Graduate Student Competition: ADSA Production Division Poster Competition, PhD Division

M111   Effects of energy supplementation for pasture forages on in vitro ruminal fermentation in continuous cultures. C. T. Noviandi*[1], M. N. McDonald[1], D. R. ZoBell[1], J.-S. Eun[1], M. D. Peel[2], and B. L. Waldron[2], [1]*Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan,* [2]*Forage and Range Research Laboratory, USDA-ARS, Logan, UT.*

Eight dual-flow continuous culture fermentors (700 mL) were used to assess effects of energy supplementation [no concentrate, 30% ground corn, or 30% dried distilled grains with solubles (DDGS)] with 4 pasture forages [tall fescue (TF) without N fertilizer (TF-NF), TF with N fertilizer (TF+NF), TF-alfalfa mixture, and TF-birdsfoot trefoil mixture (TF+BFT)] on in vitro ruminal fermentation and N utilization. Twelve dietary treatments were tested in a completely randomized design with a 3 (energy supplements) × 4 (pasture forages) factorial arrangement. Each culture fermentor was offered a total of 15 g DM/d. Forages were supplied in 4 equal portions at 0600, 1200, 1800, and 2400 h, while energy supplements were fed in 2 equal portions at 1200 and 2400 h. Three replicated runs lasted 10 d each, with the first 7 d allowed for microbial adaptation to the diets, and 3 d for sampling. Average daily culture pH was affected by energy supplementation ($P < 0.05$), but not by forage, ranging from 5.94 to 6.44. Energy supplementation increased total VFA concentration ($P < 0.01$). Corn supplementation resulted in greater VFA concentration in the TF+NF compared with DDGS supplementation, whereas the DDGS supplementation increased VFA concentration in the TF+BFT compared with corn supplementation ($P < 0.05$), leading to an interaction between energy supplements and pasture forages ($P < 0.01$). However, corn supplementation resulted in greater total VFA concentration than DDGS (43.4 vs. 41.5 mM). Decreases in ruminal ammonia-N concentration, methane production, and acetate-to-propionate ratio were observed when corn or DDGS was added into diets ($P < 0.01$). These results indicate that supplementing pasture forages with corn or DDGS enhanced microbial assimilation of ammonia-N and shifted metabolic pathways of microbial fermentation. Supplementation of corn in the TF+BFT elicited a similar ammonia-N concentration as the corn supplemented in the TF+NF. Therefore, grass-legume mixtures would be a sustainable component in grass grazing systems to improve N utilization efficiency with appropriate energy supplementation.

Key Words: continuous cultures, energy supplementation, pasture forage

M112   Evaluation of feed delivery methods for prepubertal dairy heifers during the growing period. T. S. Dennis,* J. E. Tower, and T. D. Nennich, *Purdue University, West Lafayette, IN.*

The objective of this study was to evaluate effects of feed delivery method on growth, dry matter intake (DMI), feed efficiency, and rumen fermentation characteristics of prepubertal dairy heifers during the growing period. Ninety Holstein heifers (179.1 ± 29.9 kg, 171 ± 26 d of age) were randomly assigned to 1 of 15 pens by body weight (BW). Treatment diets contained 56% forage and 44% grain mix (DM basis) and were delivered using a hay feeder and grain bunk (HF), forage and grain fed side-by-side in a bunk (SBS), or a total mixed ration (TMR) for 98 d. Heifers were weighed every 2 wk, and hip and withers heights and heart girth circumference (HGC) were measured monthly. Blood and rumen fluid were collected at the beginning, middle, and end of the study to measure plasma urea N, plasma glucose, and rumen NH_3 and volatile fatty acids (VFA). Data were analyzed as repeated measures using PROC MIXED of SAS with pen as the experimental unit. Feed delivery method affected final BW, as HF heifers were 11.1 kg and 9.7 kg heavier than SBS and TMR heifers ($P < 0.01$ and $P < 0.01$), respectively. Average daily gains were lower for SBS ($P < 0.05$) and tended to be lower for TMR ($P < 0.10$) compared with HF, averaging 0.75, 0.78, and 0.87 kg/d, respectively. Average DMI was greater for HF compared with SBS and TMR (8.2, 7.7, and 7.7 kg/d, respectively; $P < 0.01$), resulting in similar gain:feed between delivery methods overall ($P > 0.10$). Heifers fed using HF had greater HGC than SBS ($P < 0.05$) and tended to have greater HGC than TMR ($P < 0.10$); however, hip and withers heights were not affected by delivery method ($P > 0.10$). Heifers fed using SBS had increased acetate and butyrate concentrations on d 42 ($P < 0.05$), resulting in increased total VFA concentrations on d 42 ($P < 0.05$). Acetate and butyrate concentrations were similar for HF and TMR throughout the study ($P > 0.10$). Blood metabolites, rumen pH, and rumen NH_3 were not affected by delivery method ($P > 0.10$). Results from this study showed that component feeding using a hay feeder increased ADG; however, the manner of feed delivery did not affect feed efficiency or growth in prepubertal dairy heifers.

Key Words: dairy, heifer, feed delivery

M113   Prediction of pregnancy outcome using machine learning algorithms. S. Shahinfar*[1], K. Weigel[1], D. Page[2], J. Gunter[1], V. Cabrera[1], and P. Fricke[1], [1]*Department of Dairy Science, University of Wisconsin-Madison, Madison,* [2]*Department of Biostatistics and Medical Informatics, and Department of Computer Science, University of Wisconsin-Madison, Madison.*

On a daily basis making decisions about whether or not to breed a given cow and knowledge about expected outcome outcome of the breeding would have an economic impact on profitability of breeding program and net income of the farm. The outcome of each breeding can be affected by many management and physiological factors that vary between farms. Machine learning algorithms offer a great opportunity with regard to problems of multi co-linearity, missing values, or complex interactions among variables (Caravielo et al., 2006). The objective of this study was to develop a user friendly and intuitive on-farm tool to help farmers making decisions about breeding cows. To achieve our goal, we applied several different machine learning algorithms to predict the pregnancy status of each cow after breeding based on phenotypic and genotypic data. Data from 26 dairy farms in Alta Genetics Advantage progeny testing program were used, representing a 10-year period from 2000 to 2010. Reproduction, production, health events, and breeding values of cows and sires were extracted from an on-farm dairy management software and USDA-AIPL databases. The edited data set consisted of 195128 breeding records for multiparous lactation dairy cows, and each of record had 38 potential explanatory variables. Naïve Bayes classifier, Bayesian network, and bagging with RepTree were applied to the data. Among all of these methods, bagging had the best performance with 0.697, area under the ROC curve and 0.665 precision. Naïve Bayes and Bayesian network had 0.599 and 0.615 area under ROC curve respectively. An Information base variable selection procedure identified Mean conception rate in last 3 mo in herd, period, DIM at breeding, past times

breed, current times breed and calving interval as the most effective explanatory variable in predicting pregnancy outcome.

Key Words: machine learning, bagging, fertility

M114   Genes for lysine catabolism in lactating dairy cows are responsive to postruminal lysine supply. H. A. Tucker*[1], M. D. Hanigan[2], J. Escobar[3], P. H. Doane[4], and S. S. Donkin[1], [1]*Department of Animal Sciences, Purdue University, West Lafayette, IN,* [2]*Department of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg,* [3]*Department of Animal and Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg,* [4]*Archer Daniels Midland Company, Decatur, IL.*

Lysine supply is potentially limiting for milk protein production in dairy cows. The availability of lysine to the mammary gland and other tissues is a function of the quantity of metabolizable lysine and hepatic lysine catabolism. This experiment evaluated the effect of increased postruminal lysine supply on expression of aminoadipate semialdehyde synthase (AASS), a committing step in lysine catabolism in liver, and ornithine transcarbamoylase (OTC) and argininosuccinate synthase (ASS), key urea cycle enzymes. Eight multiparous early lactation Holstein cows were utilized in a replicated 4×4 Latin square. Cows were fed a lysine-limited ration and infused post-ruminally with 0, 9, 27 or 63 g/d of lysine. Periods consisted of a 10-d washout phase followed by 10 d of lysine infusion. On the last day of infusion liver samples were collected for mRNA analysis and blood samples were collected for analysis of blood urea nitrogen, amino acids, and α-aminoadipic acid. Milk protein percent was increased ($P < 0.05$) with infusion of lysine (2.53 vs. $2.68 \pm 0.05\%$ for 0 and 63g/d lysine). Blood urea nitrogen decreased ($P < 0.05$) with infusion of lysine (11.4 vs. 10.8 ± 0.4 mg/dL for 27 and 63 g/d lysine). Plasma lysine increased ($P < 0.01$) with lysine infusion (39.5, 45.8, 60.7 and 68.7 μM for 0, 9, 27, 63 g/d lysine). Plasma α-aminoadipic acid concentration increased ($P < 0.05$) with lysine infusion (2.9 vs. 4.7 ± 0.4 μM for 27 and 63 g/d lysine). Expression of OTC and ASS did not differ with increased postruminal lysine. Expression of AASS resulted in numeric differences between 0 and 63 g/d lysine (0.50 vs. 1.38 ± 0.44 arbitrary units, respectively), but were not significant ($P > 0.05$). These data indicate responsiveness of milk protein synthesis to lysine and suggests changes in amino acid and nitrogen metabolism in liver in response to postruminal lysine supply in early lactation dairy cows.

Key Words: lysine, gene expression, postruminal infusion

M115   Evaluation of rumen protected lysine supplementation to lactating dairy cows consuming increasing amounts of DDGS. H. A. Paz*[1], M. de Veth[2], R. Ordway[2], and P. J. Kononoff[1], [1]*University of Nebraska-Lincoln, Lincoln,* [2]*Balchem Corp., New Hampton, NY.*

Twenty multiparous Holstein cows were used in 4 5×5 Latin squares to determine the effects of feeding increasing amounts of dried distillers grains plus solubles (DDGS) in diets with or without the supplementation (60 g/d) of a rumen protected Lys (RPL) product (AminoShure-L; L-Lysine 38%) on milk yield and composition and plasma concentration of AA. Dietary treatments were (1) Control, (2) 10% DDGS (10DDGS), (3) 20% DDGS (20DDGS), (4) 10% DDGS+RPL (10DDGSRPL), and (5) 20% DDGS+RPL (20DDGSRPL). Basal diets were formulated using the CPM Dairy model (v3.0) to provide a predicted decreasing supply of Lys, 117, 99, and 91% of requirement for the Control, 10DDGS, and 20DDGS diet, respectively. Periods lasted 21 d with the last 3 d for data collection. Compared with cows fed the Control diet, cows fed diets with DDGS had a similar DMI (25.2 vs. 25.4 ± 0.04 kg/d; $P = 0.14$), milk yield (30.1 vs. 30.9 ± 0.11 kg/d; $P = 0.11$) and composition except for protein percentage which was higher (3.15 vs. $3.21 \pm 0.03\%$; $P = 0.03$) and resulted in higher (0.94 vs. 1.00 ± 0.05 kg/d; $P = 0.04$) protein yield by cows fed diets with 20% DDGS. Supplementation of basal diets with RPL had no effect on milk production or composition. Compared with an expected DMI of 23.3 kg/d and milk yield of 38.5 kg/d, cows had a greater intake and lower milk production across diets, which resulted in diets that were predicted to supply sufficient amounts of Lys (140, 118, 104% of requirement for the Control, 10DDGS, and 20DDGS diet, respectively). Plasma concentration of Lys decreased (11.8%; $P = 0.01$) as DDGS inclusion increased and supplementation with RPL did not change Lys concentration. For other essential AA, plasma concentrations of cows fed diets with DDGS were lower ($P \leq 0.05$) for His and Val (8.62 ± 0.03 and 40.62 ± 0.01 μg/mL) and greater ($P \leq 0.01$) for Met ($4.27 \pm <0.01$ μg/mL) compared with cows fed the Control diet (9.50 ± 0.03, 44.38 ± 0.01, $3.47 \pm <0.01$ μg/mL; respectively). Overall, inclusion of DDGS increased the yield of milk protein and when combined with RPL resulted in no response in milk production parameters suggesting that Lys was not the first limiting AA.

Key Words: dairy cow, dried distillers grains plus solubles, rumen-protected Lys

M116   Integrating nutritional and reproductive models to improve reproductive efficiency in dairy cattle. S. L. Shields*[1], H. Woelders[2], M. Boer[2,3], C. Stötzel[4], S. Röeblitz[4], J. Plöntzke[4], and J. P. McNamara[1], [1]*Department of Animal Sciences, Washington State University, Pullman,* [2]*Animal Breeding and Genomics Centre, Wageningen UR Livestock Research, Lelystad, the Netherlands,* [3]*Adaptation Physiology Group, Department of Animal Sciences, Wageningen University, Wageningen, the Netherlands,* [4]*Computational Systems Biology Group, Zuse Institute Berlin, Berlin, Germany.*

The objective was to integrate 2 existing mechanistic, dynamic models of nutritional and reproductive processes in the dairy cow. The objective of this research model is to be suitable for evaluation of data, concepts, and hypotheses regarding underlying genetic, nutritional, and physiological control of reproduction. A model of metabolism (Molly, UC Davis); which describes metabolism of glucose, amino acids, and fatty acids in tissues at an aggregated metabolic pathway level was integrated with a model of reproductive processes which describes growth and decay of the follicles and corpus luteum, gonadotropin releasing hormone, follicle stimulating hormone, luteinizing hormone, progesterone, estrogen, oxytocin, and prostaglandin F2α over time. The nutritional and reproductive processes are integrated at specific points: glucose, IGF-I, leptin and growth hormone affect rates of follicle stimulating hormone, luteinizing hormone, and follicular growth. Degradation of estrogen and progesterone is a function of metabolic clearance rate (MCR); (MCR progesterone, ng/μl = 2.6455 - 0.1606(DMI)2 - 0.5896(DMI) r[2] = 0.9964). Progesterone affects probability of embryo survival (% survival = 51.74 + 4.18 (ng/ml) r[2] = 0.9943). Pulse frequency of LH is a function of leptin (LH pulses/8h = 0.591 + 0.0015 (ng/ml)5 - 0.025(ng/ml)4 + 0.144(ng/ml)3 - 0.319(ng/ml)2 + 0.237(ng/ml) r[2] = 0.65). The probability of ovulation is a function of dominant follicle diameter (probability, % = 465.6 - 0.72(diam.)3 + 21.1(diam.)2- 180.0 (diam.); r[2] = 0.99). Probability of first service conception is a function of IGF1: (prob., % = 11.36 + 10.42(IGF1 ng/ml) r[2] = 0.97). Changing energy intake or milk production causes a pattern and direction of response in reproductive processes consistent with literature values. Increased metabolic rate decreases estrogen and progesterone concentration, reduces the ovulatory surge and decreases embryo survival. This research model

should be useful to frame specific hypotheses on control of reproductive processes by genetic and nutritional driven mechanisms.

Key Words: systems biology, reproduction, nutrition

M117   Variation of mucosal innate immune genes expression in the gastrointestinal tract of dairy calves fed with or without calf starter during weaning transition. N. Malmuthuge,* M. Oba, and L. L. Guan, *University of Alberta, Edmonton, AB, Canada.*

Weaning transition is considered as the most critical period in calf management, which causes significant level of stress in animals, and the dietary changes associated with weaning can cause functional and morphological changes in the gastrointestinal tract (GIT). However, how these drastic changes affect immunity of calves and what immune mechanisms help calves dealing with their stress are not fully understood. This study aimed to investigate the expression of mucosal innate immune genes (toll-like receptors and antimicrobial peptides) in the GIT of calves in weaning transition (8 weeks old). Holstein bull calves were assigned to one of 2 diets 2 weeks of age to 8 weeks of age; milk replacer only (MR, n = 4) or milk replacer plus calf starter (MR+S, n = 4), and mucosal tissue samples were collected from jejunum, ileum, cecum and colon at the end of feeding trial. Gene expression data were analyzed using MIXED procedure in SAS and statistical model includes diet and location as fixed effects. Expression of mucosal innate immune genes displayed distinct patterns between 2 feeding regimens. TLR 9 and 10 were differentially expressed among the GIT locations of claves fed MR ($P < 0.05$) whereas TLR 1, 2, 4, 7, 9 and 10 were differentially expressed among the GIT locations of calves fed MR+S ($P < 0.01$). TLR 2, 3, 5 and 6 showed a significantly higher expression in MR+S group than the calves fed MR. However, TLR 4 and 10 showed a significantly lower expression in MR+S calves. β-defensin and peptidoglycan recognition protein 1(PGLYRP1) expressions were observed in both groups of animals without any regional variation except for significantly higher expression of PGLYRP1 in the jejunum than the other GIT regions of MR+S calves (($P = 0.04$). However, β-defensin expression was lower in MR+S calves than MR calves with a significantly lower expression in the cecum, while PGLYRP1 showed a significantly higher expression in MR+S calves than MR calves in all regions except the ileum. Gene expression differences observed in the present study suggest that the consumption of solid feed may affect immune responses of calves and thus possibly determine the capability of calves to deal with stress associated with weaning.

Key Words: gastrointestinal tract, weaning transition, mucosal immunity

M118   Web forums as a method for engagement on contentious issues in dairying: Should dairy calves be separated from the cow within the first few hours after birth? B. A. Ventura,* M. A. G. von Keyserlingk, C. A. Schuppli, and D. M. Weary, *Animal Welfare Program, Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC, Canada.*

Over the past few decades the public has become increasingly interested in the welfare of food animals. However, the food animal industries, including the dairy industry, possess few mechanisms for discussion of contentious practices. Here we present results from a web-based forum designed to promote discussion of controversial issues among stakeholders. In the present application we asked participants to respond to the question, "Should dairy calves be separated from the cow within the first few hours after birth"? A total of 163 people participated in

4 independent web forums; 33% were students/teachers, 13% animal advocates, 23% farmers, veterinarians, and industry professionals, and 31% had no involvement in the dairy industry. Overall there was little participant consensus, with 44% choosing "yes," 48% choosing "no," and 9% neutral. Responses varied with demographics, with opposition to early separation higher among females, advocates, and those with no involvement in the industry. Participants were also able to provide reasons in support of their views, with opponents and supporters often referencing similar issues in their reasoning. Opponents of early separation gave reasons such as: it is unnatural, it compromises calf and/or cow physical health, it is emotionally stressful, and the industry can and should accommodate cow-calf pairs. In contrast, supporters of early separation reasoned that it promotes calf and/or cow physical health and production, emotional distress is best minimized by separating before bonds develop, and the industry is limited in its ability to accommodate cow-calf pairs. These results illustrate the potential of web-based forums to identify areas of shared concern and disagreement among stakeholders, providing a foundation to develop practices that satisfy both producer and consumer expectations. More generally, the results suggest that web-based forums can provide a safe platform for much needed discussion on contentious issues in the dairy industry.

Key Words: public attitudes, animal welfare, maternal filial bond

M119   A cluster analysis to describe profitability on Wisconsin dairy farms. M. Dutreuil*[1], V. E. Cabrera[1], R. Gildersleeve[2], C. A. Hardie[1], and M. Wattiaux[1], *[1]University of Wisconsin-Madison, Madison, [2]University of Wisconsin Extension, Dodgeville.*

A survey was implemented on Wisconsin dairy farms to understand the impact of farm management on profitability. Farms were selected across 3 systems: conventional (C), grazing (G) and organic (O). The objective was to characterize main factors associated with profitability. A cluster analysis using complete linkage was conducted on 20 farms as preliminary analysis: 4 O, 4 G and 12 C. The analysis yielded 3 clusters. Cluster 1 included 1 O, 2 G and 6 C farms; cluster 2 included 4 C and 1 G farms; and cluster 3 included 3 O, 1 G and 2 C farms. Clusters 1 and 3 had the same income over feed cost (IOFC, $5.97 and $5.22/d per cow, respectively) whereas cluster 2 had an IOFC of $8.09/d per cow. Farms in cluster 2 had 71 cows and 95 ha and were managed by the youngest farmers (44 years old). They used a ration with 35% grass silage (GS), 1% hay, 18% corn silage (CS) and 46% concentrate (CC). They had the greatest milk production (10,764 kg/cow per year) and the lowest percentage of milk withheld from sale (0.49%). They produced milk with 3.55% fat, 3.03% protein and 203,000 somatic cells (SCC), but received the lowest milk price (0.348$/kg). Farms in cluster 1 had 72 cows and 115 ha and were managed by 49 years old farmers. They used 20% GS, 32% hay, 12% CS and 36% CC in the ration. They had a lower milk production (7,068 kg/cow per year) and more milk withheld (1.65%) than farms in cluster 2. Their milk had 3.78% fat and 2.99% protein with a price of 0.368$/kg. Farms in cluster 3 were the smallest farms with 48 cows and 54 ha and were managed by 49 year old farmers. They used 17% GS, 54% hay, 5% CS and 24% CC in the ration. They produced the least amount of milk (4,146kg/cow per year) and withheld 3.08% of production. They had the greatest milk fat and protein content (4.36% and 3.25%, respectively), the greatest SCC (317,167) and the greatest milk price (0.480$/kg). The 3 clusters contained farms from different systems indicating that management system was not a major descriptor of IOFC. However, this study suggested that IOFC was associated with quantity and quality of milk, percentage of milk withheld, feeding strategy and age of the farmer.

Key Words: cluster analysis, farm profitability, farm management