosaceus* and *Lactobacillus buchneri*) and PN inoculant (containing *L. plantarum* and *L. buchneri*). The inoculants were applied 1× or 2× (DBB and DPN) the recommended rates. After 135 d of ensiling, silage chemical composition, aerobic stability and microbial counts were determined. The following results are based on comparing treated to Control samples. There were no treatment effects on IVDMD, CP, NDF or ADF concentrations. The pH, and NH3-N and lactate concentrations of Control and treated silages were similar (P>0.05), except for PN-treated silages, which had slightly higher (P<0.05) pH (4.06 v. 3.84) and NH3-N, and less (P<0.05) lactate (15.1 v 26.0 g/kg DM) than Control silages. Acetate concentration (g/kg DM) was greater (P<0.05) in PN, DPN and DBB silages (30.8, 40.3, 34.9), and numerically greater in BB and Mol silages (23.1 and 16.8) than in Control silages (14.3 g/kg DM). Residual sugar concentration was similar (P>0.05) in Mol and Control silages, and less (P<0.05) in inoculant-treated silages than in Control silages. Aerobic stability of disturbed silage samples was greater (P<0.05) in all inoculant-treated silages than in the control silage. Aerobic stability of undisturbed silage samples were not affected by treatment, though inoculant treated silages were numerically more stable. Dual purpose inoculants can increase the aerobic stability of corn silage without adversely affecting nutritive value. Molasses treatment did not affect the quality or aerobic stability of corn silage.

Key Words: Inoculant, Corn Silage, Molasses

666 Comparison of hays harvested at three stages of grass maturity in their effects on chewing activity and ruminal pH fluctuation of cows. F. Dohme* and A. Muenger, *Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP)*, *Posieux, Fribourg, Switzerland*.

Hay is used in rations for dairy cows as a source of effective fiber in order to maintain optimal rumen function. Thus, the objective of the experiment, carried out according to a 3 × 3 Latin square design, was to compare the effect of an immature hay harvested after 36 d of regrowth (**A**) to two mature hays harvested either 50 (**B**) or 61 d (**C**) after regrowth on chewing activity and ruminal pH fluctuation in six nonlactating rumen-cannulated cows. Each experimental period lasted 21 d with data collection from d 14 to 21. The hays (ryegrass-clover mixture) were fed ad libitum and feed intake was recorded daily. Ruminal pH and chewing activity were continuously recorded for 22 h/d with an indwelling pH electrode and with a behavior recorder, respectively. For each cow pH data were summarized separately for the day and night as mean, maximum and minimum pH and time period when pH was below 6.2. Chewing activity was separated into eating, ruminating and idling time. The hays did not differ in the DM content whereas hay A had per kg DM 16 g less NDF and 4 g and 14 g more sugar than hay B and C. With hay A, intake of DM (15.5 kg) and sugar (1.66 kg), but not of NDF (6.65 kg), was increased ($P < 0.05$) compared to hay B and C (DM: 14.7, 14.6 kg; sugar: 1.53, 1.38 kg; NDF: 6.52, 6.49 kg). The hays did not affect daily eating and idling activity. Compared to hay B and C, cows offered hay A spent 18 min/d less ($P < 0.05$) time ruminating and when expressed per kg DM or NDF intake rumination time was 2.8 and 4.2 min shorter ($P < 0.05$ for each), respectively. Only during the day mean and maximum pH was 0.16 and 0.22 units lower, respectively and the time when pH was below 6.2 was 158 min longer in cows fed hay A compared to hay B and C ($P < 0.05$ for each). The mean rumen pH over 22 h was negatively correlated to sugar intake (r = -0.67; $P < 0.01$) and unexpectedly to NDF intake (r = -0.43; P

= 0.07). In conclusion, increasing sugar intake with immature hay reduced rumen pH. Nutrient differences between hay B and C were small and could explain the lack of difference in chewing activity and rumen pH.

Key Words: Chewing Activity, Grass Maturity, Rumen pH

667 Comparative effect of brown midrib sorghum-sudan and corn silages on lactational performance, nutrient digestibility, and phosphorus retention in Holstein dairy cows. H. M. Dann[1], C. S. Ballard[1], E. D. Thomas[1], K. W. Cotanch[1], C. T. Hill[1], R. J. Grant*[1], R. Rice[2], and W. Townsend[2], [1]*W. H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Garrison & Townsend*, *Hereford, TX*.

Total mixed rations containing brown midrib sorghum-sudan grass silage (bmrSS) or corn silage (CS) at either 35 or 45% of dietary dry matter were fed to Holstein dairy cows to determine the effect on lactational performance, nutrient digestibility, and phosphorus retention. Twelve cows were assigned to one of four diets in replicated 4 × 4 Latin squares with 21-d periods. In vitro 30-h NDF digestion was 46.0% for CS and 58.3% for bmrSS. Dry matter intake was greatest when cows were fed the 35% CS (23.4 kg/d) and 45% CS (23.2 kg/d) diets, was least when cows were fed the 45% bmrSS diet (17.6 kg/d), and was intermediate when cows were fed 35% bmrSS diet (20.1 kg/d). The bmrSS diets resulted in greater BW gain per period, but similar body condition score versus CS diets. Yield of solids-corrected milk was similar among diets. Efficiency (SCM/DMI) was greater for cows fed the bmrSS than the CS diets. In vivo digestibility of organic matter and CP was greater for the CS diets than the bmrSS diets, but digestibility of neutral detergent fiber, starch, and nonfiber carbohydrate was similar among diets. Ruminal pH was greatest when cows were fed the 45% bmrSS diet (6.58), was least when cows were fed 35% CS (6.10) and 45% CS diets (6.13), and was intermediate when cows were fed the 35% bmrSS diet (6.42). Ratio of acetate (A) to propionate (P) was greatest for the bmrSS diets with no difference among diets in total VFA concentration. Phosphorus (P) balance was positive when cows consumed the 35% CS (14.6 g/d) and 45% CS (10.1 g/d) diets and slightly negative when cows consumed the 35% bmrSS (-0.1 g/d) and 45% bmrSS (-7.0 g/d) diets, but at 45% forage, fecal excretion of P was less for bmrSS than for CS. In conclusion, cows fed bmrSS had similar SCM yield with greater efficiency of production, greater ruminal pH and A:P than cows fed CS. With these diets, bmrSS was an effective alternative to the CS hybrid when fed at either 35 or 45% of the dietary DM.

Key Words: Brown Midrib, Sorghum-Sudan, Dairy Cattle

668 Exogenous fibrolytic enzymes accelerate in vitro degradation of ammonia-treated rice straw. J.-S. Eun*[1], K. A. Beauchemin[1], S.-H. Hong[2], and M. W. Bauer[3], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [2]*Sahmyook College*, *Seoul, Korea*, [3]*Syngenta Biotechnology Inc.*, *Research Triangle Park, NC*.

Supplementation with exogenous fibrolytic enzymes (EFE) can be a potential means of improving cell wall digestion and increasing nutritive value of rice straw for ruminants. Two cellulases (END1 and END2) and two xylanases (XY1 and XY2) supplied by Zymetrics (Golden Valley, MN) were evaluated for their potential to improve in vitro degradation of untreated (URS) or ammonia-treated (ARS) rice straw. Fresh, milled URS or ARS (0.45 g DM) was weighed into fermentation bottles in six replications. The resuspended enzyme products with 10 mL of water were added to rice straw at 0.4 mL/g DM substrate. Anaerobic buffer medium (18 mL) and strained ruminal fluid (4.5 mL) were sequentially added to the corresponding bottles. Headspace gas production (GP) was measured during 24 h of incubation. Apparent DM, NDF, and ADF degradation were determined at the end of the incubation. In addition, the VFA profiles were determined. Data were analyzed using the Proc Mixed procedure of SAS. While GP was not affected by adding EFE to URS, GP was increased ($P < 0.001$) starting at 18 h of incubation by adding XY1 and XY2 to ARS. Regardless of adding EFE, overall GP from ARS was two-fold higher than that from URS. Adding EFE did not affect degradability of URS. In contrast, degradabilities of DM and NDF increased ($P < 0.05$) by adding XY1 and XY2 to ARS, and ADF degradability increased ($P < 0.05$) by adding all EFE. Total VFA production was not affected by adding EFE to URS or ARS. Molar proportion of acetate decreased ($P < 0.05$) by adding XY1 and XY2 to ARS, and that of propionate increased ($P < 0.05$) by adding XY2, resulting in decreased acetate to propionate ratio ($P < 0.05$). In vitro degradability of URS was not enhanced by using EFE, whereas adding xylanases improved degradability of ARS. A synergistic relationship exists between ammonia treatment and addition of xylanase enzymes for the improved degradation of rice straw.

Key Words: Fibrolytic Enzymes, Rice Straw, In Vitro Degradation

669 Assessment of two indigestible markers for improving the accuracy of measurement of feed intake by cattle fed ryegrass. A. V. Chaves*, R. Delagarde, and A. Boudon, *UMRPL - INRA*, *St-Gilles, France.*

Estimation of feed intake by cattle is difficult, whether as a group or on an individual basis using indigestible markers and fecal sampling. Many researchers have expressed concern over the accuracy of intake estimates. The objective here was to verify whether multiple marker techniques could improve estimates of forage intake by grazing animals. The experimental design was a cross-over 4 × 4 Latin square with four 14-d periods. Four dairy cows were fed freshly cut ryegrass (*Lolium perenne*) in individual troughs (indoors) and four other cows grazed ryegrass pasture *ad libitum*. Herbage height post-cut was aimed to be identical to herbage height post-grazing. Intake by the cows fed indoors was calculated by weighing ryegrass offered and refused at every feeding, combined with herbage DM measurements and regression against estimated intake using twice daily doses of chromium and ytterbium oxides. Herbage intake was estimated over 5 consecutive days. The fecal samples were collected in the tie-stall for cow fed indoors and in the paddocks from grazing cows. Representative feed and fecal samples were analyzed for CP and ADF, and organic matter digestibility (OMD) was estimated as: [$OMD = 1.035 - 2.478/CP_{feces} - 0.0027*ADF_{feces} - 0.0571*CP_{feed}/CP_{feces}$], where CP and ADF are expressed as % of OM ($n = 31$, $r^2 = 0.92$, SE = 0.0094). Actual daily DMI (16.6 ± 2.3 kg; mean ± SD) was lower ($P \leq 0.05$) than the values (y) predicted using chromium oxide (19.4 ± 4.3 kg; $y = 8.43 + 0.39x$, $r^2 = 0.49$) or ytterbium oxide (19.0 ± 3.7 kg; $y = 7.75 + 0.47x$, $r^2 = 0.60$). When estimated intakes from both markers were averaged (y) and plotted against actual values (x), multiple marker techniques did not improve estimates of forage intake by grazing animals, where $y = 7.92 + 0.44x$, $r^2 = 0.54$, with a mean bias of +3.2 kg DM. In conclusion, the accuracy of intake measurements for cows fed ryegrass pasture was not improved using Cr and Yb oxides indigestible markers.

Acknowledgements: INRA (St-Gilles, France) post-doc grant for financial support of A.V. Chaves

Key Words: Intake, Markers, Pasture

670 Soybean hulls as an energy source for rotationally grazed Holstein heifers. J. A. Jackson*, L. J. Driedger, S. T. Franklin, M. T. Sands, K. I. Meek, J. V. Ware, and C. H Hamilton, *University of Kentucky*, *Lexington*.

Three replicated studies were conducted in spring 2003, fall 2003 and spring 2004 to evaluate the use of soybean hulls versus corn as an energy source in growing Holstein dairy heifers using intensive rotational grazing management. Hallmark® Orchardgrass (*Dactylis Glomerata L.*) was established in a 4.45 ha field during the fall of 2001. The field was divided into forty-eight 0.06 ha paddocks and one 0.5 ha section using 5 wire poly-electric fence tape. Heifers were contained as a group in the 0.5 ha section of the field to adapt to the electric fencing and pasture for 1 wk before being assigned to their respective dietary treatments. In each replicated study, 18 Holstein heifers (250 ±40 kg) were divided into pens of 3 and randomly assigned to one of two treatment groups. Dietary treatments were 1)1.8 kg/h/d of a corn based diet (control; 2.07 Mcal/kg of NE_m and 1.39 Mcal/kg of NE_g) or 2) 1.8 kg/h/d of a soybean hull based diet (SBH; 1.6 Mcal/kg of NE_m and 1.01 Mcal/kg of NE_g). Heifers were rotated to a new paddock every 3.5 d which allowed 28 d rest before paddocks

were re-grazed a second time within a replicate. Full body weights were determined initially and every 2 wk until termination at 6 wk. The pen of 3 heifers was used as the experimental unit. Forage samples were collected initially and every 2 wk until termination for quality and yield determinations. Statistical analysis revealed no effect due to season. A treatment by week interaction was detected ($P < 0.05$). Average daily gains did not differ ($P > 0.05$) and were 1.06 and 1.13 ± 0.07 kg/d for the control and SBH treatment groups, respectively. Results indicate that soybean hulls, as an energy supplement, can support equal average daily gains as corn for growing dairy heifers under intensive rotational grazing management.

Key Words: Soybean Hulls, Grazing, Dairy Heifers

671 Effect of variety on chemical composition and ruminal nutrient degradability of forage soybean silage. A. Mustafa* and P. Seguin, *McGill University*, *Ste-Anne-De-Bellevue, QC, Canada*.

A study was conducted to determine the effects of of soybean variety on chemical composition and ruminal nutrient degradabiity of silage. Two varieties of forage soybean (i.e. Kodiak and Mammouth) were sown in a field in Southwestern Quebec on May 15 2004 and harvested on September 4 2004. Harvested forages were then ensiled in mini-silos for 45 d. Two ruminally fistulated Holstein cows, in a randomized complete block design, were used to determine in situ ruminal nutrient degradabilities of the two soybean silages. Chemical analysis showed Mammouth contained higher ($P < 0.05$) NDF (49.0 vs 44.4%), ADF (37.1 vs 35.3%), and ADL (8.1 vs 6.4%) levels than Kodiak. However, CP was higher ($P < 0.05$) for Kodiak than Mammouth (20.8 vs 14.9%). Distribution of protein fractions showed that Mammouth had lower ($P < 0.05$) soluble protein and higher ($P < 0.05$) neutral and acid detergent insoluble protein levels than Kodiak. Results of the in situ study indicated that Kodiak had higher ($P < 0.05$) ruminal DM (60.6 vs 54.9%), CP (82.8 vs 75.2%) and NDF (27.2 vs 22.7%) degradabilities. It was concluded that chemical composition and ruminal nutrient degradabilities of forage soybean silage are significantly affected by variety.

Key Words: Forage Soybean, Chemical Composition, Ruminal Degradability

672 Non-protein nitrogen formation in legume silages as influenced by condensed tannins, polyphenols, and harvesting methods. J. Grabber*, C. Davidson, and L. Massingill, *USDA-ARS, US Dairy Forage Research Center*, *Madison, Wisconsin*.

The inhibition of non-protein nitrogen (NPN) formation in legume silages by protein-binding tannins and polyphenols may be influenced by the degree of tissue disruption during harvest. In 2002 and 2003, first and second cuttings of alfalfa, birdsfoot trefoil, and red clover were conventionally conditioned, wilted, and chopped or severely macerated and wilted before ensiling in minisilos. Silages were analyzed for dry matter (DM), pH, total nitrogen (N), ammonia, free amino acids, free peptides, and NPN. Silage DM averaged 34.7% and pH averaged 4.5 with no biologically relevant differences noted between forages and harvest methods. The average N content of alfalfa (3.6% of DM) was slightly greater ($P < 0.05$) than that of other forages (3.3% of DM). Harvesting method did not affect the N content of silages. Non-protein nitrogen in alfalfa silage (free of both tannins and polyphenols) averaged 69% of total N. The formation of NPN was similar or up to 22% lower ($P < 0.05$) in low to high tannin populations of birdsfoot trefoil and 37% lower ($P < 0.05$) in polyphenol-containing red clover. The formation of NPN in silage was also less ($P < 0.05$) with macerated forage (51% of total N) than with conventionally harvested forage (66% of total N). The NPN fraction of alfalfa silage was composed of 9% ammonia, 46% free amino acids, and 45% free peptides. Tannins, polyphenols, and maceration reduced levels of all NPN components, particularly the peptide fraction. The inhibition of NPN formation by maceration was greater in tannin-containing birdsfoot trefoil than in alfalfa or polyphenol-containing red clover. The results of this study indicate that tannins, polyphenols, and maceration inhibit NPN formation in legume silages, particularly if tannin-containing forages are macerated during harvest.

Acknowledgements: The authors thank Glen Broderick and Richard Muck for assistance with NPN analyses.

Key Words: Silage, Tannins, Non-Protein Nitrogen

Growth and Development: Growth Factors and Growth

673 Small intestinal composition and hydrolytic activity in neonatal calves fed nucleotides. C. Oliver*[1], C. De Jesus Arias[2], W. Keller[1], M. Bauer[1], and C. Park[1], [1]*North Dakota State University*, *Fargo*, [2]*Instituto Superior de Agricultura*, *Santiago de los Caballeros, Dominican Republic*.

The aim of this study was to determine the impact of dietary nucleotides on the small intestine of neonatal calves. Nineteen newborn Holstein bull calves (41.9 ± 1.1 kg initial body weight [BW]) were assigned to one of two dietary treatments: standard milk replacer or milk replacer supplemented with purified nucleotides at 5 times the level found in normal cow milk(monophosphate form of adenosine = 0.04, cytidine = 1.14, guanosine = 0.48, inosine = 0.64, and uridine = 10.3 µmol/kg BW per d). Calves were housed indoors in individual pens with slatted floors. At about 4 wk of age calves were weighed and given a sodium pentobarbital overdose. Small intestine was removed; samples of duodenal, jejunal, and ileal segments were harvested, the mucosa removed and flash frozen. Remaining intestine was emptied, weighed, and the length measured. Mucosal homogenate was analyzed for DNA, RNA, protein, and activity of the intestinal enzymes lactase, maltase, alkaline phosphatase, aminopeptidase N, and dipeptidylpeptidase IV. There were no differences ($P \geq 0.51$) between treatments in final body or small intestinal weights; mucosal weight, protein or RNA content, or lactase, maltase, alkaline phosphatase, or dipeptidylpeptidase IV activity. Small intestine was numerically longer in nucleotide-fed calves ($P = 0.11$). There were site of intestine effects ($P \leq 0.01$) for RNA, protein, and all enzyme activities except dipeptidylpeptidase IV. Gut DNA was influenced by an interaction of site and treatment ($P < 0.01$): DNA content increased distally, levels were similar between treatments in the duodenum and jejunum, and higher for the nucleotide group in the ileum. Aminopeptidase N was lower ($P = 0.04$) in nucleotide-fed calves, which may indicate an increase in gut maturity. Dietary nucleotides may enhance small intestinal development. Further work is needed to determine optimal dose and timing of administration.

Key Words: Nucleotide, Small Intestine, Calf

674 Fibroblast growth factor receptor 1 regulates protein metabolism in atrophic muscle. J. K. Eash*, A. L. Grant, K. M. Hannon, and D. E. Gerrard, *Purdue University*, *West Lafayette, IN*.

Skeletal muscle disuse and subsequent loss of protein is attenuated by augmenting fibroblast growth factor (FGF) signaling. The exact mechanism for this blunted muscle wasting is not known. Therefore, the objective of this study was to determine how FGF signaling affects muscle protein metabolism during disuse atrophy. Mouse gastrocnemius and soleus muscles were injected with plasmid DNA encoding fibroblast growth factor receptor 1 (FGFR-1) or control plasmid DNA, and pulsed 8 times at 200V/cm using a pulse stimulator. Mice were randomly assigned to hindlimb suspension (10d) or control treatments. Protein synthesis was determined using a flooding dose of L-[4-^{3}H]phenylalanine. Muscle proteosome activity was evaluated using electroporation of plasmid DNA encoding for ubiquitinated luciferase. Sus-

pended limbs treated with FGFR-1 tended (P=0.11) to have 28% greater ^{3}H incorporated. A similar response was observed in non-suspended mice. Hindlimb suspension alone increased (P<0.01) proteosome activity 2.3 fold. Proteosome activity of suspended mice treated with FGFR-1 was not different from controls. Curiously, non-suspended mice treated with FGFR-1 had a 2.5 fold increase (P<0.01) in proteosome activity. These data show that injection of FGFR-1 expression plasmid increases protein synthesis and proteosome activity and suggest that FGF signaling may mediate muscle atrophy by modifying the balance between protein synthesis and degradation.

Key Words: Muscle Atrophy, Fibroblast Growth Factor, Protein Metabolism

675 Effects of an intensified compared to a moderate feeding program during the pre-weaning period on body growth and pubertal age in Holstein heifers. L. Davis*, M. VandeHaar, J. Liesman, L. Chapin, and M. Weber Nielsen, *Michigan State University*, *East Lansing*.

Our objective was to determine if increasing energy and protein intake from 2 d to 6 wk of age would affect body growth, feed efficiency, and age and BW at puberty. Heifers born throughout the year at the MSU Dairy Teaching and Research Center were assigned randomly to 1 of 2 treatments with 40 heifers per treatment (moderate, M; high, H). The M diet consisted of a standard milk replacer (21.5% CP, 21.5% fat) fed at 1.2% of BW on a DM basis and a 19.9% CP starter grain fed to achieve 0.45 kg of average daily gain (ADG). The H diet consisted of a high-protein milk replacer (30.6% CP, 16.1% fat) fed at 2.1% of BW on a DM basis and a 24.3% CP starter grain fed to achieve 0.68 kg of ADG. Calves were gradually weaned at 6 wk of age. Serum concentrations of IgG taken at 48 to 60 h of age and daily rectal temperatures during the first 2 wk were not different between treatments (P > 0.3, P > 0.6, respectively), but daily fecal scores (1 to 5; 1 = firm) were higher for calves on the H diet (H = 3.28, M = 3.07; P = 0.03). Inital BW and withers height did not differ by treatment. Calves consuming the H diet had 15% greater gain:feed ratios than calves on the M diet (P < 0.01). Pre-weaning daily gain was greater for calves fed the H diet (0.64 kg/d) then those fed the M diet (0.45 kg/d; P < 0.01). At 6 wk of age, calves on the H diet were 15% heavier and 3% taller (P < 0.01, P < 0.01; respectively). Post-treatment ADG was not different (P > 0.9). Heifers fed the H diet during the pre-weaning period reached puberty earlier (M = 9.9 mo, H = 8.9 mo; P < 0.01) and at a lower BW (M = 307 kg, H = 287 kg; P < 0.02). Calves fed the H diet had greater milk replacer intake (71%), milk replacer cost (86%), and total feed cost per kg gain (25%; all P < 0.01), but calves fed the M diet had greater starter grain intake (95%) and starter grain cost (77%; both P < 0.01). We conclude that intensified feeding during the pre-weaning period increases body size and decreases age at puberty.

Key Words: Milk Replacer, Growth, Heifer

676 Developmental changes in expression of toll-like receptors in fetal porcine intestine. T. E. Burkey*, K. A. Skjolaas-Wilson, K. R. Lawrence, B. J. Johnson, and J. E. Minton, *Kansas State University*, *Manhattan*.

The intestinal epithelium and the underlying lamina propria cooperate in performing important barrier and mucosal immune surveillance functions. In addition to its role as a physical barrier containing the bacterial load within the gut lumen, the intestinal epithelium is paramount in evoking innate as well as adaptive immune responses in order to maintain gastrointestinal homeostasis. Key players in the microbial-epithelial crosstalk that directs subsequent innate and adaptive responses are a set of evolutionarily conserved pattern recognition receptors known as toll-like receptors (TLR)s. Pattern recognition receptor detection of pathogens and their cellular products initiate a signaling cascade that culminates in the release of pro-inflammatory cytokines. The objective of this experiment was to investigate the developmental changes in expression of TLRs in fetal pigs at different stages of gestation. Three fetal pigs were removed from three sows by cesarean at d 55 and d 70 of gestation (n = 9/gestational age). Intestinal tissues were collected from sterile fetuses, then rapidly frozen in liquid N2 and pulverized in a liquid N2-cooled mortar and pestle apparatus. The powdered tissue was then processed for isolation of total RNA, and quantitative real-time PCR was used to determine relative levels of expression of TLR2, 4, 5, and 9. The relative expression of all TLRs was greater (P < 0.05) at gestation d 55 than at d 70. In addition, it is also important to note that the expression of all TLRs at d 55 was similar to relative levels of TLR expression that we have observed from postnatal intestinal tissues in previous experiments. Taken together, the data indicate that the expression of fetal TLRs varies by gestational age and that substantial constitutive expression of TLRs occurs relatively early in gestation, and clearly prior to population of the pig gastrointestinal tract with commensal bacteria.

Key Words: Toll-Like Receptors, Swine, Real-Tme PCR

677 Quantification of muscle regulatory factors and myostatin in callipyge sheep. J. N. Fleming*[1,2], C. A. Bidwell[2], S. P. Jackson[1], R. D. Allen[1], and J. R. Blanton, Jr.[1], [1]*Texas Tech University*, *Lubbock*, [2]*Purdue University*, *West Lafayette, IN*.

This study quantified the mRNA levels of the four muscle regulatory factors MyoD1, myf-5, myogenin, and MRF4, as well as myostatin in the *semimembranosus* muscle of normal lambs and those carrying the callipyge mutation. Callipyge is a mutation that causes muscle hypertrophy in the loin and hindquarters of domestic sheep. The muscle hypertrophy first manifests itself at 4 to 6 wks of age in the lamb, and is only expressed in paternal heterozygotes. This study involved lambs ranging from ages 2 wks prenatal to 8 wks postnatal and included callipyge ($+^{Mat}/CLPG^{Pat}$, n = 22), maternal heterozygous ($CLPG^{Mat}/+^{Pat}$, n = 19), homozygous ($CLPG^{Mat}/CLPG^{Pat}$, n = 18), and normal ($+^{Mat}/+^{Pat}$, n = 18) genotypes. Cultured myoblast samples from a subset of lambs (n=12) and fresh tissue samples from the *semimembranosus* of each lamb were used for total RNA isolation, random-primed cDNA synthesis, and quantitative PCR. Ribosomal RNA was quantified for each sample to use as an internal calibration for total cDNA quantity. Relative expression levels were calculated using the 18S values for each sample with the ddCt method. No significant effect of genotype was detected for MyoD, myogenin, MRF4, or myostatin (P > 0.05 for all) in muscle samples. A significant effect of genotype in muscle RNA was seen for Myf5 (P = 0.0402). Mean genotype expression levels for Myf5 were highest in the maternal heterozygotes (5.179 ± 1.015), followed by normals (2.636 ± 0.674) and homozygotes (2.436 ± 0.585), while the callipyge showed the lowest relative expression levels (1.727 ± 0.278). These values are expressed as fold increase over baseline expression. When comparing muscle data to cultured myoblast data, changes were noted in all genes measured. Specifically, culturing the myoblasts for 5 days changed the relative expression levels of Myf-5, especially in the two heterozygous genotypes when compared to tissue samples from the same animals. It was noted that overall Myf5 expression was greatly reduced in all cultured cells, making the magnitude of differences between genotypes less significant.

Key Words: Callipyge, Muscle Hypertrophy, Muscle Regulatory Factor

678 Regulation of muscle protein anabolism in growing steers by fatty acids in muscle membrane phospholipids is dose-dependent. M. C. Thivierge*[1], P. Y. Chouinard[1], Y. Couture[2], P. Julien[3], P. Dubreuil[2], T. A. Davis[4], and A. Myre[1], [1]*Université Laval*, *Quebec, QC, Canada*, [2]*Université de Montréal*, *St-Hyacinthe, QC, Canada*, [3]*Laval University Medical Ctr (CHUL)*, *Quebec, QC, Canada*, [4]*USDA/ARS Children's Nutr. Res. Ctr., Dept. Pediatr. Baylor Coll. Med*, *Houston, TX, USA*.

In a previous study with growing steers, we have found that n-3 long-chain polyunsaturated fatty acids (n-3LCPUFA) present in cell membrane phospholipids are involved in the muscular regulation of protein anabolism. A dose-response effect of n-3LCPUFA on muscle protein anabolism in growing steers was studied to determine the regulatory intermediates required to achieve a maximal anabolic response with n-3LCPUFA. Six steers were used in a double 3 X 3 Latin square design with 3 graded amounts of Menhaden oil randomized over 3 experimental periods of 5 wks. Four weeks were allocated to treatment

adaptation and the measurements were carried out in the 5th wk of each experimental period. Steers were fed a basal diet meeting 114% crude protein and 105% energy requirements. Oil treatments were administrated at the rate of 4% of DMI: 1) 0% Menhaden oil + 4% control oil (60% cotton:40% olive oil; 2) 2% Menhaden oil + 2% control oil; and 3) 4% Menhaden oil + 0% control oil. A dose-response curve to insulin was determined using the hyperinsulinemic-euglycemic-euaminoacidemic clamp technique (20, 40, 80 mU insulin/(kgjavascript:cdot()h)). Whole body irreversible loss rate of phenylalanine was determined using a continuous 9-h infusion of L-[1-13C]phenylalanine (2.0 javascript:lil_mu()mol/kgjavascript:cdot()h). Insulin-stimulated disposal rates of amino acids and glucose were linearly increased (P<0.05) with graded amounts of Menhaden oil at the intermediate insulin dose. Whole body flux of phenylalanine increased concomitantly with increasing amounts of Menhaden oil, but did not reach statistical significance. A linear reduction of dry matter intake expressed in %BW (tendency, P=0.15) and a linear decrease of feed conversion (tendency, P=0.17) were associated to the beneficial effects of n-3LCPUFA on protein anabolism. These results suggest that n-3LCPUFA are novel regulators of insulin sensitivity and anabolism in growing animals.

Acknowledgements: Supported by CORPAQ and Fédération des producteurs de bovins du Québec. Thanks to Omega Protein, Reedville, VA

Key Words: Omega-3 Polyunsaturated Fatty Acids, Insulin Sensitivity, Steers

679 Effects of serum from angus cattle divergently selected for serum IGF-I concentration on myoblast differentiation. M. Updike*, M. Davis, and M. Wick, *The Ohio State University*, *Columbus*.

Despite numerous studies indicating that increased concentrations of serum IGF-I are associated with increased growth in cattle, an opposite association was found in a group of Angus cattle divergently selected for serum IGF-I concentration. Cattle with increased serum IGF-I concentration exhibited lower body weights than did cattle with decreased serum IGF-I concentration. Serum IGF-I was found to have an average correlation of -0.38 with body weight at various ages. However, serum IGF-I was found to have a correlation of 0.19 with longissimus muscle area. To further study the effects of serum from the divergently selected lines of cattle on muscle growth and development, the effects of serum from the two lines on C2C12 proliferation and differentiation were determined. Serum was collected from yearling bulls (n=6; n=3/line). C2C12 myoblasts exhibited similar proliferation when incubated with sera from either line. Compared to the control consisting of fetal bovine serum, the lag phase was much longer when using sera from the IGF-I selection lines ($p \leq 0.05$). The effects of serum from the two lines on differentiation were significant at all times points except for 0 h. C2C12 myoblasts exhibited an increased rate of differentiation when incubated with serum from the high IGF-I line, as evidenced by an increased number of cells staining positive for myosin heavy chain ($P \leq 0.05$). Electrophoretic analyses of the liver and muscle showed no differences between the two lines of cattle. However, differences were found in the electrophoretic analysis of serum. These results suggest an association between the as yet undefined component(s) of serum and muscle cells, which may be a factor contributing to the longissimus muscle area variation in two IGF-I selection lines.

Key Words: IGF-I, Myoblast, Differentiation

680 Effect of melengestrol acetate (MGA) on bovine satellite cell β-adrenergic receptor (βAR) messenger RNA (mRNA) abundance. E. K. Sissom* and B. J. Johnson, *Kansas State University*, *Manhattan*.

Melengestrol acetate (MGA) is a synthetic progestin administered to feedlot heifers to inhibit the estrous cycle. Previous research in our laboratory suggests MGA has an anti-proliferative effect on bovine muscle satellite cells. Research suggests steroids, such as progestins, can affect the levels of βAR in different tissue types. The purpose of these experiments was to investigate the effects of MGA on βAR mRNA levels in cultured, proliferating, bovine muscle satellite cells. Satellite cells were used to assess the effects of MGA (0 and 10 n*M*) on β1, β2, and β3AR mRNA levels. Cells were plated in Dulbecco's Modified Eagle Medium containing 10% fetal bovine serum on tissue culture plates coated with reduced growth factor matrigel. The MGA was added directly onto cell cultures at 0 and 48 h after plating. At 72 h, total RNA was isolated from the cells and reverse transcribed for complimentary DNA (cDNA) synthesis. Real-time quantitative-PCR was performed on the cDNA to measure βAR mRNA abundance. Melengestrol acetate addition (10 n*M*) increased (3.1-fold, $P = 0.01$) β1AR mRNA abundance. There was also a tendency (3.2 fold, $P = 0.06$) for MGA addition to increase β2AR mRNA; however, there was no significant effect ($P > 0.10$) on the level of β3AR mRNA. These results indicate MGA can increase the expression of β1AR mRNA in bovine muscle satellite cell cultures. There was also a tendency for MGA to increase β2AR levels in cell cultures. These data may aid in our understanding of potential effects of MGA in bovine skeletal muscle growth and development, as well as provide some insight into some possible responses when utilizing βAR agonists in combination with MGA in feedlot heifers.

Key Words: β-Adrenergic Receptor, Melengestrol Acetate, Skeletal Muscle

681 Myostatin prodomain transgene significantly improves dietary fat utilization for animal muscle growth. J. Yang*[1], B. Zhao[1], and R. Wall[2], [1]*University of Hawaii*, *Honolulu*, [2]*Animal and Natural Resources Institute, USDA-ARS*, *Beltsville, MD*.

Myostatin (MSTN), a member of TGF-β family, negatively regulates animal growth and muscle mass. Previously, mouse myostatin function was interrupted by transgenic over-expression of its prodomain in skeletal muscle, resulting in a significant increase in growth performance and muscle mass (Yang, et al., 2001. Mol. Rep. Dev 60: 351-61). It has been well documented that high-fat diets induce obesity in rodents. The skeletal muscle becomes a dominant metabolic focus of nutrient utilization in the prodomain transgenic mice. We hypothesized that the transgenic mice would have the capability to prevent high-fat diet induced adipose tissue overgrowth by partitioning dietary fat to skeletal muscles. Nine-week-old MSTN prodomain transgenic (TG) and littermate wild-type (WT) male mice were randomly assigned to receive high-fat diet (45% kcal% fat and 23% CP) and normal fat diet (10% kcal % fat and 23% CP) for nine weeks. At 18 weeks of age, animals were sacrificed for muscle and adipose tissue evaluation. TG mice grew much faster than WT controls as the weekly body weight of TG were 20-46% heavier than the controls in both high-fat and normal fat diet feeding experiments. In high fat diet experiment, TG mice showed enhanced muscle mass with individual muscle mass increased by 47% to 100% than WT mice. The weights of major white adipose tissue pad mass (epididymal fat, subcutaneous fat and retroperitoneal fat) were also significantly different between TG and WT mice (P<0.001). High-fat diet induced 170-220% more adipose tissue pad mass in WT than transgenic mice. The adipose tissue pad mass of transgenic mice fed with high-fat diet were not significantly different from transgenic mice fed with normal diet (P>0.05). These results demonstrate that animals carrying MSTN prodomain transgene not only have dramatic growth performance and enhanced muscle mass, but also are resistant to high-fat induced adipose tissue deposition. Thus, the data provide evidence that genetically enhanced lean-type animals are more effective in dietary fat utilization for muscle growth.

Key Words: Skeletal Muscle, Transgenic, Epididymal Fat

682 The effect of rumen fluid supplementation on neonatal dairy calf performance and the incidence of diarrhea. C. Todd*[1], D. McKnight[2], T. Godfrey[2], A. Keokkoek[2], P. Sharpe[2], L. Gooijer[1], R. Rana[2], J. Pitty Del Cid[2], and K. Leslie[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*University of Guelph*, *Kemptville, ON, Canada*.

Prevention of neonatal calf diarrhea complex is a priority for the dairy industry. A recent study has suggested that oral administration of rumen fluid to young calves may be a natural and effective way of reducing diarrhea and improving calf health. In the present trial, 30 neonatal Holstein bull calves were used to

examine the effect of oral rumen fluid supplements on calf performance and the incidence of diarrhea. The calves for this study were purchased at d 1 of age from commercial dairy farms and then transported to a calf research facility. Each calf was systematically allocated to a non-treated control group or a rumen fluid treatment group, in which 8 mL of rumen fluid was added to the milk of the afternoon feeding until d 28. Milk intake, starter intake, water intake, and fecal scores were determined daily for all experimental calves. The calves were weighed weekly and average daily gain was determined. Between d 3 and d 23, three weekly fecal samples were collected from each experimental calf. The occurrence of Cryptosporidium parvum was determined by a sucrose flotation and microscopic examination method, and fecal pH was measured. Control and rumen fluid treatment calves were not significantly different with respect to milk intake (p=0.82), feed intake (p=0.95), water intake (p=0.16), average daily gain (p=0.18), and days to weaning (p=0.96). Rumen fluid supplementation did not significantly affect the fluidity or form of calf fecal stools (p=0.83). The occurrence of C. parvum on each weekly sample did not differ between experimental groups (p=0.68, p=0.44, p=0.20, respectively). In addition, fecal pH was not significantly affected by rumen fluid supplementation (p=0.28). The present study differed from the recently published study, in that rumen fluid supplementation did not improve young calf performance or reduce the incidence of diarrhea.

Key Words: Rumen fluid, Performance, Diarrhea

683 Effects of colostrum (C) and dexamethasone (DEXA) treatment on insulin (I)-dependent glucose (G) metabolism in neonatal calves. B. Scheuer[1], L. Tappy[2], J. W. Blum[1], and H. M. Hammon*[3,1], [1]*University of Berne*, *Berne, Switzerland*, [2]*University of Lausanne*, *Lausanne, Switzerland*, [3]*Research Institute for Biology of Farm Animals (FBN)*, *Dummerstorf, Germany*.

Feeding of C and glucocorticoid (DEXA) treatment affect G metabolism and I release in neonatal calves. We have tested whether at a high glucocorticoid status after birth and C feeding influence I-dependent G utilization. Neonatal calves were randomly separated into 4 groups of 7 calves, resp. Calves were fed C or a milk-based formula and in each feeding group, calves were either treated with DEXA (30 µg/kg BW per d) or 0.9% NaCl for the first 4 d of life. On d 5 euglycemic-hyperinsulinemic clamps were performed after an overnight period of 16 h without food. Blood samples were taken before and during the clamp for determination of plasma G and I. I [1mU/(kg BW×min)] was infused for 3 h and plasma G concentrations were kept at 5 mmol/L ±10%. Clamp studies were combined with [13C]-bicarbonate (2.82 µmol/(kg BW×min) and [6,6-2H]-G (40 µg/(kg BW×min) infusions for 5.5 h (i.e., from -150 min to 180 min, relative to the start of I infusion) to determine G flux (GFx), endogenous G production (eGP), and gluconeogenesis (GNG) before and at the end of the clamp. Data were analyzed by the Mixed Model with feeding, DEXA treatment and time as fixed effects. In the pre-clamp period plasma concentrations of G and I were higher in DEXA-treated than in non-treated calves. G infusion rates were lower ($P < 0.05$) in DEXA-treated than in non-treated calves during the whole clamp study. GFx increased ($P < 0.05$) during the clamp and was higher ($P < 0.05$) at the end of the clamp in non-treated than in DEXA-treated calves. GNG did not differ between groups, but eGP tended to be lower ($P = 0.1$) in DEXA-treated than non-treated calves at the end of the clamp study. In conclusion, I alone increased G utilization, but GNG and eGP were not affected. The high glucocorticoid status impaired I-dependent G utilization, but did not influence GNG, whereas the eGP seems to be reduced during I infusion.

Acknowledgements: Supported by Swiss National Foundation and H. Wilhelm Schaumann Stiftung, Germany

Key Words: Neonate, Glucose, Insulin

684 Nutrient restriction in cows alters the number and volume of fetal myofibers. M. Du*, M. J. Zhu, G. A. Olson, B. W. Hess, W. J. Means, and S. P. Ford, *University of Wyoming*, *Laramie*.

Twenty Angus x Gelbvieh rotationally crossed cows carrying female fetuses were blocked by BW and were fed in equal numbers to either meet NRC requirements to gain weight (average = + 4.25% of BW, Control, C) or fed below NRC (nutrient restricted, NR) to lose weight (average = - 6.8% of BW) from d 30 to d 125 of gestation. On d 125, five C and NR cows were necropsied, and the remaining 5 NR cows were realimented to achieve similar BW to C cows when necropsied on d 250 of gestation. The LD muscle of fetuses at 12th rib was removed, fixed and embedded in paraffin for histochemical examination. At d 125 gestation, maternal nutrient restriction reduced the average number of myofibers in muscle bundles of fetal LD muscle; the average number of myofibers from C cows was 12.2 ± 0.34 while that of NR cows was 10.2 ± 0.53 ($P<0.05$). Comparing to the LD muscle of fetuses from C cows at d 250 gestation, maternal nutrient restriction significantly increased the volume of myofibers and reduced the number of myofibers per square area in the fetuses from NR cows; the ratio of the average cross-section area of fetal myofibers from C cows versus NR cows was 1 ± 0.07 to 1.29 ± 0.14 ($P<0.05$). The result showed that nutrient restriction during the early gestation (d 31 to d 125) significantly affected fetal muscle development by reducing the number of myofibers in each muscle bundle. This reduction in the number of muscle fibers due to maternal nutrient restriction at early gestation could not be recovered by realimentation during the late stage of gestation (d 125 to d 250), which resulted in a muscle with reduced numbers of myofibers of larger volume. The reduced number and increased volume of myofibers in fetal muscle due to maternal nutrient restriction during early stage of gestation is expected to impact the physiological function of skeletal muscle and affect meat quality of offspring, which needs further investigation.

Acknowledgements: This work was supported by National Research Initiative Competitive Grant 2003-35206-12814 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Maternal Nutrient Restriction, Cow, Fetal Skeletal Muscle

Nonruminant Nutrition: Enzyme Supplementation

685 Fate of supplemental Escherichia coli phytase in the digestive tract of young pigs. A. R. Pagano*, K. R. Roneker, and X. G. Lei, *Cornell University*, *Ithaca, NY*.

The objective of this study was to determine the functional site of a supplemental E. coli phytase and its impact on phosphorus contents of digesta in different segments of the gastrointestinal tract of pigs. A total of 18 weanling pigs (8.3 ± 0.9 kg BW) were allotted to three groups (n = 6) and were fed a low-P (0.4%) corn-soy basal diet (BD), BD + E. coli AppA2 phytase (500 U/kg), or BD + inorganic P (0.2%) for 4 wk. Individual growth performance and plasma inorganic P concentration were measured weekly. At the end of the study, all pigs were euthanized to collect digesta samples from stomach, duodenum, upper and lower jejunum, ileum, and colon. After freeze-drying, the samples were assayed for phytase activity and soluble P content. Pigs fed BD had lower ($P < 0.05$) daily weight gain, feed use efficiency, and plasma inorganic P concentrations than the other two groups. Phytase activities were similar in the digesta of stomach, duodenum, and upper jejunum, but diminished in the digesta of lower jejunum and ileum of pigs fed BD + phytase. While little phytase activity was detected in the digesta of all these segments from the other two groups, all groups had relatively high phytase activity in the colon digesta (128-267 U/kg). There was a gradual decrease in soluble P of digesta from the stomach to lower jejunum in pigs fed BD + phytase or inorganic P. Digesta soluble P in pigs fed BD was lower ($P < 0.05$) in stomach, but higher ($P < 0.05$) in upper jejunum

than that of the other two groups. In conclusion, stomach seems to be the main function site for supplemental E. coli phytase in young pigs.

Key Words: Phytase, Pigs, Digesta

686 Site of digestibility of protein and phosphorus by growing pigs fed diets without or with microbial phytase. L. L. Geraets*, M. G. Boersma, and H. H. Stein, *South Dakota State University*, *Brookings*.

An experiment was conducted to determine the site of digestibility of CP and P by growing pigs. Six growing barrows (initial BW: 39.5 kg ± 1.3 kg) were randomly allotted to one of two dietary treatments in a two-period switch-back design. Pigs on Treatment 1 were fed a corn-soybean meal based control diet (18% CP, 0.37% P) while pigs on Treatment 2 were fed the same diet supplemented with 500 FYT of microbial phytase (Rhonozyme, DSM Nutritional Products, Inc.). No inorganic P was included in the diets. Each pig was equipped with two T-cannulas, one in the proximal duodenum and one in the distal ileum. Each feeding period lasted 14 d. Fecal samples were collected on d-10, ileal samples on d-11 and d-12, and duodenal samples on d-13 and d-14. The apparent duodenal (ADD), apparent ileal (AID), and apparent total tract (ATTD) digestibility coefficients of DM, CP, and P were calculated. The digestibility of DM and CP increased as feed moved down the GI-tract with the ATTD being higher ($P \leq 0.001$) than the AID, which was higher ($P \leq 0.001$) than the ADD. The ATTD, AID, and ADD for DM were 91.2, 76.8, and 0.4% vs. 90.9, 75.7, and 1.3% for the control and phytase diets, respectively. The corresponding numbers for the digestibility of CP were 90.2, 80.7, and 13.2% vs. 89.2, 80.1, and 9.8% for the control and phytase diets, respectively. There were no differences between the two diets at any of the sites. The ATTD and the AID of P in the control diet (45.0 and 39.3%, respectively) were not different, but higher ($P \leq 0.001$) than the ADD (20.9%). For the phytase diet, the ATTD and the AID (60.0 and 56.1%, respectively) also were not different, but higher ($P \leq 0.001$) than the ADD (23.0%). Both the AID and the ATTD in the phytase diet were higher ($P \leq 0.004$) than the AID and the ATTD in the control diet. It is concluded that diets without and with microbial phytase have a low digestibility of DM, CP, and P prior to the duodenum while the majority of absorption takes place in the small intestine. There is also a significant disappearance of DM and CP in the large intestine, but that is not the case for P.

Key Words: Digestibility, Pigs, Phosphorus

687 Influence of feeding level on apparent ileal and fecal digestibilities of phosphorus and calcium in piglets fed microbial or plant phytase. T. Steiner* and R. Mosenthin, *University of Hohenheim*, *Stuttgart, Germany*.

The influence of feeding level (FL) on apparent ileal and fecal digestibilities of P and Ca in piglets fed microbial or plant phytase was investigated in a 2-period cross-over experiment. Twelve piglets (average initial BW, 7.3 kg) were individually housed in metabolism crates and surgically fitted with simple T-cannulas at the distal ileum. The animals were fed low-P (0.4%) corn-soybean meal diets supplemented with either microbial or plant phytase (550 U/kg) at a level of 2.0- (low) or 2.8-fold (high) the ME maintenance requirement, respectively. In total, there were four treatments with six observations per treatment. Fecal and digesta samples were collected during 3 d and for 24 h, respectively. Titanium oxide was included in the diets as indigestible marker. Apparent digestibilities of P were higher ($P < 0.001$) in pigs fed microbial phytase than in those fed plant phytase at the ileal (54.2 vs. 30.7%) and fecal (56.5 vs. 34.8%) level as well, demonstrating the higher efficacy of microbial compared to plant phytases. Likewise, apparent digestibilities of Ca were also higher ($P < 0.05$) in pigs fed microbial phytase compared to those fed plant phytase both at the ileal (53.8 vs. 40.7%) and fecal (59.2 vs. 50.2%) level. Increasing the FL resulted in improved ($P < 0.05$) apparent ileal (46.0 vs. 38.9%) and fecal digestibilities (46.9 vs. 44.4%) of P. Furthermore, apparent ileal P digestibility was affected ($P < 0.05$) by the interaction between FL and phytase supplementation. Apparent ileal and fecal digestibility of Ca was not improved ($P > 0.05$) by increasing FL. In conclusion, a higher FL has a positive impact on apparent ileal and fecal P digestibility in pigs fed corn-soybean meal diets containing microbial or plant phytase. Therefore, comparative studies on the efficacy of different phytases require a standardization in feed intake at a high level.

Key Words: Feeding Level, Phytase, Pigs

688 The evaluation of phosphorus feeding strategies in pigs from 12 kg to market. R. W. Fent*[1], G. L. Allee[1], D. M. Webel[2], J. D. Spencer[2], and T. S. Torrance[2], [1]*University of Missouri*, *Columbia*, [2]*United Feeds, Inc.*, *Sheridan, IN*.

An experiment using 528 barrows was conducted to evaluate diets targeted at reducing phosphorus (P) excretion from 12 kg BW to market. Pigs were allotted to one of eight dietary treatments in a wean-to-finish facility with six replicate pens/treatment (11 pigs/pen). Pigs were fed in four stages corresponding to 12-27 kg, 27-53 kg, 53-91 kg, and 91 kg-market during which dietary true digestible lysine levels were 1.30, 1.15, 0.80, and 0.65%, respectively. Treatments consisted of: 1) available phosphorus (aP) concentration at 125% of the 1998 NRC recommendation, 2) NRC dietary aP, 3) high aP early, NRC late as previously determined in our lab, 4) NRC aP to 91 kg, then no supplemental P to market, 5) high aP early, no supplemental P from 91 kg to market, 6) no supplemental P with phytase (OptiPhos™) added at 1,000 FTU/kg throughout, 7) high aP early, with 500 FTU/kg phytase replacing 0.12% aP, and 8) phytase added at 1,000, 500, and 300 FTU/kg (replacing 0.20, 0.12, and 0.10% aP) from 12-53 kg, 53-91 kg, and 91 kg-market, respectively. Metacarpal ash and breaking load were determined for one pig/pen at 53 and 91 kg BW and four pigs/pen at termination of the experiment. Removing supplemental P from the diet without phytase supplementation after 91 kg BW decreased ($P < 0.05$) ADG, ADFI, and gain:feed regardless of dietary P early in life. Gain:feed from 91 kg to market was greatest ($P < 0.05$) for those fed phytase-containing diets. Metacarpal ash and breaking load were reduced ($P < 0.05$) in pigs fed diets without inorganic P or phytase after 91 kg BW. The three phytase-containing treatments, whether replacing a portion or all of the inorganic P with phytase, resulted in similar ($P > 0.05$) growth during the final finishing stage and final bone measures with ADG similar to the 125% of NRC diet. These data suggest that removing supplemental P from the diet after 91 kg BW will affect growth performance and bone parameters regardless of prior P feeding. However, substituting some inorganic P with phytase throughout the growing-finishing period resulted in maintained weight gains and bone parameters and improved feed conversion.

Key Words: Phytase, Bone, Excretion

689 Efficacy and equivalency of an E. coli-derived phytase for replacing inorganic phosphorus in broilers and pigs. J. A. Jendza*[1], R. N. Dilger[1], J. S. Sands[2], and O. Adeola[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, UK*.

Two trials were conducted to determine the efficacy of an *Escherichia coli*-derived phytase (ECP) and its equivalence to inorganic phosphorus (iP) from monosodium phosphate (MSP). Trial 1 used 1,200 day-old male broilers in a 42-d trial to assess growth and nutrient utilization. Dietary treatments were based on corn-soybean meal basal diets (B) containing 239 and 221 g/kg CP, 8.2 and 6.6 g/kg Ca, and 2.4 and 1.5 g/kg iP in the starter and grower phases, respectively. Treatments consisted of the B, B + 0.6, 1.2, and 1.8 g/kg iP from MSP, and B + 250, 500, 750, and 1,000 FTU/kg from ECP. The ECP improved weight gain, feed efficiency, and tibia ash (linear, $P < 0.05$). On d 21, Apparent ileal digestibility of P, Arg, His, Phe, and Trp increased (linear, $P < 0.05$) in response to phytase, but DM and energy decreased at 42 d (linear and quadratic, $P < 0.05$). Apparent retention decreased for DM, energy, Ile, Lys, and Val but increased for P and Trp at 21 d (linear, $P < 0.05$). Supplementation with 500 FTU/kg was determined to be equivalent to approximately 721 mg iP from MSP in broiler diets. Trial 2 used 48, 10-kg pigs in a 28-d trial to assess growth and nutrient absorption. Dietary treatments consisted of a positive control (PC) containing 6.1 and 5.6 g/kg Ca and P, respectively, a negative control (NC)

containing 4.8 and 3.9 g/kg Ca and P, respectively, the NC diet + 0.4, 0.8, and 1.2 g/kg iP from MSP, and NC + 500, 750, and 1,000 FTU/kg ECP. Daily gain improved (linear, $P < 0.05$) with ECP addition, as did apparent digestibility of Ca and P (linear, $P < 0.01$). Supplementation with 500 FTU/kg was determined to be equivalent to approximately 533 mg iP from MSP in grower pig diets. The results of these studies showed ECP to be efficacious in releasing phytate phosphorus, and addition of 500 FTU/kg to be equivalent to between 533 and 721 mg iP from MSP.

Key Words: Broilers, *E. coli* Phytase, Pigs

690 Effect of xylanase and(or) phytase supplementation on amino acid digestibility of grower pigs fed wheat-based diets containing wheat millrun. T. Nortey*[1,2], N. Trottier[3], J. Patience[1], P. Simmins[4], and R. Zijlstra[5], [1]*Prairie Swine Centre*, *Saskatoon, SK, Canada*, [2]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [3]*Michigan State University*, *East Lansing*, [4]*Danisco Animal Nutrition*, *Marlborough, UK*, [5]*University of Alberta*, *Edmonton, AB, Canada*.

Wheat by-products such as millrun might be more readily included in swine diets if nutrients bound by arabinoxylans and phytate were made more available, such as through the use of exogenous enzymes. Effects of millrun inclusion level (L1, 20%; L2, 40%), xylanase supplementation (0 or 4,375 U/kg feed), and (or) phytase supplementation (0 or 500 FTU/kg feed) on amino acid digestibility were investigated in a 2 x 2 x 2 factorial arrangement together with a wheat-based positive-control diet. Diets were formulated to contain 3.34 Mcal DE/kg and 2.8 g apparent digestible Lys/Mcal DE and included 0.4% chromic oxide. Eighteen cannulated pigs (36.2 ± 1.9 kg) were fed three diets at 3 x maintenance in consecutive periods, to provide six observations per diet. Ileal digesta and then fecal samples were collected for 2 d. Millrun inclusion linearly reduced apparent digestibility of Asp, His, Ile, Leu, Lys, Phe, Thr, Tyr, Val ($P < 0.001$) and Phe ($P < 0.05$). Within millrun diets, xylanase supplementation improved digestibility of His, Ile, Leu, Phe, Thr, Tyr and Val ($P < 0.05$), but not Arg ($P > 0.05$). For L2, xylanase improved Lys digestibility by 5.1% from 78.6% to 82.6% ($P < 0.05$) and the latter value was not different from the positive-control diet (86.4%; $P > 0.10$). Phytase supplementation of L1 and L2 diets improved digestibility of Arg, His, Leu, Lys, Phe, Tyr and Val ($P < 0.05$). For Ile and Thr, digestibility was improved solely in L2 ($P < 0.05$). Generally, xylanase and phytase did not interact ($P > 0.10$). In summary, millrun inclusion caused a reduction in AA digestibility that could be partially overcome by xylanase and(or) phytase supplementation. In conclusion, the use of wheat millrun in swine diets can be enhanced by using supplemental xylanase and phytase, which might afford opportunities to reduce feed costs.

Key Words: Wheat Millrun, Xylanase, Pig

691 The effect of wheat variety and enzyme supplementation on pig performance. M. E. E. McCann*[1,2], K. J. McCracken[2], and P. H. Simmins[3], [1]*Agricultural Research Institute of Northern Ireland*, *Hillsborough, Co. Down, Northern Ireland*, [2]*The Queen's University of Belfast*, *Belfast, Northern Ireland*, [3]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, England*.

Although wheat is a major component of many pig diets, it has been reported to be the most variable in terms of chemical composition and nutritive value. This variation arises from a number of factors, including variety. Wheat nutritive value can also be affected by non starch polysaccharide (NSP) content, the presence of the 1B/1R gene and endosperm hardness. The aim of this experiment was to examine the effect of wheat variety, enzyme supplementation, endosperm hardness and the IB/IR gene on the production performance of growing pigs. Six wheat varieties were formulated into 12 diets, differing in wheat variety, with or without supplementation with exogenous enzyme (Porzyme 9100; inclusion rate, 1 g/kg) and offered to a total 120 individually housed crossbred (Large White x Landrace) pigs from 8-12 weeks of age. Liveweight gain (LWG, g/d), dry matter intake (DMI, g/d) and feed conversion ratio (FCR) were determined weekly. There were no significant effects on pig performance as a result of variety, enzyme addition, endosperm hardness or the presence of the IB/IR gene. However, wide ranges in LWG, DMI and FCR were observed for pigs offered the 12 experimental diets (650-772 g/d, 1063-1171 g/d and 1.52-1.72, respectively) which may be important in a commercial situation. The lack of variety and 1B/1R gene effects can be attributed to the lack of difference in chemical composition. The results also indicated that, in contrast to previous research, hard wheat was not more efficiently utilised than soft wheat and that enzyme supplementation did not have any significant effect on pig performance.

Key Words: Wheat, Enzyme, Pigs

692 The effect of enzyme supplementation on energy and crude protein digestibility of wheat distiller's dried grains with solubles in grower-finisher pigs. G. P. Widyaratne*[1,2] and R. T. Zijlstra[3], [1]*Prairie Swine Centre Inc.*, *Saskatoon, SK, Canada*, [2]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [3]*University of Alberta*, *Edmonton, AB, Canada*.

Wheat distiller's dried grains with solubles (DDGS) have a lower energy digestibility than wheat, which is likely due to an increased arabinoxylan content as a result of starch removal during ethanol production. Yet, wheat DDGS had a DE content not different than wheat. The objective of the present study was to study the effect of enzyme supplementation on total-tract energy and crude protein (CP) digestibility of wheat DDGS. Wheat-based diets with or without 40% wheat DDGS were tested with or without supplemented xylanase (4,000 U/kg feed) in a 2 x 2 factorial arrangement using eight 30-kg barrows, according to a repeated Latin square design. Following a 6-day acclimation, feces samples were collected for 2 days. The energy digestibility was 5.7% higher for wheat than wheat DDGS ($P < 0.05$). However, xylanase supplementation did not improve energy digestibility in wheat or wheat DDGS ($P > 0.10$). The DE content was similar in wheat and wheat DDGS, and was not improved by xylanase supplementation ($P > 0.10$). In contrast to the previous study, total-tract CP digestibility did not differ between wheat and wheat DDGS ($P > 0.10$), and xylanase supplementation did not improve CP digestibility of wheat or wheat DDGS ($P > 0.10$). However, the digestible CP content was 15.6% higher for wheat DDGS than wheat ($P < 0.05$), indicating that feeding wheat DDGS causes a high N absorption into the body. In summary, wheat DDGS has a lower energy and similar CP digestibility as wheat, and xylanase supplementation did not improve energy or CP digestibility in either wheat or wheat DDGS ($P > 0.10$). In conclusion, in the specific batch of wheat DDGS used in the present study, arabinoxylans might not be the limitation for energy or CP digestibility or the selected level of xylanase was not proper to increase either energy or CP digestibility.

Key Words: Pig, Enzyme, Digestibility

693 The effect of cereal type and enzyme supplementation on nutrient digestibility, intestinal microflora, volatile fatty acid concentration and manure ammonia emissions from pigs. J. M. O' Connell, T. Sweeney, C. Byrne, J. J. Callan, and J. V. O' Doherty*, *University College Dublin*, *Ireland*.

A 2 x 2 factorial arrangement was used to investigate the interaction between cereal type (wheat vs. barley) and an exogenous enzyme supplement (with or without a glucanase/xylanase mix) on apparent nutrient digestibility, large intestinal microflora, volatile fatty acid (VFA) profile and in vitro manure ammonia emissions from pigs. Urine and faeces were collected over 7 days from 16 boars (four/treatment, 80.0 kg live weight) that were housed in metabolism crates. After collections, the pigs were slaughtered and the contents of the intestinal tracts were removed for analysis. There was an interaction ($P < 0.05$) between cereal type and enzyme inclusion in apparent nutrient digestibility, gut microflora, VFA production and in vitro ammonia emissions. The inclusion of enzyme to barley diets increased DMD, OMD and N digestibility compared to unsupplemented diets, however there was no effect of enzyme inclusion in wheat diets. Pigs offered unsupplemented barley-based diets had higher populations of bifidobacteria in the caecum and colon than enzyme supplemented barley diet, however, there was no effect of enzyme supplementation in wheat-based diets. Pigs offered barley based diets had a significantly reduced acetic acid:

propionic acid ratio in the caecum ($P < 0.001$) and in the colon ($P < 0.001$) compared to wheat based diets. In the absence of an enzyme supplement, barley-based diets reduced the proportion of isovaleric acid ($P < 0.05$) and isobutyric acid ($P < 0.05$) in the caecum and colon and also reduced manure ammonia emissions during storage from 0 to 240 hours ($P < 0.05$) compared to the wheat diet, however there was no effect of cereal type in enzyme supplemented diets. In conclusion, the inclusion of an enzyme to barley-based diets increased nutrient digestibility but also increased ammonia emissions.

Key Words: Pigs, Cereal, Enzyme

694 Effect of a multi-enzyme preparation on the gut morphology of weaning piglets. S. Jakob*[1], J. Wolinski[2], R. Zabielski[2], and D. Laubitz[2], [1]*Adisseo France SAS*, *Commentry, France*, [2]*The Kielanowski Institute of Anim. Physiol. and Nutr. PAS*, *Jablonna, Poland*.

An experiment was conducted to evaluate the influence of a multi-enzyme preparation (Rovabio™ Excel LC; ADISSEO, France; 17 enzymatic activities with main activities being Endo-1.4-β-Xylanase & Endo-1.3(4)-β-Glucanase) on the gut morphology of weaning piglets. At d 28 of age, 12 piglets (9.9 ± 0.7 kg) were divided into two groups consisting of six animals each and assigned to two different treatments: 1) a basal diet based on corn and soybean meal (ME, 13.9 MJ/kg; CP, 17.5%; Lys, 11.5 g/kg) and 2) an experimental diet consisting of the basal diet supplemented with Rovabio™ Excel at a level of 200 mL/t. The piglets were housed individually, fed ad libitum the diets for 3 weeks and were euthanized on d 23. Samples from duodenum, jejunum (proximal, mid, distal) and ileum were taken. Villi length and crypt depth were determined by means of confocal microscopy. Data was analyzed by ANOVA. The enzyme supplementation increased ($P < 0.01$) the crypt depth (+10.6%, +23%, +6.3%, +10.4%, and +8.5% for duodenum, distal-, mid-, proximal-jejunum and ileum, respectively), which indicates an enhanced secretion into the lumen, presumably related to changes of the osmolarity of digesta. The enzyme supplementation mediated the hydrolysis of NSP and therefore increased the appearance of mono- or short oligomeric sugars. This could probably be the main reason for the change in osmolarity. The villi length is increased ($P < 0.01$) in the duodenum (control: 380 ± 98 um; enzyme: 470 ± 105 um) as well as in tendency ($P < 0.08$) in the proximal jejunum (control: 353 ± 82 um; enzyme: 374 ± 53 um). This enlarged the mucosa surface and therefore improved its capacity to absorb nutrients. The effect of the enzyme supplementation on crypt depth as well as on villi length was evident mostly in the proximal parts of the gut, indicating a pronounced action of the enzyme preparation on NSP in the duodenum and proximal jejunum. In conclusion, the supplementation of feed with Rovabio™ Excel influences positively the gut morphology of weaning piglets.

Key Words: Villi Length, Enzyme, Piglet

695 Effect of a multi-enzyme preparation on rheological parameters of liquid feed for pigs. S. Jakob*[1], M. Türk[2], and T. Zenke[2], [1]*Adisseo France SAS*, *Commentry, France*, [2]*ATB Bornim*, *Potsdam, Germany*.

The supplementation of feed for piglets and growing-finishing pigs with a multi-enzyme preparation (Rovabio™ Excel; ADISSEO, France; 17 enzymatic activities with main activities being Endo-1.4-β-Xylanase & Endo-1.3(4)-β-Glucanase) can decrease intestinal viscosity, and increased nutrient digestibilities and animal performance, regardless the dietary raw materials, have been observed. The aim of this in vitro study was to determine whether a supplementation with this multi-enzyme preparation decreases the viscosity of liquid feed. A wheat based meal diet (wheat, 720 g/kg; wheat bran, 47 g/kg; soy bean meal, 175 g/kg; premix, 40 g/kg) was supplemented or not with 50 g/t of Rovabio™ Excel. The two diets were mixed with water (20°C; adjusted to pH 5.2 with lactic acid) to obtain DM contents between 25 and 35%, graded into steps of 1%. A special rotary viscometer was operated with a horseshoe agitator and an internal rotating cylinder for recording mixing- or flow curves, respectively. The mixing curve, expressing the torque (mN m), has been recorded for 90 min. Using the same sample, a flow curve was established by increasing the shear rate (1/s), allowing for calculation of the apparent viscosity (Pa/s). Three curves per treatment were established. Data were analysed using repeated-measures ANOVA and post Scheffe's test. An immediate action of the enzyme was observed, as after 10 minutes, a reduction ($P < 0.01$) of the relative torque of 20% could be measured. After 90 min, the relative torque was reduced ($P < 0.01$) by 30%, indicating a continuing action of the enzyme and showing its stability in liquid feed. Dependent on the shear rate, a total reduction ($P < 0.01$) in apparent viscosity of 40 to 50% was obtained, allowing for savings on costs for pumping, maintenance of pumps and providing feed lowered in viscosity to the pigs. The flow curves show the possibility to increase dry matter contents of 2 to 2.5% without increasing the viscosity when using the enzyme preparation. Thus, reduced quantities of manure are realizable. The supplementation of liquid feed with RovabioTM Excel is influencing positively the rheological properties of liquid feed.

Key Words: Enzyme, Liquid Feeding, Pig

696 Evaluation of cellulolytic enzyme supplementation on production indices of poultry fed soyabean hull meal based diets. B. O. Esonu*[1], R. O. Izukanne[1], and O. A. Inyang[2], [1]*Federal University of Techology*, *Owerri, Imo State, Nigeria.*, [2]*Michael Okpara College of Agriculture*, *Umuagwo, Imo State, Nigeria*.

Two experiments were conducted to evaluate cellulolytic enzyme supplementation on the production indices of broilers and laying hens fed soybean hull meal based diets. In the first experiment, five broiler finisher diets were formulated to contain soybean hull meal at 0%, 10%, and 20% (without enzyme supplementation) and 10% and 20% (with 1.0% enzyme supplementation). Each diet was fed to 72, 4-week old broiler chicks for 28 days. There were significant differences ($P < 0.05$) in feed intake, feed cost/kg weight gain and feed conversion ratio among the groups. The birds on control diet (0% soybean hull meal without enzyme supplementation) performed significantly better ($P < 0.05$) than the other groups. In the second experiment, seven experimental layer diets were formulated to incorporate soybean hull meal at 0%, 10%, 20%, and 30% (without enzyme supplementation) and 10%, 20% and 30% (with 2% enzyme supplementation). Each diet was fed to 60 laying birds for 90 days. There were significant differences ($P < 0.05$) in feed intake, feed conversion ratio, egg weight, Haugh unit, hen-day production, feed cost/dozen eggs, digestibility of crude protein and crude fibre among the groups. However, there were no significant differences ($P > 0.05$) among the groups in egg yolk colour, shell thickness albumen and yolk indices and digestibility of dry matter. The results of these experiments suggest that 1.0% and 2.0% cellulolytic enzyme supplementation at 20% and 30% dietary levels of soybean hull meal for broiler and layer diets, respectively, could not significantly affect ($P > 0.05$) the performance indices of broilers and laying hens.

Acknowledgements: University Research Committee

Key Words: Cellulolytic Enzyme, Soybean Hull Meal, Broilers and Laying Hens

697 Effect of stocking density and fence line barrier on the behavior of dairy cattle. J. M. Huzzey*, P. Valois, T. J. DeVries, M. A. G. von Keyserlingk, and D. M. Weary, *University of British Columbia*, *Vancouver, British Columbia, Canada*.

The objectives of this study were to evaluate the effect of using a headlock (HL) or a post-and-rail (PR) barrier on the behavior of dairy cows, and to determine how this effect interacts with stocking density. Thirty-six lactating Holstein cows were divided into four groups, two assigned to each barrier design. Groups were followed for 40 d and then switched to the alternate barrier for a subsequent 40 d. Within each 40 d period, each of the four groups were tested at four stocking densities (see Table), each lasting 10 d, with densities assigned to the groups using a 4x4 Latin square. Time-lapse video was used to quantify feeding, standing and competitive behavior at the feed bunk. Data were analyzed using a general linear model with group as the observational unit. Daily feeding times were higher (P=0.001) and duration of inactive standing in the feeding area was lower (P<0.001) when using a PR barrier compared to a HL barrier (Table). Feeding time increased (P<0.001) and inactive standing decreased (P<0.001) for both barrier designs as cows were given more space to feed. Cows were displaced more often from the feeding area (P=0.005) when the stocking density was increased, but this effect was greater (P=0.002) for cows using the PR barrier. In summary, regardless of feed barrier, increasing stocking density reduced feeding time and increased inactive standing time. The PR barrier allowed for increased feeding time and reduced inactive standing time, but also increased the frequency of competitive displacements especially when cows were overstocked.

Feed Barrier	Stocking Density	Feeding Time (min/d ± SE)	Inactive Standing Time (min/d ± SE)
HL	1.33 HL/cow	276.13 ± 6.45	96.80 ± 4.77
HL	1.00	264.79 ± 6.45	103.21 ± 4.77
HL	0.67	249.91 ± 6.45	106.82 ± 4.77
HL	0.33	218.68 ± 6.45	119.83 ± 4.77
PR	0.81 m/cow	290.68 ± 6.45	81.23 ± 4.77
PR	0.61	287.01 ± 6.45	88.56 ± 4.77
PR	0.41	268.00 ± 6.45	93.20 ± 4.77
PR	0.21	234.44 ± 6.45	111.65 ± 4.77

Key Words: Feed Barrier, Stocking Density, Feeding Behavior

698 Effect of feeding frequency on the behavior of lactating dairy cows. T. J . DeVries* and M. A. G. von Keyserlingk, *The University of British Columbia*, *Canada*.

The time of feed delivery alters the time of peak activity at the feed bunk, indicating that dairy cows respond strongly to the delivery of fresh feed. It follows that the frequency of feed delivery should also affect cow behavior. To date, few researchers have investigated the effects of feeding frequency on the behavior of group-housed dairy cows. The objective of this study was to examine the effects of frequency of feed delivery on the feeding and lying behavior of group-housed dairy cows. This objective was tested in two experiments. In each experiment, 48 lactating Holstein cows, split into groups of 12, were subjected to each of two treatments in a cross-over design. The treatments for the first experiment were: 1) delivery of feed once per day (1x), and 2) delivery of feed twice per day (2x). The treatments for the second experiment were: 1) delivery of feed 2x, and 2) delivery of feed four times per day (4x). In each experiment, cows were milked twice daily and fed a TMR containing 49% forage and 51% concentrate (DM basis). For both experiments, time-lapse video was used to quantify the feeding and lying behavior of the cows. Using the pen as the experimental unit, treatment effects were tested by paired t-tests. Cows fed 2x increased (P = 0.04) their daily feeding time by 10 min compared to when they were fed 1x. Cows further increased (P = 0.04) their daily feeding time by 14 min when they were fed 4x compared to when they were fed 2x. Frequency of feed delivery had no effect (P = 0.9) on the daily lying time of the cows. Despite this, there were changes in the daily distribution of lying time. Cows fed 1x took 13 min longer (P = 0.01) to lie down after the return from the morning milking compared to when they were fed 2x. When cows received feed 4x, they lay down 11 min sooner (P = 0.03) after milking than when fed 2x. These results indicate that increasing the frequency of feed delivery increases the amount of time that cows spend feeding. These results also indicate that the feeding and lying patterns of dairy cows are affected by the frequency of feed delivery.

Key Words: Feeding Frequency, Feeding Behavior, Dairy Cow

699 The Cornell Net Carbohydrate and Protein System: An evolving model. T. Tylutki* and D. Fox, *Cornell University*, *Ithaca, NY*.

The Cornell Net Carbohydrate and Protein System (CNCPS), a cattle nutrition model, has been under continuous development since the early 1980s. The upcoming version (CNCPSv6) has undergone a comprehensive review with the addition of recent biological advances. This review highlighted several critical areas requiring corrective actions including: partitioning ash to microbes, NFC bacterial peptide uptake, NFC bacterial nitrogen requirements, FC microbial growth at different rumen pHs, efficiency of energy utilization for maintenance, the calculation of heat production, and others. Heat production and the efficiency of energy utilization for maintenance are now based upon diet characteristics. The review also resulted in different implementation strategies for growth and body reserves. Body reserves now encompass energy and protein (versus only energy) and can desired end points inputted to force either reserves mobilization or replenishment. Biological principles updated include: expanded carbohydrate pools, new passage rate equations, and updating energy conversions (ME to NE) and incorporating lactose in milk energy calculations according to the 2001 Dairy NRC. An additional change is in the NFC calculation where NDIN is no longer included. This change is based upon the AOFC NDF method that utilizes sodium sulfite (which removes the nitrogen from the NDF fraction). As CNCPSv6 was re-engineered, new programming techniques utilizing object-oriented methods and optimization procedures have been implemented. A shift from least cost formulation to maximizing income over feed costs has also occurred. An initial comparison with CPM version 3.0 for a diet formulated for 45.4 kg milk shows: ME supply, 6% lower in CNCPSv6; ME required, 4% higher; MP supply, 5% lower; MP required, 2% lower. Total microbial flow is predicted to be 2% lower in CNCPSv6. Model predictions, utilizing data from controlled studies, will be presented illustrating the impact of these changes on: predicted bacterial yield; ME, MP, and amino acid supply and requirements; whole animal performance; and herd nutrient excretion.

Key Words: Models, Systems

700 Impact of the level of aggregation of feed carbohydrate (CHO) fractions on predictions of the Cornell Net Carbohydrate and Protein System (CNCPS). C Lanzas*, L. O. Tedeschi, and D. G. Fox, *Cornell University*, *Ithaca, NY*.

The CNCPS model accounts for the effect of variation in feed CHO fractions in predicting nutrient requirements and animal performance. However, current fractionation schemes aggregate VFA and organic acids (OA) with sugars and soluble fiber with starch in predicting microbial growth and CHO digestion, which may limit the accuracy of the model. A Monte Carlo analysis was conducted with a typical lactating dairy cow ration to compare the current CHO scheme (**A** = sugars and OA, **B1** = starch and soluble fiber, **B2** = available NDF, **C** = unavailable NDF) with the expanded CHO scheme developed for CPM

Dairy (**A1** = acetic, propionic and butyric acids, **A2** = lactic acid, **A3** = OA, **A4** = sugars, **B1** = starch, **B2** = soluble fiber, **B3** = available NDF, **C** = unavailable NDF). A database provided by Dairy One lab was used to obtain the distributions of these CHO fractions for the ingredients used, which are commonly used in the northeast US (corn, alfalfa silages, high moisture corn, soybean meal, and distillers grains). CNCPS predicted values for these two levels of aggregation are summarized below. The mean of Met allowable milk and MP from bacteria was lower with the expanded scheme. The model presented similar robustness as indicated by the SD for both schemes. For both levels, the SD for MP and Met milk was mainly due to variations in rates of fiber digestion (r = 0.45), NDF and starch in corn silage (r = 0.41), and silage OA and sugars (r = -0.20). We conclude the expanded CHO fractions can be added to the CNCPS model with little risk of use. However, to fully account for differences in feed CHO utilization, further modifications in the structure of the current model will be needed.

	Current CHO fractions	Expanded CHO fractions
Mean±SD	Mean±SD	
ME allowable milk (kg/day)	34.2±1.06	34.2±1.05
MP allowable milk(kg/day)	33.7±1.24	33.1±1.22
MP from bacteria (g/day)	1304±46.4	1273±44.6
Met allowable milk(kg/day)	32.7±1.72	31.8±1.68
Fecal N excretion	228±3.7	226±3.6
Urinary N excretion (g/day)	212±3.7	215±3.6

Key Words: Feed Carbohydrate, Simulation, Nutritional Models

701 The energy system of the 2001 Dairy NRC: Challenges for a ration formulation program. M. VandeHaar*, *Michigan State University*, *East Lansing*.

The energy system of the 2001 Dairy NRC is considerably more complicated than that of the 1989 NRC. The 2001 NRC was developed to be a retrospective evaluation program. The objective of this simulation study was to determine how the new system works as a prospective formulation program. Whereas a retrospective program examines a diet that has already been consumed by a cow and thus is at least reasonable, the prospective ration formulation program must be able to develop a new diet without prior knowledge of how the cow will eat it. Estimation of feed energy values using the composition of ingredients is likely an improvement over the previous system of book NEL values. However, protein is overvalued in the model, with an energy value of 5.6 kcal/g of digested protein but with the same constant conversion of DE to ME as in 1989. More importantly, the digestibility discount is now adjusted for level of intake, and, although feed factors are not used in predicting feed intake, they are used in predicting digestibility. Nonfat feeds with the highest TDN values at 1X maintenance are discounted the most with increasing intake. As an evaluation program, this may work well. However, as a formulation program for high producing cows, the new system predicts nearly the same energy-allowable milk with a high grain diet as with a high forage diet. Because the feed intake equation does not use feed factors, the implicit assumption is that a cow can eat as much of a high forage diet as a high grain diet. Thus, least-cost formulation programs would be unjustly biased toward high forage diets for high-producing cows (>54 kg of milk per day). As a diet formulator, the 2001 NRC model favors diets for high producing cows that are higher in fat, protein, and fiber than are optimal for high production. Possible solutions are to lower the energy value of digested protein to 4.8 kcal/g and to remove feed factors from the equation for predicting the digestibility discount, or to add feed factors to the equation for predicting feed intake.

Key Words: Ration Software, 2001 Dairy NRC

702 Corn grain endosperm type and brown midrib 3 corn silage: ruminal fermentation and microbial N efficiency in lactating dairy cows. C. C. Taylor* and M. S. Allen, *Michigan State University*, *East Lansing*.

Interactions of endosperm type of corn grain and the brown midrib 3 (*bm3*) mutation in corn silage on ruminal fermentation and microbial N efficiency of lactating dairy cows were evaluated. Eight ruminally and duodenally cannulated cows (72 ± 8 d in milk; mean ± SD) were used in a duplicated 4 × 4 Latin square design experiment with a 2 × 2 factorial arrangement of treatments. Grain treatments were dry corn grain from hybrids with floury or vitreous endosperm; silage treatments were corn silage from a hybrid with the *bm3* mutation or its isogenic control hybrid without the *bm3* mutation. Diets contained 26% neutral detergent fiber and 17% crude protein. Treatment corn grain and silage supplied 23% and 38% of the diet DM, respectively. Data were analyzed by a mixed effects model and orthogonal contrasts were determined for main effects of corn grain endosperm type and corn silage hybrid and their interaction. Mean and minimum ruminal pH was reduced by floury corn grain and *bm3* corn silage ($P < 0.05$). Non-ammonia N (NAN) and non-ammonia non-microbial N (NANMN) flow to the duodenum did not differ among treatments. Microbial N flow was similar among endosperm types in *bm3* silage diets but in control silage diets vitreous grain numerically increased microbial N flow 185 g/d compared to floury grain (interaction $P < 0.17$). There were no interactions of main treatment effects for microbial N efficiency (MNE) and type of silage did not affect MNE, but MNE was numerically higher for diets containing vitreous compared to floury corn grain (41.3 versus 34.5 g/kg truly ruminally degraded organic matter; $P < 0.12$). MNE was negatively correlated with ruminal starch digestibility ($r = -0.47$; $P < 0.01$) and positively correlated with mean ruminal pH ($r = 0.53$; $P < 0.006$) and rate of starch passage from the rumen ($r = 0.46$; $P < 0.01$) across cow period means. Microbial N efficiency and ruminal pH are affected by starch digestion kinetics, which varies according to corn endosperm type.

Key Words: Endosperm, Microbial Efficiency, Ruminal pH

703 Effects of corn grain endosperm type and conservation method on site of digestion, ruminal digestion kinetics and microbial nitrogen production of lactating dairy cows. Y. Ying* and M. S. Allen, *Michigan State University*, *East Lansing*.

Eight ruminally and duodenally cannulated Holstein cows (73 ± 39 DIM; mean ± SD) were used in a duplicated 4 x 4 Latin square design. A 2 x 2 factorial arrangement of treatments was used with main effects of corn grain endosperm type (floury or vitreous) and conservation method (dry or high-moisture, HM). Diets were formulated to 26.6% neutral detergent fiber and 16.5% crude protein. Corn grain treatments supplied 86.6% of dietary starch. True ruminal starch digestibility was increased by HM compared to dry (87.2 vs. 64.3%, $P < 0.001$) and for floury compared to vitreous (83.7 vs. 67.7%, $P < 0.001$) treatments. The increase for HM compared to dry corn was because of an increase in digestion rate (31.4 vs. 24.4 %/h, $P < 0.05$) and a decrease in passage rate (7.1 vs. 16.3 %/h, $P < 0.001$) of starch. Rate of starch digestion was not affected by endosperm type; the increase in ruminal starch digestibility for floury compared to vitreous was because of a 53% decrease in rate of starch passage from the rumen (7.5 vs. 16.0 %/h, $P < 0.001$). Total tract digestibility of starch was similar across treatments exceeding 95% because of compensatory post-ruminal digestion. Ruminal pH was increased (6.22 vs. 6.10, $P = 0.002$) by dry compared to HM corn. Dry corn treatment tended to increase non-ammonia N flow to the duodenum (466 vs. 431 g/d, $P = 0.08$) by increasing flow of non-ammonia non-microbial N (211 vs. 111 g/d, $P < 0.001$) despite a decrease in microbial N flow (255 vs. 320 g/d, $P < 0.01$) compared to HM treatment. Vitreous corn increased non-ammonia non-microbial N flow to the duodenum (187 vs. 135 g/d, $P < 0.05$) compared to floury corn treatment but microbial N flow to the duodenum was not affected by endosperm type. Efficiency of microbial N production was not affected by treatment. Endosperm type and conservation method of corn grain greatly affect digestion kinetics and ruminal digestibility of starch as well as flow of N fractions to the duodenum.

Key Words: Corn Endosperm, Conservation, Ruminal Digestion Kinetics

704 Evaluation of near infrared calibrations for corn kernel hardness parameters and relationship to degradabilities. D. Ngonyamo-Majee*[1], R. Shaver[1], J. Coors[1], D. Sapienza[2], J. Lauer[1], and P. Flannery[1], [1]*University of Wisconsin*, *Madison*, [2]*Sapienza Analytica*, *Johnston, IA*.

We previously evaluated kernel hardness parameters and degradabilities of 33 inbreds and developed near infrared (NIR) calibrations. For this study we developed 13 hybrids from crosses of selected inbreds covering low (0-30%), medium (30-70%) and high (70-100%) vitreousness (V) classifications and test lines (Mo17Ht and B73) for evaluation of the NIRS calibrations. Six check hybrids, W64AxOh43 carrying opaque-2 (o2), floury-2 (fl2), sugary-2 (su2) and amylose-extender (ae1) mutant genes, straight W64AxOh43, and B73xMo17Ht were included. The hybrids were grown at the West Madison Research Station during 2003 in 3*5m row plots in a randomized complete block design with three replicates. Harvesting was at three maturity stages (HS1=½ milk line; HS2=black layer; HS3=21d post black layer). Dried kernels were ground through a 1mm Wiley mill screen for NIRS prediction of V, density (D) and stenvert hardness measures of grinding time (T) and height in collection receptacle (CH). In-situ ruminal (RDMD) and total (TDMD; Pioneer Hi-bred Int. in vitro enzymatic method on ruminal residue) DM degradabilities were determined on 6mm ground samples and correlated with NIRS predicted hardness parameters. Correlations (r) are presented in the table. All NIRS-predicted hardness parameters were correlated (P<0.001) with degradability measurements. Stenvert CH correlations were better than T. NIRS density correlations were better than NIRS V correlations from either manual dissection or visual rating. Correlations for stenvert CH gave similar correlations as both V calibrations.

Parameter	NIRS calibration	0-hr	RDMD	TDMD

Key Words: Corn, Vitreousness, Degradability

705 Long term feeding of wet corn distillers grains and lactation performance of dairy cows. G. S. Mpapho*, A. R. Hippen, K. F. Kalscheur, and D. J. Schingoethe, *South Dakota State University*, *Brookings*.

The objectives of this study were to evaluate milk production, dry matter intake, and milk composition of dairy cows fed wet corn distillers (WDG) at 15% of diet dry matter. Sixteen multiparous and fourteen primiparous Holstein, and eight multiparous Brown Swiss cows were randomly assigned to one of the two treatments. Cows were blocked by parity, breed, and expected calving date. Experimental diets contained 35% corn silage and 15% alfalfa hay (DM basis) and were fed from 22 to 105 DIM. The treatment group was fed WDG at 15% of diet DM. In the control diet (CTL), WDG was replaced by corn grain, soybean meal, and extruded and expeller soybean meals. Diets were balanced (DM basis) at 17% CP, 21.7% forage NDF, 5.5% ether extract, and 1.63 Mcal NEL/kg. The diet was offered for ad libitum intake. Dry matter intake of cows fed WDG and CTL (19.0 and 20.5 kg; P > 0.20) did not differ between treatments. Milk production (35.4 and 33.7 kg/d) and 4% FCM (33.4 and 32.1 kg/d) were not different (P > 0.40). Concentrations of milk components and milk component yields were also not affected by diet, although milk lactose percentage tended to be higher for WDG than CTL (4.97 and 4.89%; P < 0.07). Cows fed WDG had higher MUN (15.6 and 13.3 mg/dL; P < 0.02). Diet was found to interact with parity as primiparous cows had greater DMI on CTL than for WDG (19.3 vs 15.3 kg/d) whereas diet did not affect DMI of multiparous cows (P < 0.03 for diet*parity). Other effects observed included parity and breed. Multiparous cows produced more milk than primiparous cows (22.2 and 17.3 kg/d; P < 0.001) and Holstein cows produced more milk than Brown Swiss cows (39.3 and 29.5 kg/d; P < 0.01). Milk fat (4.05 and 3.38%; P < 0.01) and milk protein (3.10 and 2.86%; P < 0.02) were greater for Brown Swiss than Holstein cows. Results from this experiment showed that feeding WDG at 15% of diet dry matter does not affect lactation performance.

Key Words: Wet Distillers Grains, Milk Production, Dairy Cows

706 Feed intake and lactation performance of Holstein cows fed graded amounts of a poultry-based protein and fat supplement (PRO*CAL). S. J. Freeman*[1], P. J. Myers[1], C. J. Sniffen[2], and T. C. Jenkins[1], [1]*Clemson University*, *Clemson, SC*, [2]*Fencrest, LLC*, *Holderness, NH*.

PRO*CAL has recently been introduced as a new dairy feed supplement, which consists of nutrients from poultry processing plants reacted to yield a dry, free-flowing product high in both protein and fat. A previous continuous culture study with mixed ruminal microorganisms demonstrated that PRO*CAL, despite its high fat content, did not have negative effects on fermentation and that unsaturated fatty acid components were more resistant to biohydrogenation than fatty acids in soybean oil. This study was done to determine the effects of PRO*CAL on feed intake and lactation performance. Four levels of PRO*CAL were fed to 24 Holstein cows (50 ± 15 DIM) for 6 weeks in a randomized block design. Target concentrations of PRO*CAL in the blended ration were designed to keep diets isonitrogenous but replace 0 (diet0), 33 (diet33), 67 (diet67), or 100% (diet100) of the bypass protein supplied. The data were analyzed using the mixed procedure of SAS with α=0.05. Diet had no effect on dry matter intake, milk yield, or milk composition. When averaged across all weeks, milk yield averaged 41.9 kg/d, and milk fat and protein percentages averaged 3.29 and 2.55, respectively. A diet by week interaction (P < 0.05) occurred because milk yields were similar for all diets through week 2, but from weeks 3 through 6, milk yields were higher (P < 0.05) for diet67 and diet100. As PRO*CAL increased in the diet, milk concentrations of C18:0, trans C18:1, C18:1, and C18:2 increased (P < 0.05). The results show that PRO*CAL can be fed to lactating dairy cows as a poultry-based source of bypass protein and fat without negative effects on feed intake or milk production. Also, PRO*CAL has the added advantage over other bypass protein supplements of enhancing milk yield, presumably due to its higher fat and energy values.

Acknowledgements: Partial financial support and PRO*CAL was provided by Simmons Protein, Southwest City, Missouri.

Key Words: PRO*CAL, Dry Matter Intake, Milk Yield and Composition

707 Effects of feeding whole cottonseed coated with starch, urea, or yeast on performance of lactating dairy cows. K. M. Cooke* and J. K. Bernard, *The University of Georgia*, *Tifton*.

Thirty Holstein cows were used in an 8-wk randomized block trial to test the viability of select additives included in the gelatinized starch coating applied to whole cottonseed (WCS) on nutrient intake and digestibility and milk yield and composition. Treatments included WCS coated with 2.5% gelatinized corn starch (CONTROL); control plus 0.5% urea included in the coating (UREA);or control plus 2.0% yeast culture in the coating (YEAST). The diets were fed once daily behind Calan doors. Dry matter intake, milk yield and composition were similar for cows fed CONTROL and UREA. There was a tendency for increased milk fat yield (P = 0.09) in cows fed UREA compared with CONTROL. Energy corrected milk yield (ECM) increased 6.5 % and efficiency of milk production (ECM per unit of DMI) increased 5.3% when cows were fed UREA compared with CONTROL, but the differences were not significantly different (P = 0.16 and P = 0.15, respectively). Percentage lactose was numerically lower (4.89 vs. 4.77 %) for cows fed UREA compared with CONTROL. Intake (P < 0.0001) and whole tract apparent digestibility of fat ether extract (P = 0.07) were higher, but the apparent digestibility of dry matter (P = 0.005), crude protein (P = 0.01), NDF (P = 0.003) and ADF (P = 0.001) was lower for cows fed UREA compared with the control. Inclusion of yeast culture in the coating tended to decrease the percentage of milk protein and solids-not-fat (2.8 and 2.0% respectively) in milk and increased the efficiency of milk production (P = 0.06), but no differences were observed for milk yield or other milk components. Intake of crude protein was lower (P = 0.04) and apparent digestibility of acid detergent fiber was higher (P = 0.03) for cows fed diets containing YEAST compared with control. The results of this trial indicate that the inclusion of urea or yeast culture in the gelatinized starch coating applied to whole cottonseed may potentially improve the efficiency of milk production and numerically increase yield of ECM.

Key Words: Cottonseed, Starch, Urea

708 Mammary use of glucose when milk yield is reduced by once daily milking and/or feed restriction in dairy cows. J. Guinard-Flament*, E. Delamaire, S. Lemosquet, and Y. David, *UMR INRA-Agrocampus Rennes Production du Lait*, *Rennes, France*.

A decrease in milk yield may alter mammary use of plasma glucose for lactose production through a modified mammary supply, uptake and/or metabolic fate of glucose. A study was conducted to better understand mammary glucose utilization following a decrease in milk yield induced by once daily milking (ODM) and/or feed restriction (FR). Five multiparous dairy cows (30 kg/d of milk) were fitted with an ultrasonic flow probe to measure mammary blood flow (MBF) and with two catheters to determine arteriovenous differences in glucose concentrations (AV). Mammary use of glucose was measured on d 7 of each experimental week according to a reversal design in which the cows were milked once or twice daily while fed a diet providing 98 or 70% of needs determined before the trial. Data were analyzed by Anova using PROC GLM of SAS. No interaction between ODM and FR was observed. The decrease in milk yield induced by ODM was larger (-5.1 kg/d) than with FR (-2.9 kg/d) ($P < 0.01$). This difference was not due to a lower mammary supply of glucose with ODM because it was less reduced with ODM than with FR (-1.7 *vs.* -3.4 mmol/min, respectively). MBF decreased by about 0.8 L/min with ODM and FR ($P < 0.01$) but arterial concentration of glucose was higher with ODM ($P < 0.03$). The difference in milk response between ODM and FR was not also due to a different decline in the mammary uptake of glucose (MBF × AV). It decreased by 0.75 mmol/min for ODM and FR ($P < 0.01$) in response to a reduced or unchanged glucose AV ($P < 0.06$ and 0.32, respectively). In fact, the difference in milk yield decrease, induced by the two treatments, was due to a more efficient intracellular use of glucose towards lactose synthesis with FR (80 *vs.* 72%). Thus, glucose supply, uptake and metabolic fate are differently involved in the regulation of milk yield by ODM and FR, implying a decrease in MBF and different intra-mammary regulations resulting in an altered glucose AV for ODM and an increased use of glucose towards lactose synthesis with FR.

Key Words: Glucose, Udder, Dairy Cow

Ruminant Nutrition: Beef and Small Ruminant—Nitrogen Metabolism

709 Metabolizable protein effects on ammonia emissions and nitrogen excretion of steers. D. Panetta*, W. Powers, and J. Russell, *Iowa State University of Science and Technology*, *Ames*.

Protein degradability effects on N metabolism and NH_3 emissions were evaluated. In Exp 1, eight steers (initial BW, 338 kg) were fed diets containing urea (D1: 10.6% CP), soybean meal (D2: 10.1% CP), or soybean meal and urea (D3: 16.9% CP). In Exp 2, nine steers (initial BW, 268 kg) were fed diets containing 0 (D0: 12.7% CP), 12 (D12: 10.7% CP), or 24% (D24: 12.9% CP) distillers dried grain with solubles (DDGs). Feces and urine collections and DMI determination occurred during one 4-d period in Exp 1 and three 3 to 6-d periods in Exp 2. An 800-g, as-excreted mixture of urine and feces from each steer was placed into duplicate plastic tubs. Air passed over the excreta at a rate of 3 L/min for 96 h and NH_3 was trapped in boric acid. In Exp 1, DMI (7.3 kg/d) and ADG (0.55 kg/d) did not differ ($P > 0.05$) between diets. Digestibility of DM (61.9%) did not differ with diet, but total Kjeldahl nitrogen (TKN) digestibility was greater in steers fed D3 (65.7 vs. 50.7 and 41.5% on D1 and D2). Daily fecal DM, NH_4^+-N, and TKN mass did not differ between diets. Steers fed D1 excreted less urinary NH_4^+-N (4.8 vs. 8.7 and 9.1 g/d for D2 and D3). Steers fed D2 excreted less urinary TKN (32.3 vs. 42.5 and 49.5 g/d for D1 and D3). In Exp 2, steers fed D0 had lower DMI (4.0 vs. 5.5 and 5.4 kg/d for D12 and D24) and ADG (-0.80 vs. 0.32 and 0.24 kg/d for D12 and D24). Intake of TKN was greater for D24 (104.9 vs. 78.6 and 88.2 g/d for D0 and D12). Digestibility of DM (77.9%) and TKN (67.3%) were unaffected by diet. Steers fed D24 had greater fecal TKN (32.7 vs. 23.6 and 25.3 g/d for D0 and D12) and NH_4^+-N (4.22 vs. 2.94 and 2.82 g/d for D0 and D12) but daily urinary TKN (12 g) was unaffected by diet. Urinary NH_4^+-N was greater for steers fed D0 (9.1 g/d) than D12 (5.4 g/d). Daily NH_3-N emissions were 170, 99, and 97 mg for D1, D2, and D3 and 70, 29, and 53 mg for D0, D12, and D24. The daily portion of total emitted NH_3 increased with time (18, 25, 28, 29% and 22, 23, 27, 28% for d 1, 2, 3, and 4 of Exp 1 and 2). Metabolizable protein fractions play a larger role than dietary CP in influencing N excretion and NH_3 emissions and DDGs, as a UIP source, contributes to reduced NH_3 emissions.

Key Words: Ammonia, Protein

710 Effects of energy source on methionine utilization by growing steers. G. F. Schroeder*, E. C. Titgemeyer, M. S. Awawdeh, J. S. Smith, and D. P. Gnad, *Kansas State University*, *Manhattan*.

We evaluated the effects of different supplemental energy sources on methionine (Met) utilization in growing steers. Ruminally cannulated Holstein steers were used in two 6 × 6 Latin squares with data pooled for analyses. In Exp. 1, steers (148 kg) were fed 2.3 kg DM/d of a diet based on soybean hulls. Treatments (2 × 3 factorial) were abomasal infusion of 0 or 3 g/d of L-Met, and supplementation with no energy or with glucose (360 g/d) or fat (150 g/d) continuously infused into the abomasum. In Exp. 2, steers (190 kg) received 2.6 kg DM/d diet and were provided in a 2 × 3 factorial with 0 or 3 g/d L-Met and with no supplemental energy or with acetate (385 g/d) or propionate (270 g/d) continuously infused into the rumen. Energy sources supplied 1.3 Mcal ME/d. In both trials, all steers received basal infusions of 400 g/d acetate into the rumen and a mixture (125 g/d) of all essential AA except Met into the abomasum. Nitrogen balance (23.6 vs 27.8 g/d, $P<0.01$) and whole-body protein synthesis (2.1 vs 2.3 kg/d, $P<0.07$) were increased by Met supplementation, indicating that Met limited protein deposition. Energy supply reduced ($P<0.01$) urinary N excretion and increased ($P<0.01$) N retention, without differences among energy sources. Increases in N retention in response to Met were numerically greater when energy was supplied. Efficiency of supplemental Met utilization was 11% when no energy was supplemented but averaged 21% when 1.3 Mcal ME/d was provided. Whole-body protein synthesis and degradation were not affected by energy supply. Serum insulin concentrations were increased by glucose and propionate supplementation. Serum IGF-I concentrations were increased by supplementation with Met or glucogenic sources of energy. In growing steers, N retention was increased by energy supplementation even though Met limited protein deposition, suggesting that energy supplementation improves the efficiency of AA utilization. These responses were independent of the source of energy supplemented.

Acknowledgements: This project was supported by National Research Initiative Competitive Grant no. 2003-35206-12837 from the USDA Cooperative State Research, Education, and Extension Service.

Key Words: Energy, Methionine, Growth

711 Ruminal fermentation of ^{15}N-labeled alfalfa hay N fractions *in vitro*. A. Melgar* and A. N. Hristov, *University of Idaho*, *Moscow*.

The objective of this study was to compare the ruminal *in vitro* rate and extent of bacterial utilization of ^{15}N-labeled alfalfa hay N fractions. Nitrogenous fractions from green house-grown alfalfa hay were isolated and incubated *in vitro* with mixed ruminal populations. The following N fractions were prepared: insoluble N (InsN), soluble protein N (SolPN), non-protein N (NPN), neutral-detergent insoluble N (NDFN), and acid-detergent insoluble N (ADFN). Casein labeled with ^{15}N (Cas) was used as a control. Incubation was repeated three times (n=3). All N fractions were incubated with ruminal inoculum/buffer media containing sugars, starch, and pectin as energy sources. Concentration of ^{15}N in the incubation media was 5.6 mg/L. Samples were taken at 0, 0.25, 0.5, 1, 2, 4, 6, and 8 h, fractionated into: ammonia N (NHN), bacterial N (BactN), N

associated with particulate matter and adherent microorganisms (SolidN), and non-ammonia, non-bacterial, non-protein N (NABPN), and analyzed for ^{15}N-enrichment. Data were analyzed through regression or as a completely random design by time of sampling. Treatment means were separated by a pairwise *t*-test. The greatest ($P < 0.05$) rate of release of ^{15}N into NHN was associated with SolPN. The rates of ^{15}N release from InsN and NPN were greater ($P < 0.05$) than from NDFN, ADFN, and Cas. The rate of recovery of ^{15}N into BactN (as proportion of the total ^{15}N recovered) was greater ($P < 0.05$) for SolPN than for any other N fraction except NPN (1.26 and 0.94 h^{-1}, respectively). The rates for InsN, Cas, NDFN, and ADFN were 0.46, 0.24, 0.10, and 0.02 h^{-1}, respectively. At the incubation end-point, the greatest ($P < 0.05$) proportion of ^{15}N recovered in BactN was with SolPN (13.4% of the total recovered) and the least with ADFN (0.5%). The greatest ($P < 0.05$) proportion of ^{15}N recovered in NABPN was with Cas (47.8%) and the least with NDFN (7.4%). Most ^{15}N was recovered in NHN with NPN (8.1%, $P < 0.05$) followed by SolPN (3.6%). These results indicate a rapid bacterial utilization of N from alfalfa hay SolPN and NPN fractions in the rumen.

Key Words: Alfalfa, Nitrogen, Rumen

712 Total splanchnic flux of nutrients in wethers fed oscillating crude protein diets. S. L. Archibeque*, H. C. Freetly, and C. L. Ferrell, *USDA, ARS; U.S. Meat Animal Research Center*, *Clay Center, NE*.

We hypothesized that oscillating dietary CP would improve ruminant N retention by increasing nutrient flux compared to static dietary CP regimens. Chronic indwelling catheters were surgically implanted in a mesenteric artery, mesenteric vein, hepatic vein, and portal vein of 18 growing Suffolk × Dorsett wethers (44.65 ± 3.59 kg). Wethers had ad libitum access to the following diets: 1) Low (9.91% CP), 2) Med (12.5% CP), or 3) Low and High (14.19% CP) oscillated on a 48 h interval (**Osc**). Dry matter intake tended ($P = 0.09$) to be greater in Osc (1,313 g/d) than Low (987 g/d) fed wethers, but not those fed Med (1,112 g/d). Nitrogen intake was not different between Osc (25.3 g/d) and Med (22.2 g/d) fed wethers but was reduced ($P < 0.01$) in wethers fed Low (16.0 g/d). Osc wethers (6.66 g/d) retained more ($P < 0.02$) N than either Low (3.20 g/d) or Med (3.96 g/d) fed wethers. There were no discernable alterations in nutrient flux over the 4 d oscillation period (Time × Diet interaction, $P > 0.15$). Arterial blood flow was lower ($P = 0.02$) in Osc (32 L/h) fed wethers than either Med (48 L/h) or Low (69 L/h) fed wethers. Net release of α-amino N by the portal-drained viscera (**PDV**) did not differ ($P = 0.44$) among the Low (35.9 mmol/h), Med (34.3 mmol/h), or Osc (53.0 mmol/h) fed wethers. Net PDV release of ammonia N was lower ($P = 0.03$) in Low fed wethers, which was accompanied by a similar decrease ($P = 0.02$) in hepatic ammonia N uptake. Urea N concentrations tended ($P < 0.08$) to be reduced in arterial (1.67 mM), portal (1.58 mM), and hepatic (1.70 mM) blood in wethers fed the Low diet compared to Med or Osc fed wethers. However, net release of urea N did not differ across the PDV ($P = 0.30$), liver ($P = 0.76$), or total splanchnic tissues ($P = 0.42$). Portal net uptake of glutamine was greater ($P < 0.01$) in the Low (7.6 mmol/h) fed wethers than those fed the Med (3.46 mmol/h) and Osc (3.08 mmol/h) diets. There were no alterations ($P > 0.15$) in glutamate, glucose, lactate, or oxygen flux. Although diet effects on PDV and splanchnic release of α-amino N were not significant, numerical differences were consistent with observed patterns of N retention.

Key Words: Nitrogen, Metabolism, Wethers

713 Splanchnic metabolism of nutrients in response to methionine supplementation in ewes. T. Thelen*[1], J. Taylor[2], C. Loest[1], S. Wang[2], and G. Lewis[2], [1]*New Mexico State University*, *Las Cruces*, [2]*USDA-ARS, US Sheep Experiment Station*, *Dubois, ID*.

Nulliparous yearling Rambouillet cross ewes (61.9 ± 2.6 kg BW) fitted with chronic indwelling hepatic (H), portal (P), and mesenteric vein and mesenteric artery (A) catheters were used in a randomized design to determine whether dietary methionine affected splanchnic metabolism of nutrients. Treatments were no added methionine (CON; n = 5) or 1.2 g of rumen-protected methionine (MET; Mepron M85, Degussa; n = 6) bolused twice daily at feeding (1.3 kg/d sugar beet pulp pellets, DM basis). Arterial, P, and H blood samples were simultaneously collected before treatment (h 0) and then every 2 h for 12 h. Continuous para-aminohippurate (3% wt/vol; 0.57 mL/min; mesenteric vein) infusion was used to estimate vessel plasma flows. The treatment × time interaction was significant ($P = 0.04$) for P-A lactate concentration differences. The lactate P-A differences were greater ($P = 0.04$) for MET at h 12 compared to CON (h 12 = 0.06 vs. -0.07 mM, respectively, SE = 0.04). Methionine P-A and H-P ammonia concentration differences were lower ($P < 0.05$) than CON (P-A = 0.13 vs. 0.22 mM and H-P = -0.11 vs. -0.20 mM, respectively, SE = 0.03). Hepatic plasma flow was greater ($P = 0.02$) for MET than for CON (140.9 vs. 104.2 L/h, respectively, SE = 7.29); however, treatment did not affect portal and arterial plasma flows. The treatment × time interaction was significant ($P = 0.03$) for ammonia portal-drained viscera flux, which was lower ($P = 0.01$) at h 4 for MET compared to CON (h 4 = 9.40 vs. 26.30 mmol/h, respectively, SE = 4.60). Methionine treatment did not affect glucose venous-arterial concentration differences or flux. In conclusion, supplemental rumen-protected methionine increased hepatic plasma flow and decreased ammonia flux across the portal-drained viscera.

Key Words: Nutrient Flux, Methionine, Ewes

714 Effects of supplemental RDP versus increasing amounts of supplemental RUP on N retention and digestion of a low-quality forage diet by growing lambs. R. L. Atkinson*, C. D. Toone, and P. A. Ludden, *University of Wyoming*, *Laramie*.

Twelve suffolk wether lambs (29.9 ± 2.7 kg BW) were used in a 4 × 4 Latin square designed experiment to compare supplemental RDP versus increasing amounts of supplemental RUP on N retention and digestion of a low-quality forage diet. Lambs were fed a basal diet of crested wheatgrass hay (4.9% CP, 60% NDF, 40% ADF) for ad libitum consumption, plus one of four protein supplements: isolated soy protein fed to meet RDP requirements assuming a microbial efficiency of 11% of TDN (CON), or corn gluten meal (RUP) fed at 50, 100, or 150% of the supplemental N provided by CON (C50, C100, and C150, respectively). Source and level of supplemental protein had no effect ($P \geq 0.31$) on forage OM intake. Total tract OM digestibility did not differ ($P = 0.10$) between CON and C100. However, OM digestibility increased ($P = 0.004$) from 50.8 to 53.7% as level of RUP increased. Similarly, total tract NDF and ADF digestibilities increased ($P \leq 0.04$) with increasing RUP, but did not differ ($P \geq 0.27$) between CON and C100. Although lambs fed C100 had lower ($P = 0.05$) fecal N excretion (g/d) than those fed CON, urinary N excretion ($P = 0.20$), total tract N digestibility ($P = 0.64$), and N retention ($P = 0.34$) were similar between CON and C100. Supplemental RUP increased ($P = 0.001$) N intake, but also increased ($P \leq 0.008$) both fecal and urinary N excretion. Nonetheless, total tract N digestibility ($P = 0.001$) was enhanced with increasing RUP supplementation, resulting in improved N retention both in g/d ($P = 0.001$) and as a percentage of N intake ($P = 0.004$). However, supplemental RUP had no effect ($P \geq 0.59$) when expressed as a percentage of digested N. Although increasing the amount of supplemental RUP may have provided additional metabolizable protein for tissue deposition, these data further suggest that a portion of the supplemental RUP may be used as a source of N for endogenous recycling, thereby maintaining forage intake and digestion similar to lambs fed supplemental RDP.

Key Words: Ruminally Degradable Protein, Ruminally Undegradable Protein, Nitrogen Recycling

715 Nitrogen balance in goats fed a novel byproduct protein source. S. Freeman*[1], M. Poore[1], P. Ferket[1], G. Huntington[1], and T. Middleton[2], [1]*North Carolina State University*, *Raleigh*, [2]*AgProvisions, LLC*, *Kenansville, NC*.

Disposing of spent laying hens presents environmental and economic challenges to the poultry industry. Processing hens into feedstuffs has been explored as an

option for disposal. Using a mechanical deboner, hens were separated into hard and soft tissues. The hard tissue (bones, feathers, and connective tissue) was further processed using hydrolysis and co-extrusion with soybean hulls to yield a meal (94.2% DM, 22.2% CP). This product was incorporated into soybean meal/corn based pellets to provide 0, 20, 40, or 60% of the added N. Pellets with no added N served as negative control (-C). Concentrates were offered to 25 wether goats (avg initial wt 22.8kg) that had been blocked by weight. The total diets were 50% hay and 50% concentrate. They were fed to achieve 10% orts. Following 14d of adaptation, feed offered was stabilized and kids were fitted with fecal collection bags for a 5d total excreta collection. A day after the excreta collection ended, blood was collected via jugular venipuncture before feeding and at 2, 4, and 8h after feeding. Ruminal fluid was also obtained at 4h after feeding. Dietary treatment had no influence (P>.10) on ruminal pH (5.7), total VFA (97.8mM), or A/P ratio (3.2). Likewise, DM digestibility (68.7%) and the proportion of absorbed N retained (24.7%) were not altered by treatment. Results of contrasts between -C and N-supplemented diets and among the N-supplemented diets are given below. Ruminal NH_3 showed a trend towards a quadratic relationship among N-supplemented diets (p=.1012). These data show that the hard tissue meal performed similarly to the standard protein source, soybean meal.

Parameter	-C	0	20	40	60	Contrast
DMI (g/d)	608	703	710	673	779	a
DM Digestibility (%)	69.2	69.2	68.0	67.9	68.9	
N intake (g/d)	7.6	12.4	12.0	12.0	14.3	a,c
Fecal N (g/d)	3.7	4.5	4.6	4.5	5.4	a,b
N Digestibility (%)	47.0	60.5	57.0	57.5	55.6	a,b
N retained (g/d)	1.0	2.2	1.4	2.1	2.5	a,c
%urinary N as urea	66.7	81.8	83.0	82.6	86.8	a
Ruminal NH3 (mg/dl)	2.53	13.9	12.2	12.3	15.8	a

a: -C differs from N-supplemented (P<.10), **b:** linear relation among N-supplemented (P<.10), **c:** quadratic relation among N-supplemented (P<.10)

Key Words: N-Balance, Byproduct, Protein

716 Monitoring the fate of microwave treated whole cottonseed proteins in the rumen. A. A. Sadeghi*[1] and P. Shawrang[2], [1]*Islamic Azad University*, *Tehran, Iran*, [2]*Tehran University*, *Karaj, Iran*.

The objective of this study was to determine ruminal protein degradability characteristics of untreated 2, 4 and 6-min microwave (800 W) treated whole cottonseed (WCS) by using nylon bags and sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE) techniques. Nylon bags of untreated and treated WCS (2-mm particle size) were suspended into the rumen of three Holstein steers from 0 to 48h, and data was fitted to non-linear degradation characteristics to calculate effective rumen degradation (ERD). Degradation coefficients of CP were significantly (P<0.05) affected with microwave irradiation, reducing the values for wash out fraction and constant degradation rate, but increasing the values for potentially degradable fraction. The ERD of CP decreased (P<0.05) as microwave processing time increased. The effective CP degradability of 2, 4 and 6-min microwave treated WCS were 675, 590 and 487 g/kg, respectively, that were lower than untreated WCS (735 g/kg). From SDS-PAGE pattern, WCS proteins are composed of three major components; Globulin 9S, Globulin 5S and Albumin 2S, accounting for 12, 30 and 40 percent of buffer soluble WCS proteins, respectively. Electrophoretic analysis of untreated, 2, 4 and 6-min microwave treated WCS protein residues revealed that three subunits of albumin 2S were degraded completely within 2, 4, 24 and 48-h, respectively. Globulin 5S were degraded in the middle of incubation periods. Two subunits of globulin 9S in untreated and treated WCS were degraded within middle and longest incubation periods, respectively. In vitro crude protein digestibility of 4-min microwave treated WCS was highest among treatments. In conclusion, WCS proteins appeared to be effectively protected from ruminal degradation by a 4-min microwave treatment. SDS-PAGE results indicated that Globulin 9S in untreated, whereas Globulin 9S, Globulin 5S and Albumin 2S in microwave treated WCS make the bulk of escaped protein.

Key Words: Whole Cottonseed, Microwave Processing, SDS-PAGE

717 Monitoring the fate of steam flaked corn proteins in the rumen. A. A. Sadeghi*[1] and P. Shawrang[2], [1]*Islamic Azad University*, *Tehran, Iran*, [2]*Tehran University*, *Karaj, Iran*.

The objectives of this study were to monitor the fate of steam flaked corn true proteins in the rumen using electrophoresis and nylon bag techniques and to evaluate the effect of steam flaking on ruminal crude protein (CP) and starch degradation characteristics of corn grain (CG). Nylon bags of untreated and steam flaked CG (360 g/L) were suspended into the rumen of three 450 kg Holstein steers from 0 to 48-h, and data was fitted to non-linear degradation characteristics to calculate effective rumen degradation. Untreated and steam flaked CG differed (P<0.05) in CP and starch degradation characteristics. Degradability coefficients of CP were significantly (P<0.05) affected by steam flaking, reducing the values for wash out fraction and constant degradation rate, but increasing the values for potentially degradable fraction. The effective CP degradability of steam flaked CG (457 g/kg) was lower than that for untreated CG (512 g/kg). For starch, steam flaking increased (P<0.05) the wash out fraction and decreased the potentially degradable fraction. The degradation rate of latter fraction increased with this treatment. The effective starch degradability of steam flaked CG (710 g/kg) was higher than that for untreated CG (641 g/kg). From electrophoretic analysis, four major components were observed: prolamin (zein), albumin, globulin and glutelin. From 12.5% slab gel analysis, the globulin appeared to be composed mainly of subunits with a molecular mass ranging from 25 to 50 kDa. Corn zein was consisted of two major subunits of 22 and 24 kDa. Electrophoretic analysis of protein residues revealed that steam flaking decreased degradation of corn true protein. The bulk of the rumen escaped protein for untreated corn was only zein and for steam flaking were both zein and other protein fractions. In conclusion, corn proteins appeared to be effectively protected from ruminal degradation and starch fermentation improved by steam flaking.

Key Words: Corn Grain, Steam Flaking, SDS-PAGE

718 Urea treatment of corn straw and its use in fattening of Holstein bull calves. S. A. Shiri*, *Agricultural and Natural Resources Research Center of Khorasan*, *Mashhad, Iran*.

Corn fiber residues collected following grain harvesting, chopped and treated with commercial urea at five levels including 0, 2, 3, 4 and 5% (one liter water per one kilogram DM basis after 45 days). Dry matter degradability was determined by using three fistulated sheep. The incubation times were 0, 2, 4, 8, 16, 24, 36, 48, 72 and 96 hours, after feeding. The results showed that the best level of urea for treating of corn straw based on DM degradability was 3%. The voluntary intake of untreated and treated corn straw (3% urea) was determined in 6 calves per treatment. The results showed that treating of corn straw increased voluntary intake (P<0.01). In the other experiment, the effect of three different diets including: a) treated corn straw with 3% urea(30%) + alfalfa hay (10%) + concentrate (60%), b) untreated corn straw (30%) + alfalfa hay (10%) + concentrate (60%) and c) control diet (traditional ration containing wheat straw (15%) + alfalfa hay(10%) + concentrate (75%)) on 18 bull calves (6 calves per ration) for a period of 126 days was evaluated. The results showed that mean daily gain of the calves in rations a, b and c were 1050, 865 and 880 g respectively and the differences among of treatments were significant (P<0.05). Voluntary feed intakes based on metabolic body weight were 141, 133 and 150 $g/kg^{0.75}$ for ration a, b and c respectively. The differences among treatments were not significant. Feed to gain ratios (kg/kg) for the diets containing treated corn straw (3% urea) and the control were 9.77 and 14.76, respectively. It was concluded that treating corn straw with urea (3% DM) can increase voluntary intake, feed efficiency and daily gain and decrease cost of production in growing bull calves.

Key Words: Corn Straw, Degradability, Calves

719 Degradability of dry matter and crude protein of sugar beet tops and crown silage treated with urea and molasses in Iranian Balouchi sheep. M. Raisianzadeh*[1], G. Moghaddam[2], M. Daneshmesgaran[3], H. Fazaeli[4], and M.

Nowrozi[1], [1]*Agricalture and Natural Resources Research Center of Khorasan*, *Mashhad, Khorasan, Iran*, [2]*University of Tabriz*, *Tabriz, Azarbayegan, Iran*, [3]*Ferdowsi University of Mashhad*, *Mashahd, Khorasan, Iran*, [4]*Animal Science Research Institute of Iran*, *Karaj, Tehran, Iran*.

Sugar beet tops and crown (SBTC) is one of the important agricultural waste products in Iran. Economically, the best method of applying SBTC in ruminant feeding is ensiling. SBTC was treated with additives and ensiled for two months. Degradability characteristics were determined by in situ method. Two male Balouchi lambs (8 months of age) were fitted with a rumen fistula and were fed a diet consisting of alfalfa hay (50%) barley grain (30%) and SBTC (20%). Dried samples were grounded through a 2 mm screen prior to incubation. Nylon bags were placed in the rumen for 0, 2, 4, 8, 16, 24, 48 and 72 hours. Treatments were: 1) unchopped SBTC. 2) Chopped SBTC, 3) Chopped SBTC + 5 % molasses, 4) Chopped SBTC + 5% molasses + 2% urea, 5) Chopped SBTC + 10 % molasses, 6) Chopped SBTC + 10 % molasses + 2% urea and 7) Chopped SBTC + 10% molasses + wheat straw (8% of dry matter). After removal from the rumen, the bags were washed using cold water and dried in air forced oven. The equation of $P = a + b (1- e^{-ct})$ was used for the in situ degradability which P is DM and CP degradability (%) at time t, a is soluble fraction, b is slow degradable fraction, e is logarithmic number, c is fractional rate and t is time of incubation. Means were compared with LSmean. By increasing molasses in silages, degradability of dry matter was enhanced ($P<0.05$). The greatest rapidly degradable coefficient (a) of dry matter was observed in treatments 3 and 5 (0.59 and 0.62 respectively). Slowly degradable coefficient (b) of dry matter in treatment 5 was decreased by increasing molasses in comparison with control silage (0.26 vs. 0.33). The increase of urea did not affect the degradability coefficients of silages, however, it just caused the coefficient (a) to change from 0.55 in control treatment to 0.57 in treatment 6. By increasing the amount of molasses and adding urea, rapidly degradable coefficient of crude protein was increased whereas slowly degradable coefficient was decreased. Adding wheat straw to the silage 7 decreased the rapidly degradable coefficient (a) and increased the slowly degradable coefficient (b).

Key Words: Degradability, Sugar Beet Tops, Silage

AUTHOR INDEX

Abstract numbers preceded by M are Monday Posters, numbers preceded by T are Tuesday posters, and W are Wednesday posters

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

Membership Advantages

Some of the personal benefits afforded active members of the American Society of Animal Science include the following:

- A convenient means of keeping up-to-date on current scientific and production developments.
- An avenue for personal involvement in fostering high standards and professional developments in Animal Science.
- Full access to our World Wide Web site (www.asas.org) and the option to receive a printed copy of each monthly *Journal of Animal Science*.
- Receiving copies of the Society's newsletter, Membership Directory, and advance registration information for national and sectional meetings.
- Eligibility to present abstracts at national and sectional meetings and to submit manuscripts for publication at reduced rates in the *Journal of Animal Science.*
- Eligibility to provide personal leadership to the field of Animal Science by serving on the Board of Directors or society committees or by accepting other society assignments.
- Eligibility to be selected for prestigious society-sponsored awards.
- Receiving reduced registration rates for national and sectional meetings.

Eligibility for Membership

Membership is open to individuals interested in research, instruction or extension in Animal Science or associated with the production, processing, marketing and distribution of livestock and livestock products.

Sustaining Membership

Individual Sustaining Membership is offered to any individual dedicated to ASAS and the animal agriculture industry. As an individual Sustaining Member you will enjoy all benefits of membership plus the following advantages of this upgraded status:

- Listing of your name on the back cover of the *Journal of Animal Science* and on the ASAS Web site.
- Satisfaction of knowing your contribution will add to the overall quality of the Society and will supply additional funding to the annual meeting, special symposia, and the *Journal of Animal Science.*

2005 Application for ASAS Membership

SPONSORED BY: _____

NAME _____
First M.I. Last (family)

MAILING ADDRESS _____

_____

City _____ State (Province) _____

Postal Code _____

CURRENT EMPLOYMENT

Company/Institution _____

Phone No. (_____) _____

FAX No. (_____) _____

e-mail _____

MEMBERSHIP DATA BANK

Position Type:
[ ] Academic [ ] Industry [ ] International [ ] Governmental
Gender [ ] Male [ ] Female

Nationality: _____

Discipline:
[ ] Animal Behavior
[ ] Applied Animal Science
[ ] Breeding and Genetics
[ ] Growth & Development
[ ] Meat & Muscle Biology
[ ] Nutrition
[ ] Pharmacology & Toxicology
[ ] Physiology & Endocrinology
[ ] Other _____

Species:
[ ] Beef Cattle [ ] Horses [ ] Sheep & Goats
[ ] Companion Animals [ ] Laboratory Animals [ ] Swine
[ ] Dairy Cattle [ ] Poultry [ ] General

MEMBERSHIP APPLICATION TYPE

[ ] Individual Sustaining Membership		$350.00
Professional Membership with electronic *Journal*		
[ ] all countries		$110.00
Professional Membership with paper copy of the *Journal*		
[ ] US, Canada, Mexico		$160.00
[ ] all others	air mail optional, add $200	$185.00
Postdoctoral Fellow*		
[ ] with electronic *Journal*		$ 55.00
[ ] with paper copy of *Journal*; US, Canada, Mexico		$105.00
[ ] with paper copy of *Journal*; all others		$130.00
Student Affiliate* [ ] Graduate [ ] Undergraduate		
[ ] with electronic *Journal*		$ 20.00
[ ] with paper copy of *Journal*; US, Canada, Mexico		$ 70.00
[ ] with paper copy of *Journal*; all others	air mail optional, add $200	$ 95.00

*Certification of eligibility required. I certify that applicant is either a regularly enrolled college student who does not hold a full-time position or is a postdoctoral fellow under my supervision.

_____
(Signature of Advisor)

Return application with check made payable to **AMERICAN SOCIETY OF ANIMAL SCIENCE**, 1111 N. Dunlap Ave., Savoy, IL 61874, or charge to:

[ ] Mastercard [ ] Visa [ ] American Express

Card Number _____

_____ _____
Card's expiration date Cardholder's signature

2005 Membership Application
AMERICAN DAIRY SCIENCE ASSOCIATION
1111 N. Dunlap Avenue, Savoy, IL 61874
Phone: 217/356-5146 FAX: 217/398-4119
Please print or type the following information

☐ **New Member** ☐ **Renewing Member (include member ID#_____)**

Name _____
Last *First* *Middle*

Div/Dept _____

Company/Institution _____

Address _____

_____

City _____

State _____ Zip _____ Country _____

Phone _____ FAX _____ e-mail _____

Date of Birth _____

FIELD OR AREA OF INTEREST — CHECK ONE ☐ **Production Division** ☐ **Dairy Foods Division**

MEMBERSHIP TYPE

☐ Professional Membership, includes electronic version of the *Journal of Dairy Science*	$110.00
☐ Post-Doc Membership, includes electronic version of the *Journal of Dairy Science*	$55.00
☐ Undergraduate Student Membership, includes electronic version of the *Journal of Dairy Science*	$5.00
☐ Graduate Student Membership, includes electronic version of the *Journal of Dairy Science*	$10.00
☐ Corporate Sustaining Membership, includes electronic version of the *Journal of Dairy Science*	$500.00

Yes, I want to receive a Paper Copy of the *Journal of Dairy Science* (4th class postage included)

☐ US, Canada, Mexico	$50.00 Additional
☐ All other Countries	$75.00 Additional
☐ Air mail optional	$200.00 Additional

Certification of eligibility is required for Student Affiliates. I certify that applicant is a regularly enrolled college student who does not hold a full-time job.

Signature of Advisor _____

Payment Type (please circle) **Check** **Money Order**

Check or Money Order must be payable in US Funds and drawn on a US bank.
If paying by credit card, please complete the following:

MasterCard/VISA _____ Exp. Date _____

American Express _____ Exp. Date _____

Signature _____

ASAS SUSTAINING MEMBERS

We express our appreciation to the following organizations and individuals who support the efforts of the American Society of Animal Science and the *Journal of Animal Science* through Sustaining Membership.

Corporate

- **Ajinomoto Heartland LLC**
  Chicago, IL
- **Akey**
  Lewisburg, OH
- **Archer Daniels Midland Co.**
  Decatur, IL
- **Babcock Genetics, Inc.**
  Holmen, WI
- **Diamond V Mills, Inc.**
  Cedar Rapids, IA
- **Elanco Animal Health**
  Greenfield, IN
- **Fats & Proteins Research Foundation**
  Bloomington, IL
- **Global Pig Farms, Inc.**
  Setagun, Gunma, Japan
- **International Ingredient Corporation**
  St. Louis, MO
- **Kent Feeds, Inc.**
  Muscatine, IA
- **Land O'Lakes Purina Feed, LLC**
  Gray Summit, MO
- **Monsanto Company**
  St. Louis, MO
- **Mosaic**
  Riverview, FL
- **National By-Products, LLC**
  Des Moines, IA
- **National Pork Board**
  Des Moines, IA
- **Nutra-Flo Protein Products**
  Sioux City, IA
- **PCS Sales**
  Northbrook, IL
- **PIC USA**
  Franklin, KY
- **Pioneer Hi-Bred International, Inc.**
  Johnston, IA
- **Prince Agri Products, Inc.**
  Quincy, IL
- **Ralco Nutrition, Inc.**
  Marshall, MN
- **Zinpro Corporation**
  Eden Prairie, MN

Individual

Stephen L. Armbruster
W. Dwight Armstrong
Jerome F. Baker
Frances C. Buonomo
Roger G. Campbell
Remi de Schrijver
Christopher J. Dietel
Kenneth S. Eng, Jr.
Paul F. Engler
Melvin G. Greeley
Beret K. Gronvold
Scott Herber
Walter C. Koers
Cuccolini Labadini
William M. Larson
Pascal Lebreton
Robert W. Lee
John L. Montgomery
William A. Olson
Donald E. Orr, Jr.
Rodney L. Preston
Frank L. Prouty
Ned S. Raun
Ivan G. Rush
Hidesuke Karl Sera
Edward J. Simpson
James P. Timmerman
Robert W. Touchberry
Abe Turgeon
Drew A. Vermeire

ADSA Sustaining Members

30+ years

ADM Alliance Nutrition, Inc.
Decatur, IN

Agway Inc.
Syracuse, NY

Cargill Animal Nutrition
Minneapolis, MN

Church & Dwight Co., Inc.
Princeton, NJ

20–29 years

Elanco Animal Health

Eli Lilly & Company
Indianapolis, IN

Land O'Lakes, Inc.
St. Paul, MN

Land O'Lakes/Purina
St. Louis, MO

Monsanto Agricultural Co.
St. Louis, MO

Pfizer Animal Health
Kalamazoo, MI

Pioneer Hi-Bred International, Inc.
Johnston, IA

Quest Int'l Bioproducts Group
Rochester, MN

Rhodia Inc.
Madison, WI

Westfalia Surge Inc.
Naperville, IL

10–19 years

Akey, Inc.
Lewisburg, OH

Alltech, Inc.
Nicholasville, KY

Custom Dairy Performance
Clovis, CA

Diamond V Mills, Inc.
Cedar Rapids, IA

Kent Feeds, Inc.

Evergreen Mills, Inc.
Muscatine, IA

Kraft Foods

Kraft Cheese Division
Glenview, IL

National By-Products, Inc.
Des Moines, IA

Zinpro Corporation
Eden Prairie, MN

1–9 years

Adisseo USA, Inc.
Alpharetta, GA

Biovance Technologies, Inc.
Omaha, NE

BioZyme Incorporated
St. Joseph, MO

DSM Food Specialties USA, Inc.
Menomonee Falls, WI

Fort Dodge Animal Health
Princeton, NJ

IMC
Lake Forest, IL

Performance Products, Inc.
Schertz, TX

Prince Agri Products, Inc.
Quincy, IL

Quali Tech
Chaska, MN

Ridley, Inc.
Mankato, MN

Varied Industries
Mason City, IA

West Central Soy
Ralston, IA

The American Dairy Science Association celebrates its 88th year of publishing research work and three decades of Sustaining Membership. Through the *Journal of Dairy Science* the latest technical and scientific information is provided to all segments of the industry. Never before has the demand been as great as it is today to publish the scientific work in progress throughout the world.

In support of the efforts to continue to publish the works of those dedicated to the betterment of mankind and the dissemination of knowledge, we express our appreciation to these organizations that support the American Dairy Science Association and the *Journal of Dairy Science* through Sustaining

ASAS Foundation Appreciation Clubs

Members of the American Society of Animal Science (ASAS) are indebted to each other. Many have been students of ASAS members or have benefited from the work of ASAS members. Thus, the ASAS Foundation supports the formation of Appreciation Clubs to honor outstanding members of ASAS. Formation of Appreciation Clubs will allow those who have benefitted from the work of a particular member of ASAS to make a gift either in perpetuity or for special activities in the name of the honored person.

Yes, I would like to make a contribution to the following Appreciation Club:

- ☐ Dr. Robert G. Zimbelman
- ☐ Dr. H. Allen Tucker
- ☐ Dr. Billy N. Day
- ☐ Dr. Joseph P. Fontenot
- ☐ Dr. David H. Baker
- ☐ Dr. Harold D. Hafs
- ☐ I would like to form a Club in honor of _____
- ☐ General Donation to the Foundation

Payment

- ☐ $100 ☐ $200
- ☐ $300 ☐ $500
- ☐ $1000 ☐ Other $ _____

Payment method: ___ Check ___ Visa ___ MasterCard ___ American Express

Card #: _____ Exp. Date: _____

Installments available, contact the ASAS office.

Donor Information

Name _____

Address _____

_____

Phone _____

Signature _____ Date _____

Return to :

ASAS Foundation
1111 N. Dunlap Ave.
Savoy, IL 61874

Phone: 217/356-9050
Fax: 217/398-4119

2005 ABSTRACT SPONSORS

ALLTECH
MILK PRODUCTS INC.
MONSANTO COMPANY

ADSA-ASAS FUTURE MEETING DATES

JULY 9-13, 2006
Minneapolis, Minnesota
ADSA CENTENNIAL

JULY 27-31, 2008
Indianapolis, Indiana
ASAS CENTENNIAL

ADSA-ASAS-PSA FUTURE MEETING DATES

JULY 8-12, 2007
San Antonio, Texas