

Ruminant Nutrition: Feeding, Ruminal Fermentation, and Efficiency of Production III

TH97 Effects of different feeding frequencies on feeding behavior of feedlot Nellore cattle. J. Silva^{2,3}, T. V. B. Carrara¹, M. C. S. Pereira², A. L. N. Rigueiro², D. H. M. Watanabe², D. D. Estevam², D. P. Silva², D. V. F. Vicari², I. C. Batista Junior², F. T. V. Pereira², D. J. C. Oliveira⁴, G. P. Mateus⁴, C. A. Oliveira², and D. D. Millen^{*2}, ¹São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, ²São Paulo State University (UNESP), Dracena, São Paulo, Brazil, ³Supported by FAPESP, São Paulo, São Paulo, Brazil, ⁴APTA, Andradina, São Paulo, Brazil.

This study, conducted at the São Paulo State University feedlot, Dracena Campus, Brazil, was designed to determine the effects of different feeding frequencies on feeding behavior of Nellore cattle. The experiment was designed as a completely randomized block, replicated 12 times, in which 48 18-mo-old yearling Nellore bulls (358.2 ± 19.4 kg) were fed in individual pens for 94-d according to the following treatments: (1) feeding one time daily (1×; 0800), (2) feeding 2 times daily (2×; 0800 and 1400), (3) feeding 3 times daily (3×; 0800, 1100 and 1400), and (4) feeding 4 times daily (4×; 0800, 1100, 1400 and 1700). The adaptation program consisted of ad libitum feeding of 2 adaptation diets over period of 14-d with concentrate level increasing from 60% to 86% of diet DM. The finishing diet contained: 67.0% cracked corn grain, 14.0% sugarcane bagasse, 9.0% soybean hulls, 5.5% soybean meal, 4.0% supplement containing 30% of urea, and 0.5% limestone (DM basis). Orthogonal contrasts were used to assess linear, quadratic, and cubic relationship between feeding frequency and the dependent variable. Visual appraisal was made on d 42 of the study, and then every 5 min during 24 h. Feeding behavior data was collected as follows: time spent eating (EAT), ruminating (RUM), resting (RES) expressed in minutes and number of meals per day (MEA). The meal length (MLE) in minutes was calculated as follows: EAT/MEA. Also, DMI was measured on d-42 of the study. Feeding frequency did not affect ($P > 0.10$) EAT and MEA. However, as feeding frequency increased, RUM (1× = 427.08 min; 2× = 385.83 min; 3× = 455.83 min; 4× = 429.17 min) and RES (1× = 837.50 min; 2× = 877.08 min; 3× = 779.58 min; 4× = 831.25 min) were cubically affected ($P < 0.01$). Likewise, as feeding frequency increased, DMI was affected ($P = 0.02$) linearly (1× = 8.34 kg; 2× = 8.69 kg; 3× = 9.59 kg; 4× = 9.15 kg). Thus, based on the results of this study, increasing feeding frequency affected RUM, RES and DMI of feedlot Nellore cattle. In a practical way, feeding yearling Nellore bulls 3 times daily seems to be the most feasible option, because longer RUM lead to greater DMI and shorter RES.

Key Words: behavior, frequency, zebu

TH98 Effects of different feeding frequencies on rumen papillae of feedlot Nellore cattle. T. V. B. Carrara^{2,3}, J. Silva², M. C. S. Pereira², A. L. N. Rigueiro², D. H. M. Watanabe², D. D. Estevam², D. P. Silva², D. V. F. Vicari², C. A. Oliveira², I. C. Batista Junior², F. T. V. Pereira², R. V. G. Soutello², M. D. B. Arrigoni¹, and D. D. Millen^{*2}, ¹São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, ²São Paulo State University (UNESP), Dracena, São Paulo, Brazil, ³Supported by FAPESP, São Paulo, São Paulo, Brazil.

This study was designed to determine the effects of different feeding frequencies on morphological parameters of rumen papillae of feedlot cattle. The experiment was designed as a completely randomized block, replicated 12 times, in which 48 18-mo-old yearling Nellore bulls (358.2

± 19.4 kg) were fed in individual pens for 94-d according to the following treatments: (1) feeding one time daily (1×; 0800 h), (2) feeding 2 times daily (2×; 0800 and 1400 h), (3) feeding 3 times daily (3×; 0800, 1100 and 1400 h), and (4) feeding 4 times daily (4×; 0800, 1100, 1400 and 1700 h). The adaptation program consisted of ad libitum feeding of 2 adaptation diets over period of 14-d with concentrate level increasing from 60 to 86% of diet DM. The finishing diet contained: 67.0% cracked corn grain, 14.0% sugarcane bagasse, 9.0% soybean hulls, 5.5% soybean meal, 4.0% supplement containing 30% of urea, and 0.5% limestone (DM basis). At harvest, rumenitis incidence (RUM) was determined, on the entire washed rumen, using a scale of 0 (no lesions noted) to 10 (severe ulcerative RUM). Likewise, a 1-cm² fragment of each rumen was collected from cranial sac. Manually, the number of papillae per cm² of rumen wall (NOP) was determined and 12 papillae were randomly collected from each fragment, and scanned, and mean papillae area (MPA) was measured by software for image analysis. The rumen wall absorptive surface area (RASA) in cm² was calculated as follows: 1 + (NOP × MPA) – (NOP × 0.002). Orthogonal contrasts were used to assess linear, quadratic, and cubic relationship between feeding frequency and the dependent variable. Feeding frequency did not affect ($P > 0.10$) RUM (1× = 2.0; 2× = 1.8; 3× = 2.2; 4× = 2.3), NOP (1× = 44.6; 2× = 43.3; 3× = 39.5; 4× = 42.4), MPA (1× = 0.52 cm²; 2× = 0.49 cm²; 3× = 0.47 cm²; 4× = 0.56 cm²), and RASA (1× = 23.09 cm²; 2× = 21.64 cm²; 3× = 20.17 cm²; 4× = 24.61 cm²). Thus, based on the results of this study, increasing feeding frequency did not negatively affect morphological parameters of rumen papillae of Nellore cattle.

Key Words: frequency, rumenitis, Zebu

TH99 Manipulating wheat source and monensin level on growth performance, carcass characteristics, and fatty acid of feedlot cattle. L. Xu^{*1,2}, Y. Jin¹, M. L. He², and W. Z. Yang², ¹College of Food Science and Engineering, Inner Mongolia Agricultural University, Hohhot, Inner Mongolia, China, ²Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.

A study was conducted to evaluate growth performance, carcass trait and composition of fatty acid in carcass of feedlot steers fed diets varying grain type and monensin (Mon) dosage. Two hundred crossbred steers (initial BW 488 kg) were blocked by BW, allotted to 20 pens, and then randomly assigned to 5 treatments (4 pens per treatment) with 2x2+1 factorial arrangement. Treatments were control (CON: 10% barley silage, 90% barley-based concentrate, and 28 ppm Mon), and diets substituting soft or hard wheat for barley combining with 28 or 44 ppm Mon. The CON is a standard feedlot diet in western Canada. DMI (averaged 11.3 kg/d) was not different between barley and wheat or between soft and hard wheat diets. However, increasing Mon reduced ($P < 0.01$) DMI by 6% (11.7 vs. 11.0 kg/d). Intakes (g/d) of unsaturated FA (USFA; 119 vs. 121) were not different between barley and wheat diets, whereas that of saturated (SFA) was greater ($P < 0.01$) for barley diet (41 vs. 35). Further, intakes of PUFA and total FA were lower ($P < 0.01$) with soft (90 and 149) than with hard wheat (97 and 164) diets. Final BW (728 kg), ADG (1.79 kg) and G:F (159 g/kg DM feed) were not different between treatments. Carcass characteristics were generally not affected by treatments except that dressing percentage was slightly greater ($P < 0.05$) for barley (60.4%) than for wheat (59.7%) diet. Additionally, steers fed soft wheat had less ($P = 0.05$) back fat (18.2 vs. 20.6 mm)

and greater ($P < 0.05$) meat yield (52 vs. 50%) compared with hard wheat diet. Substitution of wheat for barley grain did not affect the total MUFA and PUFA, but decreased ($P < 0.05$) vaccenic acid (VA; 0.72 vs. 0.50% of total FA) and α -linolenic acid (ALA; 0.26 vs. 0.23% of total FA). These results indicate that wheat can effectively replace barley grain in finishing ration without negatively influencing growth performance, carcass traits and FA composition in meat. Feeding higher Mon seemed to have limit benefits to production efficiency even though DMI was reduced.

Key Words: feedlot steer, monensin, wheat source

TH100 Transcriptome analysis of epithelial and connective tissue fractions of rumen papillae from lactating dairy cattle. M. A. Steele*¹, O. AlZahal¹, S. Greenwood¹, J. C. Matthews², and B. W. McBride¹, ¹University of Guelph, Guelph, ON, Canada, ²University of Kentucky, Lexington.

Transcriptome analysis of bovine rumen papillae has provided insight into dietary regulation of the rumen epithelial function. However, previous studies examined expression of epithelial and connective tissues combined in whole papillae, and therefore did not account for tissue specific contributions to nutrient regulation. The objective of this study was to develop a technique to determine the differences in gene expression in epithelial and connective fractions of rumen papillae. Tissue was biopsied from lactating dairy cows, frozen in cryomolds, cut into sections, dehydrated, stained and epithelial and connective sections isolated by laser capture microdissection. The total RNA was isolated from epithelial and connective tissue and global gene expression from with the highest RNA integrity ($n = 3$) was assessed using Affymetrix GeneChip Bovine Gene 1.0 ST Array. Data pre-processing was conducted using RMA method and detection of significant genes was conducted using ANOVA. The model included the fixed effect of tissue and a Benjamini-Hochberg false discovery rate of 0.1 was applied. There were 366 genes differentially expressed between tissues ($P < 0.001$). Analysis of epithelial and connective tissue using Ingenuity Pathways Analysis showed that epithelial and connective tissue in rumen papillae had distinct molecular signatures. Epithelial signatures were enriched with tight junction genes (DSG1, DES1, DCN) and connective signatures were enriched with genes involved in cell structure and extracellular matrix composition (ACTA2, ACTG2, COL6A1, COL6A3, CL1A1, COL1A2, COL3A1, MYL9). The top ($P < 0.01$) networks between the 2 tissues from the Ingenuity Pathway Analysis included Connective Tissue Disorders, Dermatological Diseases, Gastrointestinal Diseases and Tissue Morphology. Molecular signatures uncovered from this study using laser capture microdissection highlight the importance of examining the roles of cell types within rumen papillae when targeting therapies and studying mechanisms that affect nutrient regulation.

Key Words: rumen papillae, epithelium, gene expression

TH101 Feeding behavior and lactational performance in response to reciprocal combinations of barley and corn grains in the diets of Holstein cows. S. Kargar*^{1,3}, G. R. Ghorbani¹, M. Khorvash¹, and D. J. Schingoethe², ¹Department of Animal Sciences, College of Agriculture, Isfahan University of Technology, Isfahan, Iran, ²Dairy Science Department, South Dakota State University, Brookings, ³Department of Dairy Science, College of Agricultural and Life Sciences, University of Wisconsin-Madison, Madison.

The effect of diets based on barley (BBD) or corn (CBD), or their equal blend (BCBD) on dry matter intake (DMI), feeding, chewing behavior,

and performance of lactating dairy cows were evaluated. Nine multiparous Holstein cows (75 ± 10 d in milk) were used in a triplicated 3×3 Latin square design with 21-d periods. Forage to concentrate ratio (40:60) was similar among treatments. Dry matter intake was not influenced by treatment ($P = 0.66$) and averaged 25.6 kg/d. Milk yield was similar across treatments ($P = 0.51$) but was numerically greater for cows fed BCBD than those fed others (48.0, 49.3, and 48.6 kg/d for cows fed BBD, BCBD, and CBD, respectively). Milk protein concentration ($P = 0.75$) and yield ($P = 0.36$) did not change across treatments and were 2.83% and 1.37 kg/d, respectively, on average. Milk fat percentage also increased ($P < 0.03$) in cows fed CBD relative to cows fed BCBD but not BBD (2.31, 2.28, and 2.57%, for cows fed BBD, BCBD, and CBD, respectively). However, cows fed CBD tended ($P < 0.08$) to yield greater milk fat than those fed BBD. Feed efficiency (milk yield/DMI) remained unchanged at 1.92. Dietary treatment did not influence meal and rumination patterns including number of bouts per day, duration of each meal, and inter-meal interval as well as eating rate and meal size. Although not significant, barley- compared with corn-based diets increased rumination time and thereby total chewing time by 36 min (766 vs. 730 min). These results indicate that the substitution of barley with corn have minimal effect on feeding behavior and productive responses of dairy cows.

Key Words: dairy cow, feeding behavior, grain source

TH102 Rumination times in balanced dairy cow rations. S. Rengman*¹, B. Johansson¹, L. Karlsson², M. Murphy¹, A. Sterk³, and E. Weurding³, ¹Lantmännen Lantbruk Feed Development, Malmö, Sweden, ²Felleskjøpet Feed Development, Trondheim, Norway, ³Agri-firm Innovation Center, Apeldoorn, Netherlands.

Ruminating and eating times are seen as indicators of sufficient structural feed in dairy cow diets. Several feeding systems have recommendations for chewing time related to DMI or NDF intake. High producing cows consume 5–6 kg NDF from forages, which are assumed to be governing rumination activities. The object of this study was to examine the variation in rumination times on several diets, differing in structural value as well as in proportions of easily fermentable carbohydrates and slowly digestible carbohydrates. Trial 1 (change over trial, $n = 24$) examined forage NDF. Trial 2 ($n = 48$, continuous trial) compared similar NDF levels from concentrates or forages, in a TMR. Trial 3 ($n = 48$, continuous trial) compared diets differing in structural values. DMI, milk production, milk composition and rumination times were recorded in all trials. Rumen pH was measured continuously in trial 3. All trials were conducted between Mar and Nov 2012. Forages were different mixes of grass, whole crop barley and corn silages. Rumination times were in the range 425–575 min/day. Cow variation was large but there were no clear associations between rumination times and diet composition or nutrient intakes. In Trial 1 no effect was seen on rumination times between high dietary NDF (34%) or low dietary NDF (28%), nor in milk composition. In Trial 2, a higher DMI was observed with diets containing NDF mostly from concentrates compared with diets containing NDF mostly from forage. No differences in milk yield or rumination times were observed but high amounts of concentrate NDF gave higher milk fat contents ($P < 0.05$). Particle sizes, determined with the Penn State separator, were within the recommended intervals. In Trial 3, diets high in structural values (peNDF = 34) had only a slightly higher rumination time than diets with lower structural values (peNDF = 30) but no significant correlation between rumen pH and rumination times. With balanced diets with normal forage contents to dairy cows in production there does not appear to be a simple correlation between rumination times and intake of structural feeds. Disturbances might

be due to aspects of feeding systems and housing management rather than dietary factors.

Key Words: health, production, rumen

TH103 Water intake in crossbred dairy calves. A. L. Silva¹, M. I. Marcondes¹, F. S. Machado², F. C. Sousa¹, A. S. Trece¹, M. M. D. Castro¹, T. E. Silva¹, and J. P. P. Rodrigues^{*1}, ¹Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, ²EMBRAPA Gado de Leite, Juiz de Fora, Minas Gerais, Brazil.

Water is one of the main important nutrients for animals. Water requirements can be attended by 3 sources: free water intake (WI), water contained in foods and water produced by body's metabolism nutrients. The objective was to determine free water intake (WI) for crossbred Holstein-Zebu calves aged between 0 and 60 d. The experiment was conducted at Department of Animal Science, at Universidade Federal de Viçosa, Brazil. Eighteen male calves, crossbred Holstein-Zebu, with an initial body weight of 36 ± 5.5 kg, were used. The animals were distributed into 3 treatments with 6 replications, and these consisted of 3 different levels of milk intake, which were 2, 4 and 8 L per day. The animals had free access to water and concentrate (starter). The animals were fed twice a day at 0600 and 1500 h, and water intake were measured every day at 0600 h. One container was maintained without access for animals, for calculations water evaporation. Environmental variables were also considered: relative humidity (RH), temperature and humidity index (THI) and black globe temperature and humidity index (BGTHI). Environmental effects, milk and starter intake and age were used in a multiple regression model, considering both linear and quadratic effects, to estimate calves WI. The test was conducted using MIXED procedure, SAS, at the level of significance of 5%. It was verified significant effects of dry bulb temperature ($P < 0.0001$), age in days ($P < 0.0001$), and starter intake ($P = 0.0028$) on WI. We did not observe quadratic effects for any of the tested variables ($P > 0.05$) and the multiple linear regression to estimate WI in calves can be expressed by equation: $WI = -2.9648 + 0.187 \times T_{db} + 0.02756 \times Day + 0.7257 \times SI$, where WI = water intake (L/d), T_{db} = dry bulb temperature ($^{\circ}C$), Day = age of animal (da), SI = starter intake (kg/d). It can be concluded that water intake can be estimated using parameters as dry bulb temperature, age of animals and starter intake. Supported by CNPq, CAPES, FAPEMIG and INCT-CA/Brazil.

Key Words: dry bulb temperature, milk, starter

TH104 Improving the preweaning performance of dairy calves through sensory stimulation. A. Mereu¹, R. Hernández², J. C. Macías², J. Vargas¹, M. Candelas², and I. R. Ipharraguerre^{*1}, ¹Lucta SA, Barcelona, Spain, ²Nuplen, Gomez Palacio, Dgo., México.

Fostering newborn calves to consume solid feed before weaning can contribute to ensure proper rumen development, growth, and health during this critical phase. We hypothesized that conferring the starter feed sensorial properties (smell and taste) similar to the milk replacer (MR) may allow stimulating intake of solid feed before weaning. To test this hypothesis, 50 Holstein calves (37.1 ± 4.6 kg of BW; 2.6 ± 1.5 d of age) were housed individually, paired by BW, and allotted to a control (CON) or a treatment (TRT) group ($n = 25$). From d 3 after birth until weaning (d 57), calves were fed 2 L of MR (20% CP, 20% CF) twice daily and a multi-particle starter (22.5% CP, 3.5% CF) for ad libitum intake. From the onset of the experiment onwards, the starter was offered either plain (CON) or treated (TRT) with an additive (1 kg/ton; Luctarom SFS-R; Lucta S.A., Spain) developed to emulate the sensory

properties of the MR. Calves had ad libitum access to water throughout the trial. Starter and MR consumption were recorded daily whereas BW and chest diameter (CD) were measured at birth and d 57. Data were analyzed as a mixed-effects model with repeated measures in time in which calf was treated as random effect and treatment, week, and their interaction were considered as fixed effects. Over the last 4 weeks of the study, TRT calves consumed progressively more starter than CON animals reaching significance ($P < 0.01$) the week before weaning (942 vs. 1183 g/d). As a result, mean starter consumption tended ($P < 0.18$) to be higher for TRT (28.4 kg/calf) than CON calves (24.4 kg/calf). Compared with CON, feeding TRT increased ($P < 0.05$) ADG (325 vs. 412 g/d) and CD (95.4 vs. 89.6 cm), and tended ($P = 0.14$) to improve FG by 25% (1.5 vs. 1.2). In conclusion, conferring the MR and starter feed similar sensory properties stimulated calves to consume more solid feed and thereby improved their rate growth until weaning.

Key Words: calf, weaning, palatability

TH105 Intake, digestibility, and ruminal parameters in heifers fed treated jatropha (*Jatropha curcas*) seed cake. L. D. Silva, O. G. Pereira*, S. C. Valadares Filho, K. G. Ribeiro, T. C. Silva, and R. Tamehiro, Federal University of Viçosa, Department of Animal Science, Viçosa, Minas Gerais, Brazil.

The residue from the extraction of jatropha seed oil has a high concentration of crude protein and toxicity, mainly caused by phorbol ester, requiring treatment for use in animal feed. The aim of this study was to evaluate the effect of replacing soybean meal (SBM) for jatropha seed cake, with the peel, treated with ethanol (TJC), in diet for heifers, on intake, total digestibility of nutrients, pH and ruminal ammonia concentrations and indicators of liver function. The treatment of jatropha cake was made in an equipment of the Soxhlet type in an extraction system by ethanol 98%. Four heifers fitted with ruminal and abomasal cannulas were used, with an average initial body weight of 379 ± 2.13 kg, distributed in a 4x4 Latin square. The animals received 4 complete diets, isonitrogenated, containing 65% corn silage and 35% concentrate, in DM basis. The treatments consisted of 4 levels of replacement of SBM by TJC + urea/ammonium sulfate in the diet: 0, 33, 67 and 100%, in DM basis. Data were subjected to variance analysis using SAS. The content of phorbol ester in TJC was 0.04 mg/g. The intake of DM, OM, CP, EE, NFC and TDN decreased linearly ($P < 0.05$) with the increasing addition of TJC in the concentrate of the diets. It was recorded values of 1.8, 1.6, 1.6 and 1.2% of body weight, for DM intake in diets with 0, 33, 67 and 100% of TJC, respectively. There was no effect ($P > 0.05$) of TJC levels on total tract digestibility of nutrients of the diets. The averages were 68.3, 70.5 and 60.9% for DM, OM and CP digestibilities, respectively. The highest levels of TJC in the diets resulted in higher values ($P < 0.05$) of ruminal pH, however, it did not affect ($P > 0.05$) ruminal ammonia concentration. The serum levels of enzymes AST and ALT, which are indicative of liver function, were not affected ($P > 0.05$) by the diets. Thus, it can be concluded that in spite of the reduction of phorbol esters, the jatropha cake treatment with ethanol was not sufficient to promote an adequate intake of nutrients by heifers. Supported by CNPq, INCT-CA and FAPEMIG.

Key Words: dry matter intake, phorbol ester, ruminal ammonia

TH106 In situ degradation kinetics of brown midrib corn silage hybrids harvested prior to or at maturity. M. S. Holt^{*1}, K. Neal¹, J.-S. Eun¹, J. E. Creech², A. J. Young¹, and X. Dai³, ¹Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan, ²Department of Plant, Soils, and Climate, Utah State

University, Logan, ³Utah Agricultural Experiment Station, Utah State University, Logan.

The objective of this study was to assess in situ DM and NDF degradation kinetics for new pre-matured BMR (pmBMR) varieties that can be double-cropped compared with a sole crop mature BMR (mBMR; Mycogen F2F387; Mycogen Seeds, Indianapolis, IN) and conventional corn silage (CCS; Dekalb DKC61-72; Monsanto Co., St. Louis, MO) harvested at maturity. Double-crop pmBMR varieties were the MasterGraze MC-BMR (pmBMR1; Masters Choice Inc., Anna, IL) and the synthetic BMR84 (pmBMR2; Ray Brothers Seed Farms, Ironside, OR). Two nonlactating dry (DC) and 2 multiparous lactating Holstein dairy cows (LC) were used for in situ measurements for ruminal degradation kinetics of DM and NDF. Four dietary treatments were compared: CCS, mBMR, pmBMR1, and pmBMR2. All cows received the 4 treatments, and data were analyzed separately for DC and LC. Total units of degraded DM were greatest for BMR hybrids compared with CCS in both DC and LC ($P < 0.01$). Incubating pmBMR1 had the lowest undegradable fraction with the greatest potentially degradable fraction and total units of degraded DM followed by mBMR in DC and LC. Incubating CCS had the least units of degraded DM for both cows with the greatest undegradable fraction in DC. Total units of degraded NDF were greater for BMR hybrids compared with CCS in DC and LC ($P < 0.01$). The pmBMR1 had the greatest potentially degradable fraction of NDF and extent of degradation in DC, whereas incubating mBMR resulted in the greatest potentially degradable fraction of NDF in LC. In addition, the greatest extent of digestion in LC was achieved by pmBMR1, while pmBMR2 had the greatest undegradable NDF fraction in LC. Incubating CCS caused the least units of degraded NDF for both DC and LC, whereas pmBMR2 had the greatest undegradable fraction of NDF and the least potentially degradable fraction of NDF for both DC and LC. Taken as a whole, this study indicates that rumen degradability may have been influenced more by hybrid than stage of maturity, as pmBMR1 had the greatest degradability, and pmBMR2 was not as degradable as mBMR.

Key Words: conventional corn silage, brown midrib corn silage, in situ degradation kinetics

TH107 Tail arterial blood or tail venous blood: Could represent external pudic arterial blood? Y. D. Zhang, J. Q. Wang*, D. P. Bu, M. Zhao, X. Q. Zhou, P. Zhang, and Y. J. Xu, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Arterial blood and venous blood are essential for estimating uptakes of milk component precursors by the mammary gland using arteriovenous difference. This blood also should be representative of the artery supply and venous drainage of udder. Representative venous blood could be easily collected from subcutaneous abdominal veins in dairy cows. Whereas arterial blood is harder to collect as external pudic arterial vessels embedded in the depth of muscle than venous vessels. Therefore, 13 Chinese lactating Holstein dairy cows (milk yield = 27 ± 2 kg/d) in mid-lactation (days in milk = 110 ± 20 d) were used to validate the technique of tail arterial blood or tail venous blood represented external pudic arterial blood. Tail arterial blood and tail venous blood was collected separately using blood collecting needle in the tail median coccygeal artery and tail median coccygeal vein vessel, external pudic arterial blood was collected using puncture needle in the abdomen. The samples were analyzed for copper, zinc, calcium, manganese, ferrum, free amino acids, and fatty acids. Data were analyzed using the GLM procedure of SAS (SAS 8.2; SAS Institute Inc., Cary, NC). No differences were found in copper (19.55 vs. 18.21 vs. 20.62 $\mu\text{mol/L}$, $P >$

0.05), zinc (37.20 vs. 36.78 vs. 38.45 $\mu\text{mol/L}$, $P > 0.05$), calcium (2.13 vs. 2.09 vs. 2.13 mmol/L, $P > 0.05$), manganese (1.00 vs. 1.00 vs. 1.02 mmol/L, $P > 0.05$), ferrum (7.19 vs. 7.17 vs. 7.20 mmol/L, $P > 0.05$), total free amino acids (1716.79 vs. 1721.43 vs. 1765.29 nmol/mL, $P > 0.05$), essential amino acids (879.97 vs. 878.25 vs. 916.32 nmol/mL, $P > 0.05$), non-essential amino acids (836.82 vs. 843.18 vs. 848.97 nmol/mL, $P > 0.05$), and total fatty acids (2898.24 vs. 2959.00 vs. 2984.45 $\mu\text{g/mL}$, $P > 0.05$) content in tail arterial blood, tail venous blood and external pudic arterial blood. It suggested that tail arterial blood or tail venous blood may represent external pudic arterial blood for calculating arteriovenous difference of substrates of milk synthesis.

Key Words: tail arterial blood, tail venous blood, external pudic arterial blood

TH108 Milk production and ruminal fermentation characteristics of dairy cows grazing birdsfoot trefoil pasture on a commercial organic dairy farm. R. G. Christensen¹, J.-S. Eun^{*1}, A. J. Young¹, and J. W. MacAdam², ¹Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan, ²Department of Plants, Soils, and Climate, Utah State University, Logan.

Grazing cows on tannin-containing legumes such as birdsfoot trefoil (BFT; *Lotus corniculatus* L.) has been reported to improve dietary N utilization efficiency and milk production. This experiment investigated milk production and ruminal fermentation of grazing dairy cows on BFT on a commercial organic dairy farm for 10 wk in a completely randomized design. Eighteen multiparous cows in mid-lactation were paired by previous milk production, parity, and DIM, and randomly assigned to 2 grazing treatments: cool-season grass pasture (GP) vs. BFT pasture (BFTP). Cows received 2.27 kg of concentrate (barley grain and vitamin and mineral supplement) twice per day following milking. Experiment lasted a total of 10 wk, with 2 wk for adjustment to pasture treatments and 8 wk for data and sample collection. Milk yield and components were measured every 2 wk, whereas ruminal fluid was obtained using a Geishauser probe 3 h after p.m. feeding at 3, 6, and 10 wk of study. Milk yield averaged 26.4 kg/d, and was similar between treatments. Cows grazed on the BFTP tended to increase ECM yield ($P = 0.09$) compared with those on the GP (28.7 vs. 25.8 kg/d). In addition, cows grazed on the BFTP produced 3.57 kg/d more of 3.5% FCM compared with those on the GP ($P = 0.03$). Grazing cows on the BFTP resulted in increased milk fat concentration compared with the GP (3.86 vs. 3.44%; $P = 0.02$). Milk fat (1.02 vs. 0.88 kg/d, $P = 0.01$) and protein yield (0.87 vs. 0.69 kg/d; $P < 0.01$) were higher for the BFTP compared with the GP. Concentrations of MUN and ruminal ammonia-N did not differ between treatments. Total VFA concentration increased for the BFTP compared with the GP ($P < 0.01$). In addition, proportion of propionate was higher for cows grazed on the BFTP compared with those on the GP ($P < 0.01$). Overall results in this study indicate that grazing dairy cows on the BFTP enhanced ruminal fermentation as evidenced by increase total VFA concentration, which supported increased ECM and 3.5% FCM yields.

Key Words: birdsfoot trefoil pasture, lactating dairy cow, milk production

TH109 Behavior and physiological changes of dairy calves in response to the level of intake and weaning method. M. P. C. Gallo^{1,3}, M. R. Paula^{1,2}, D. Lezier^{1,2}, M. C. Soares^{1,3}, G. B. Mourao^{1,2}, and C. M. M. Bittar^{*1,2}, ¹ESALQ/USP, Piracicaba, Sao Paulo, Brazil, ²CNPq, Brasilia, DF, Brazil, ³Fapesp, Sao Paulo, Sao Paulo, Brazil, ⁴Capes, Brasilia, DF, Brazil.

The effect of concentrate intake level at wk 5 of age and weaning method on the behavior and physiological changes of dairy calves was studied. In a 2 × 2 factorial design, 36 dairy calves were classified as presenting high (HCI: > 350g/d) or low (LCI: < 350 g/d) concentrate intake at the 5th week of life, and weaned by 2 methods: abrupt or gradual. Animals were individually housed, had water and concentrate free-choice and were fed 4L of milk-replacer. The abrupt weaning was done at the 8th week of age. Animals gradually weaned received milk-replacer at the rate of 4 L/d until wk 6, 3 L/d from wk 6 to wk 7, 2 L/d from 7 to 2 d before weaning, and 1 L/d until weaning at wk 8 of age. On d -14, -7, -2, 0, 2, 7 relative to weaning, animal's behavior was monitored and rectal temperature (RT), heart beat (HB) and respiratory rate (RR) measured 3 times (6, 12 and 18 h). There was no significant interaction of intake level and weaning method for all variables ($P > 0.05$). Weaning method had no effect ($P > 0.05$) on HB (97/min), RR (43.6/min) or RT (38.8°C). Concentrate intake level affected ($P = 0.02$) heartbeat, being 9% higher for the HCI group (102; 93 beats/min). Concentrate intake level had no effect on respiratory rate (43.6/min; $P > 0.05$), but affected rectal temperature at 18 h, with higher value for animals at the LCI group (39.2; 39.0°C, $P = 0.019$). Concentrate intake level had no effect on animal behavior ($P > 0.05$). Animals gradually weaned spent 17.5 more minutes eating concentrate (86.9 vs. 69.5 min; $P < 0.002$). On d 2, animals abruptly weaned vocalized more than those gradually weaned (112; 36 vocalizations/15 h; $P < 0.05$). On average, animals change some of the behavior parameters from d 0 to 2 and 7 after weaning ($P < 0.05$): decreased time standing; and increased time lying down, eating concentrate, grazing and ruminating. Even though the level of intake has effects on animals' performance, it did not affect animals' behavior. Weaning method changed some important behavior parameters, suggesting the gradual weaning method as the most adequate for animals' well-being.

Key Words: milk feeding, vocalization, weaning stress

TH110 Effects of different dry period managements on rumen microbiota before and after calving. H. R. Khazanehei*, J. C. Plaizier, S. Li, and E. Khafipour, *University of Manitoba, Winnipeg, MB, Canada.*

The effects of 2 dry period managements on rumen microbiota pre and postpartum were determined in 24 multiparous Holstein cows. Treatments were a 60-d dry period (60-d trt) with a 39-d far-off and a 21-d close-up diets, and a 40-d dry period (40-d trt) during which only the close-up diet was fed. The close-up diet had higher NEL and lower NDF but similar CP compared with far-off (1.43 vs. 1.28 Mcal/kg, 50 vs. 38%, and 14.6 vs. 14.7% DM basis, respectively). A common diet was fed to all cows after calving (1.69 Mcal/kg, 17.6% of CP, and 31% of NDF). Rumen samples were taken at wk -2, 2 and 7 relative to calving. Relative quantifications of 14 classical rumen bacteria, methanogenic archaea and ciliate protozoa were performed using real-time PCR and reported as fold change compared with -2 wk of the 60-d trt. There was no difference in the populations of *Anaerovibrio lipolytica*, *Anaerovibrio lipolytica*, *Fibrobacter succinogenes*, *Megasphaera elsdenii*, *Ruminobacter amylophilus*, *Ruminococcus albus*, *Selenomonas ruminantium*, *Succinivibrio dextrinosolvens*, and *Treponema bryantii* between weeks in the 60-d and the 40-d trts. Ciliate protozoa ($P < 0.04$), and *Succinimonas amylolytica* ($P < 0.03$) decreased postpartum in the 40-d trt. The shift in ciliate protozoa is likely due to a longer exposure to a high-energy diet in the 40-d trt, which reduced rumen pH and possibly the retention time. Acetate is a growth stimulator of *S. amylolytica* and probably after calving the increased grain:forage ratio and consequently the reduced acetate resulted in lower numbers of this bacteria. Methanogenic archaea

($P < 0.05$) and *R. flavifaciens* ($P < 0.05$) increased postpartum in the 40-d trt. The higher methanogenic archaea are possibly due to the higher population of H₂-producing bacteria and the formate production by *R. flavifaciens* in the 40-d trt. *P. albensis* ($P < 0.01$, $P < 0.02$) and *P. bryantii* ($P < 0.04$, $P < 0.02$) increased in the 40-d and the 60-d treatments after calving, respectively. In conclusion, rumen microbiome results didn't show a huge advantage of using one management rather than the other.

Key Words: dry period, rumen microbiota

TH111 Enteric methane emissions from dairy cows fed corn silage or barley silage based diets. C. Benchaar*¹, F. Hassanat¹, R. Gervais², P. Y. Chouinard², H. Petit¹, and D. Massé¹, ¹*Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Sherbrooke, QC, Canada,* ²*Département des Sciences Animales, Université Laval, Québec, QC, Canada.*

The objective of this study was to compare enteric CH₄ emissions from dairy cows fed corn silage (CS) or barley silage based diets. Nine lactating, multiparous Holstein cows (DIM = 114 ± 33; BW = 707 ± 49 kg; milk yield 46.9 ± 2.6 kg) used in a replicated 3 × 3 Latin square (32-d periods, 14-d adaptation) were fed (ad libitum) a TMR (60:40, forage:concentrate ratio) with the forage portion being either barley silage (0% CS), corn silage (100% CS) or a 50:50 mixture (50% CS). Diets were formulated to contain 16.2% CP and 1.63 Mcal/kg NE_L. Production of CH₄ was determined (3 consecutive days) using respiration chambers. Dry matter digestibility and milk performance were determined over 6 consecutive days. Linear and quadratic contrasts (MIXED Procedure; SAS) were used to determine the effects of increasing CS proportions on variables response. Significance was declared if $P \leq 0.05$ and tendencies if $0.05 < P \leq 0.10$. Dry matter (DM) intake (21.9, 24.9, and 26.2 kg/d for 0, 50 and 100% CS, respectively), and digestibility (63.2, 65.8 and 69.3% for 0, 50 and 100% CS, respectively) increased linearly as the proportion of CS in the diet increased. Yields of milk, fat-corrected milk (FCM) and energy-corrected milk (ECM) increased linearly ($P \leq 0.01$) as dietary CS inclusion rate increased. Methane production tended ($P = 0.07$) to respond quadratically (487, 540 and 523 g/d for 0, 50 and 100% CS, respectively) to increasing CS dietary proportion. Linear decreases were observed when CH₄ production was adjusted for DM (22.3, 21.8 and 19.1 g/kg for 0, 50 and 100% CS, respectively) or gross energy intake (6.60, 6.49, 5.67%, for 0, 50 and 100% CS, respectively). When expressed on FCM and ECM yield bases, CH₄ emissions were numerically lower when cows were fed 100% CS treatment (i.e., quadratic effect $0.12 \leq P \leq 0.15$). In conclusion, under the experimental conditions of the current study, cows fed corn silage based diets exhibited lower CH₄ energy losses (up to 14% less) than cows fed barley silage-based diets.

Key Words: corn silage, barley silage, methane

TH112 Midwestern US by-product feedstuffs vary in ruminal nutrient digestion. J. Goeser*¹, C. Heuer^{1,2}, and L. Meyer¹, ¹*Rock River Laboratory Inc., Watertown, WI,* ²*University of Wisconsin, Madison, Madison.*

Feedstuff byproducts fed to commercial dairy and feedlots are offshoots of grain refinement processes and may vary in ruminal nutrient digestion. NRC (2001) published feed library values for nutrition balancing but in some cases cites less than 10 samples. Our objective was to evaluate byproduct feed nutrient and digestion variation and assess RUP relative to NRC (2001) values. Soybean meal (n = 13), expeller meal (n = 12), canola meal (n = 11), corn distillers grain (n = 17), corn

gluten feed (n = 28), and soy hull (n = 8) samples were incubated, intact if meal or ground (4mm) if whole, in situ (6g per bag for 16h) in each of 3 lactating dairy cows consuming a commercial diet with a standard in each run. Residue bags were rinsed until effluent was clear to remove microbial CP. Bags were dried and weighed to determine DM digestion. Sample and combined residues were analyzed for N by combustion technique. A subset of samples was analyzed for NDF by modified Mertens technique. Nutrient digestion was calculated as [sample nutrient (g) – residue nutrient (g)]/sample nutrient (g). Data were analyzed using a linear model with fixed effects of feed and week and sample ID as random using SAS JMPv10. Feedstuff 16h in situ means were compared by Tukey's test. Feedstuff RUP means then were regressed on NRC (2001) feed library RUP values for 4× maintenance DMI and 50% forage diet. Feeds differed ($P < 0.05$) in 16h DMD, RUP and NDFD (Table 1). NRC feed RUP relationship with mean 16-h in situ feed RUP was $\text{NRC RUP} = -11.1 + 1.04 \times 16\text{-h in situ RUP}$, $R^2 = 0.82$. While slope differed from zero (1.04, $P < 0.05$), the $R^2 = 0.82$ suggests deviation from NRC library RUPs. These results may be used to supplement feed library values for modeling.

Table 1. Commercial feedstuff nutrient content, 16-h in situ rumen dry matter digestibility (DMD), undegradable CP (RUP) and NDF digestibility (NDFD).

	CP	NDF	DMD	SE	RUP	SE	NDFD	SE
Corn gluten feed	24.8	36.4	75.0 ^a	1.1	17.1 ^c	1.5	47.6 ^a	2.8
Corn distillers grains	35.2	37.4	60.9 ^b	1.4	49.6 ^a	1.9	40.1 ^{ab}	3.4
Soy hulls	12.7	58.5	52.6 ^c	2.0	35.6 ^b	2.7	30.0 ^b	4.7
Canola meal	43.6		68.6 ^{bc}	1.7	30.1 ^b	2.2		
Expeller meal	48.0		61.8 ^{cd}	1.6	55.9 ^a	2.1		
Soybean meal	52.2		82.0 ^a	1.7	24.4 ^{bc}	2.3		

^{a-c}Means with differing superscripts differ ($P < 0.05$).

Key Words: by-product, rumen, digestion

TH113 Milk fatty acid profiles in Holstein dairy cows fed a corn straw or mixed forage diet. Y. D. Zhang, X. W. Zhao, J. Q. Wang, D. P. Bu*, P. P. An, and X. W. Xu, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Forages play an important role in fatty acid composition of bovine milk fat. Corn straw is traditional forage source in diets for lactating cows in small farms in china and has been replaced partly by Chinese wildrye, alfalfa hay and corn silage in model dairy farms. Objectives of this study was to examine diets differing in forage source and concentration on milk fat content and milk fatty acid (FA) composition. Twenty 4 Chinese lactating Holstein dairy cows in mid-lactation (136 ± 37 d in milk) were randomly assigned to high forage diets (MF, C:F = 40:60) with Chinese wildrye, alfalfa hay and corn silage as the forage source or low forage diets (CS, C:F = 60:40) with corn straw as the forage source. Experiment lasted for 9 week with first 2 week as adaption period. Milk samples were collected weekly and analyzed for fat content and fatty acid profiles. Data were analyzed as repeated measurements using PROC MIXED of SAS. Milk fat content was not different between 2 groups. Compared with CS diets, feeding MF diets increased C18:0, C18:3 and C20:0 content ($P < 0.01$) in milk fat, tended to decrease C < 16 fatty acids content (P

< 0.05), especially C8:0 ($P = 0.06$), C10:0 ($P = 0.08$), C12:0 ($P = 0.07$) and C14:1 ($P = 0.01$) content in milk fat. while stearoyl-coenzyme A desaturase activity of C14:1/C14:0 ($P = 0.06$), C16:1/C16:0 ($P = 0.08$) and cis9C18:1/C18:0 ($P = 0.01$) were lower for MF group than CS group. There were no significant effect on MUFA ($P = 0.23$), PUFA ($P = 0.17$) and SFA ($P = 0.23$) content in the 2 diets. These data suggest that different forage diets alter milk fatty acids profiles.

Key Words: milk fatty acid, corn straw, mixed forage

TH114 Effects of replacing alfalfa hay and corn silage with corn straw in diets on feeding behavior of dairy cows. Y. D. Zhang, D. P. Bu, J. Q. Wang*, P. Zhang, J. Guo, M. Zhao, and X. Q. Zhou, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

A study was conducted to determine the effects of replacing alfalfa hay and corn silage as the only forage source with corn straw on feeding behavior. Thirty-two primiparous Holstein cows (55 ± 15 d, days in milk) were divided into 2 groups fed ad libitum a TMR containing either 17.30% alfalfa hay and 18.77% corn silage (control group) or 36.07% corn straw (CS group). The experiment period was 105 d with 14 d adaptation. Cows were fed with auto feeding system and feeding behavior was recorded continuously using a computerized monitoring system (RIC system, Insentec B.V., Marknesse, the Netherlands). Data were analyzed using the MIXED procedure of SAS (SAS 8.2; SAS Institute Inc., Cary, NC). Total visiting time per day was similar in the experimental groups (51.06 vs. 56.97 times/day, $P = 0.21$). Compared with the control group, meals per day (5.63 vs. 8.57 meals/d, $P < 0.01$), dry matter intake (17.43 vs. 21.35 kg/d, $P < 0.01$), crude protein intake (2.90 vs. 3.84 kg/d, $P < 0.01$) and consumption rate (68.65 vs. 103.25 g DM/min, $P < 0.01$) were lower in the CS group, indicating more attractiveness to the cows for feeding alfalfa hay and corn silage than the cows for feeding the corn straw as the forage source. These results indicate that forage sources affected feeding behavior of dairy cows.

Key Words: mixed forage, corn straw, feeding behavior

TH115 Efficacy of a commercial colostrum replacer in delivering passive immunity to Holstein calves. D. L. Cook*¹, T. TerHune², M. T. Socha³, D. Carlson¹, D. J. Tomlinson³, and J. M. DeFrain³, ¹Milk Products, Chilton, WI, ²HMS Veterinary Development, Tulare, CA, ³Zinpro Corporation, Eden Prairie, MN.

Twenty male Holstein calves (mean birth weight, 41.8 ± 0.9 kg) from singleton births were assigned to a study to determine efficacy of a commercial colostrum replacer. All calves were from one commercial dairy herd and obtained from cows using a clean catch procedure to minimize environmental contamination and eliminate possibility of the calf nursing the cow. Prior to feeding the calf a dose of the colostrum replacer, the calf was weighed and a blood sample was collected for determination of pre-feeding serum IgG concentration. Between 1.3 and 2.4 h post birth, calves were fed 375 g of a colostrum replacer using a nipple bottle. The 375 g of colostrum replacer provided 150 g IgG and was reconstituted with 1.3 L of hot water (mean temperature, $47 \pm 1^\circ\text{C}$) for a final volume of 1.4 L. A second blood sample was collected 24 ± 1 h after the colostrum replacer feeding. Serum IgG concentrations were determined using a radial immunodiffusion test for quantification of bovine IgG (Triple J Farms Product #728411; Kent Laboratories, Bellingham, WA). Average serum IgG concentrations were 14.0 ± 0.5 mg/mL and exceeded 10 mg/mL ($P \leq 0.05$). Mean apparent efficiency of IgG absorption was $38.5 \pm 1.8\%$ and incidence of failure of passive

transfer (serum IgG <10 mg/mL) was 10% (2/20 calves). The colostrum replacer was efficacious in delivering passive immunity to calves.

Key Words: calf, colostrum replacer, passive immunity

TH116 Lactational performance and ruminal fermentation profiles of dairy cows fed diets containing birdsfoot trefoil hay. R. G. Christensen¹, J.-S. Eun^{*1}, A. J. Young¹, and J. W. MacAdam², ¹Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan, ²Department of Plants, Soils, and Climate, Utah State University, Logan.

Feeding condensed tannin-containing forages such as birdsfoot trefoil (BFT; *Lotus corniculatus* L.) to dairy cows has been reported to increase lactational performance through improved dietary N utilization. The objective of this study was to determine the effects of feeding BFT hay (BFTH) diets compared with alfalfa hay (AH) diet on lactational performance and ruminal fermentation profiles of dairy cows. Nine Holstein dairy cows (131 ± 15 DIM) were fed 3 experimental diets in a replicated 3 × 3 Latin square design with periods of 14-d adaptation and 7-d data and sample collection. Within each square, cows were randomly assigned to sequential dietary treatments as follows: AH-based TMR (AHT), AH and BFTH-based TMR (AHBFTHT), and BFTH-based TMR (BFTHT). The diets contained 42.0% AH, BFTH, or their combination as sources of forage and were isonitrogenous (16.1% CP) and isocaloric (1.60 Mcal/kg DM). Feeding the BFTHT increased DMI compared with the AHT (26.4 vs. 25.6 kg/d; *P* < 0.01). Cows fed the BFTHT tended to increase (*P* = 0.08) milk yield compared with those fed the AHT (39.9 vs. 38.3 kg/d). Feeding BFTH-containing diets tended to increase milk protein concentration (*P* = 0.09), resulting in increased milk protein yield (*P* = 0.03). Feeding the AHBFTHT tended to decrease milk fat concentration compared with the AHT or the BFTHT (*P* = 0.09). Concentration of MUN did not differ across dietary treatments. Dairy efficiency (ECM yield/DMI) was highest due to feeding the BFTHT. While total VFA concentration tended to increase (*P* = 0.10) by feeding the BFTHT compared with the AHT or the AHBFTHT, feeding BFTH-containing diets decreased acetate-to-propionate ratio compared with the AHT. Concentration of ammonia-N was similar across diets. Contrary to our expectation, feeding BFTH in dairy diets did not influence ruminal N fermentation, whereas feeding BFTH at a relatively high dietary concentration increased feed intake and milk production of mid-lactation dairy cows. The positive effects may have resulted from enhanced ruminal fermentation as evidenced by increased VFA production.

Key Words: birdsfoot trefoil hay, lactating dairy cow, ruminal fermentation

TH117 Feed efficiency and carcass traits of Nellore and Angus young bulls fed whole corn grain diet. J. R. R. Carvalho¹, M. M. Ladeira^{*1,2}, M. L. Chizzotti¹, P. D. Teixeira¹, L. A. Silveira¹, and M. C. L. Alves¹, ¹Universidade Federal de Lavras, Lavras, MG, Brazil, ²Purdue University, West Lafayette, IN.

The objective was to evaluate the feed efficiency and carcass traits of Nellore and Angus young bulls fed with a regular feedlot diet and a whole corn grain (WCG) diet without the use of forage. Thirty-six animals, with average BW of 381.2 ± 11.87 kg, were used in a completely randomized design using a 2 × 2 factorial arrangement (2 breeds and 2 diets). The usual diet contained 30% corn silage and 70% of concentrate. The WCG diet presented 85% of corn and 15% of a commercial pellet based on soybean meal and minerals. Both diets had 12.5% CP and 2.88 Mcal/kg of ME. The animals were fed in individual pens and

the performance was evaluated after 16h of fasting. Two animals, one Nellore and one Angus did not adapt to the WCG diet. After 81 d the animals were slaughtered using cerebral concussion and slitting of the jugular vein. Data were analyzed using PROC GLM in SAS. Angus cattle had greater weight gain, dry matter intake and feed efficiency (Table 1). Similar results were observed for hot carcass weight, rib eye area and fat thickness. However, Angus showed tendency to smaller dressing percentage, which may be explained by a greater proportion of the gastrointestinal tract in the BW of this breed (4.25 vs. 3.81^a, *P* < 0.01). The whole corn grain diet provided greater feed efficiency without influence on carcass traits.

Table 1. Dry matter intake (DMI), average daily gain (ADG), feed efficiency (G:F), hot carcass weight (HCW), longissimus dorsi muscle area (LMA), back-fat thickness (BF) and dressing percentage (DP) of young bulls fed high concentrate diets¹

Item	Nellore		Angus		SEM	<i>P</i> -value		
	30:70	WCG	30:70	WCG		Breed	Diet	B × D
DMI (kg/d)	10.4	6.9	13.8	10.2	0.41	<0.01	<0.01	0.44
ADG (kg/d)	1.4	1.0	2.0	1.8	0.16	<0.01	0.21	0.60
G:F	0.128	0.152	0.147	0.202	0.0126	0.01	<0.01	0.12
HCW (kg)	280.9	259.0	315.0	315.4	10.85	<0.01	0.31	0.30
LMA (cm ²)	72.1	67.6	84.8	79.3	5.13	0.02	0.32	0.91
BF (mm)	4.5	3.5	6.9	6.6	0.15	<0.01	0.19	0.46
DP (%)	59.5	60.1	58.3	59.2	0.57	0.08	0.16	0.78

¹30:70 = diet containing 30% forage and 70% concentrate; WCG = diet with 85% corn grain and 15% commercial pellet (WCG).

Key Words: breed, feedlot, high concentrate

TH118 The relationship between carcass and non carcass composition and visceral organ mass, and residual feed intake in finishing beef cattle. M. L. Nascimento^{*1}, G. E. Carstens², F. R. B. Ribeiro², W. K. Krueger², L. O. Tedeschi², M. E. Davis³, and W. E. Pinchak⁴, ¹University of Sao Paulo, Piracicaba, SP, Brazil, ²Texas A&M University, College Station, ³Ohio State University, Columbus ⁴Texas AgriLife Research, Vernon.

The objective of this study was to examine the relationships between residual feed intake (RFI) and carcass, non-carcass composition, and visceral organs in finishing beef cattle. Trials involving 56 Angus bulls and heifers divergently selected for serum insulin-like growth factor-I (IGF-I; Trial 1), and 36 crossbred steers fed diets with no tannin, condensed or hydrolysable tannin sources (Trial 2) were used for this study. DMI of high-grain diets (2.85 Mcal ME/kg) was measured for 56 d, and RFI computed by regression of DMI on mid-test BW^{0.75} and ADG within gender. Thirty-two bulls and heifers with divergent RFI in trial 1, and all steers in trial 2 were harvested, and dissectible percentage of 9–11th rib lean and fat measured. Empty gastrointestinal tract (GIT), visceral organs, and dissectible fat depots surrounding GIT, visceral organs and KPH were weighed. IGF-I was significant for several traits in Trial 1, whereas, diet effects were not significant for any trait in Trial 2. Thus, appropriate traits in Trial 1 were adjusted before meta-analysis. Meta-regression was conducted using Proc Mixed (SAS) with RFI class and gender as fixed effects, and trial and harvest group as random. DMI and F:G of low-RFI animals was 18.7% and 16.2% lower (*P* < 0.001)

than in high RFI animals. High-RFI animals tended ($P = 0.07$) to have greater LM area and percentage dissectible lean, and lesser backfat depth ($P < 0.10$) and dissectible fat ($P = 0.15$) than high-RFI animals. Final BW, carcass and empty BW (EBW), rumen, small and large intestines, liver, heart, kidney, dissectible KPH and visceral organ fat (g/kg EBW) were similar ($P > 0.10$) between low- and high-RFI animals. Low-RFI animals had lesser ($P < 0.05$) empty GIT (10.4 vs. 11.0 ± 0.3 g/kg EBW) and dissectible GIT fat (5.82 vs. 6.36 ± 0.23 g/kg EBW), and tended ($P = 0.07$) to have lesser total dissectible internal fat (8.61 vs. 9.15 ± 0.29 g/kg EBW) compared with high-RFI animals. Differences in visceral organ mass did not contribute to variation in RFI. However, low-RFI animals tended to deposit less carcass fat and had 8% less dissectible GIT fat than high-RFI animals.

Key Words: feed efficiency, visceral organ

TH119 Use of a fescue seed model to study effects of ergot alkaloids on temperature regulation in steers. J. Eisemann*, G. Huntington, M. Poore, M. Hanna, and M. Williamson, *North Carolina State University, Raleigh.*

The objective was to measure changes in surface temperature (ST) of the left ribs, rectal temperature (RT), blood pressure (BP), heart rate (HR), respiration rate (RR), and serum prolactin (PRL) in steers fed diets containing either endophyte-free (E-) or toxic endophyte-infected (E+) fescue seed under conditions where the environmental temperature (ET) was within the thermoneutral zone (TNZ). Angus steers ($n = 8$) were housed indoors in individual pens and adapted to a basal diet of 40% concentrate mix:60% switchgrass hay. Seed replaced soyhulls in the basal diet for E- and E+ (2.0 mg/d ergovaline; 5.8 μ g/kg BW). Design was a single reversal with 14-d periods (PD) and 21 d between PD. Baseline measurements were taken 2 d before the start of each PD. Measurements were taken at 0730, 1230 and 1530 on d 4, 8, and 14 of each PD. Digital infrared thermographic imaging was used to measure ST. Automated, digital BP equipment with the inflatable cuff on the tail was used for BP and HR. Data analysis included effects of treatment, day, time of day, and period, with d -2 data as a covariate. Mean (SD) daily ET min was 11.4°C (2.2) and max was 17.0°C (3.4). Steers' BW and DMI did not differ ($P < 0.82$) for E- and E+ and were 348 and 347 kg, and 6.91 and 6.92 kg/d, respectively. Similarly, RT (38.2 and 38.1°C), RR (24 and 24 breaths/min), and diastolic BP (56 and 58 mmHg) did not differ ($P < 0.31$) for E- and E+, respectively. Steers' HR (72 vs. 65 beats/min) and systolic-diastolic BP difference (55 vs. 50 mmHg) were greater ($P < 0.05$) with E- than E+. Compared with E+, systolic BP (114 vs. 106 mmHg, $P < 0.07$) and PRL (71 vs. 43 ng/mL, $P < 0.15$) tended to be greater and ST (31.0 vs. 31.5°C , $P < 0.18$) tended to be lesser for E-. Steers' RT, ST and RR increased ($P < 0.01$) with sampling time on a given day. Values at 0730, 1230, and 1530 were: RT ($^{\circ}\text{C}$) 38.0, 38.2, and 38.4, respectively; ST ($^{\circ}\text{C}$) 29.8, 31.7, and 32.2, respectively; and RR (breaths/min) 22, 24, and 24, respectively. Decreased HR and BP responses to E+ are similar to responses previously reported for steers where ET was above the TNZ.

Key Words: steer, tall fescue, environmental temperature

TH120 Soybean hull and enzyme inclusion effects on diet digestibility and growth performance in beef calves consuming corn-based diets. J. R. Russell*, W. J. Sexten, and M. S. Kerley, *University of Missouri, Columbia.*

A feedlot study was conducted to determine increasing soybean hull (SH) inclusion and enzyme addition effects on diet digestibility and

animal performance. The hypothesis was SH inclusion and enzyme addition would increase fiber digestibility with no negative effect on animal performance. Eight treatments (TRT) were arranged in a 4×2 factorial using 4 diets (DIET) and 2 enzyme inclusion rates (ENZ). The diets contained whole shell corn (WSC) with 0, 7, 14 or 28% SH replacing WSC. The ENZ was a commercial proprietary mix of *B. subtilis*, *A. oryzae* and *T. viride* (CattleMace, R&D Life Sciences, Menomonie, WI) included in diets at 0% (E0; S0, S7, S14, S28) or 0.045% (E45; S0e, S7e, S14e, S28e). Eighty steers (287 ± 31 kg BW) were stratified by weight and blocked into one heavy block and one light block per TRT (2 pen/TRT). Steers were fed for 70 d with titanium dioxide included in the final 14 d and fecal samples collected on d 70. Diets were balanced for post-ruminal AA and RDP based on available ME. Individual DMI was measured using a GrowSafe FI system. There was no difference ($P > 0.05$) in initial BW, final BW or ADG. The DMI was cubic ($P < 0.05$) due to DIET and was greatest for 7 and 28% SH. There was no difference ($P > 0.05$) in DMI due to ENZ or DIET \times ENZ. There was a DIET \times ENZ interaction ($P < 0.05$) for G:F in which S0, S0e, S14e and S28e were greatest ($P < 0.05$). The S14e and S28e were greater ($P < 0.05$) than S14 and S28, thus ENZ improved G:F in WSC diets with greater SH inclusion. There was no ENZ or DIET effect ($P > 0.05$) on any digestibilities except ADF in which E0 was greater ($P < 0.05$) than E45. The NDF digestibility tended to have a cubic response ($P = 0.1$) to DIET and was greatest for 7 and 28%. The only DIET \times ENZ interaction for digestibilities was nitrogen ($P < 0.05$). Fiber digestibility in WSC diets did not improve with SH inclusion or ENZ addition. Steers fed WSC diets containing 14–28% SH and 0.045% ENZ converted feed at the same rate as steers fed 100% WSC with no difference in ADG.

Key Words: digestibility, fermentation, soybean hulls

TH121 Doses of monensin in combination with virginiamycin in the diet of Nellore beef cattle in feedlot. J. M. B. Benatti*¹, J. A. A. Neto¹, I. Sokoloski², M. H. Moretti¹, P. Terencio³, F. D. Resende⁴, and G. R. Siqueira⁴, ¹Universidade Estadual Paulista-FCAV, Jaboticabal, São Paulo, Brazil, ²Universidade de São Paulo-EsAlq, Piracicaba, São Paulo, Brazil, ³Cargill, São Paulo, Brazil, ⁴Agência Paulista de Tecnologia dos Agronegócios, Alta Mogiana, Colina, São Paulo, Brazil.

In Brazil the use of antibiotics is common in total diets, but the combination of 2 additives is recent practice and little studied. This study aims to determine the dose of monensin in combination with virginiamycin in the diet of Nellore beef cattle in feedlot. The treatments consisted of a control diet and different doses of monensin (0, 10, 20 and 30 mg / kg DM) associated with virginiamycin (25 mg / kg DM). For this, we used 280 Nellore beef cattle, with initial body weight of 348.2 ± 29.07 kg, distributed in 35 pens with 8 animals each. A randomized complete block design was used (block as initial body weight) and considered the pen as repetition, being 7 per treatment. Data was analyzed using PROC MIXED procedure of SAS (version 9.0) and means were compared by orthogonal contrasts (control vs. virginiamycin; effect linear, quadratic and cubic within the dose of monensin), it was considered as statistically significant $P < 0.10$ and was explored trends $P < 0.20$. The virginiamycin provided alone improved feed efficiency by 12.9% during the adaptation period ($P < 0.10$) and tended to increase body weight ($P = 0.154$) and reduce dry matter intake ($P = 0.12$). As for the total period of confinement, virginiamycin increased carcass weight ($P = 0.06$) and tended to increase the final BW ($P = 0.10$) and ADG ($P = 0.16$). Monensin in combination with virginiamycin during adaptation had an increasing linear effect trend for feed efficiency ($P = 0.12$) and decreasing linear effect on body weight ($P = 0.01$), weight daily gain

($P = 0.01$) and dry matter intake ($P < 0.01$). Already in the total period of confinement, monensin caused decreasing linear effect for dry matter intake ($P = 0.03$), no adjustment of behavior for gain ($P = 0.642$), with an average 1.375 kg/day and increase linear effect for feed efficiency ($P = 0.01$). Virginiamycin increases carcass weight compared to the control treatment. The inclusion of monensin doses up to 30 mg/kg DM associated virginiamycin reduces consumption, does not alter weight gain and improves feed efficiency in Nellore beef cattle

Key Words: adaptation, additive combination, antimicrobial

TH122 Using near-infrared spectroscopy (NIRS) to predict the relationship between fecal starch concentration and feed efficiency for feedlot cattle. L. J. Jancewicz^{*1,2}, M. L. Swift¹, G. B. Penner², J. J. McKinnon², K. A. Beauchemin¹, and T. A. McAllister¹, ¹*Agriculture and Agri-Food Canada*, ²*University of Saskatchewan*.

This study evaluated the relationship between starch content of feces and feed efficiency (gain:feed; G:F) of feedlot cattle. A feedlot study was conducted using 160 crossbred beef steers (538 ± 35.6 kg) allocated to 1 of 4 finishing diets (4 pens/treatment, 10 steers per pen) in a 2×2 factorial treatment arrangement. Treatments differed in the type of cereal grain (barley vs. wheat) and processing index (PI) (75 vs. 85%). A lower PI indicates more extensive processing. Fecal samples were collected from the rectum of 5 steers from each pen every 28 d for 3 periods. Each period, the samples were pooled by pen, and dried and ground using a 1-mm sieve. A NIRS (Unity Spectrastar 2400 RTW) was used to predict fecal starch concentration using dried ground samples and using an equation developed from 144 fecal samples. Samples for the equation were sourced from previous studies that evaluated a wide range of dietary treatments and included total fecal collection from beef cattle. Barley processed to a PI of 85% resulted in 54.2% more starch in the feces than when processed to 75% ($P < 0.01$). For wheat, this increase was 63.7% ($P < 0.01$). Grain source had no effect on G:F, however, PI did have an effect on G:F ($P < 0.05$). There was no correlation between fecal starch concentration and G:F for the barley-based diets; however, for cattle fed wheat-based diets, a correlation was observed between starch and G:F ($r = -0.78$, $P < 0.05$). These data demonstrate the potential of using fecal material to predict G:F in feedlot cattle, but suggest the relationship is affected by the difference in response to processing between grain sources.

Key Words: NIR, feed efficiency, fecal starch

TH123 Annual energy requirements of Nellore cows, pregnant in different breeding seasons, in Brazilian savannah. A. L. B. Netto¹, J. C. Souza¹, H. J. Fernandes^{*2,1}, E. P. Rosa², B. D. D'Auria², A. Aguiar³, L. O. Tedeschi⁴, L. M. Surita², and L. M. Paiva², ¹*Federal University of Mato Grosso do Sul, Campo Grande, MS, Brazil*, ²*State University of Mato Grosso do Sul, Aquidauana, MS, Brazil*, ³*University of Florida, Gainesville*, ⁴*Texas A&M University, College Station*.

The objective of this research was to compare the energy requirements of beef primiparous cows (*Bos* sp.), that got pregnant in the spring of 2009 (November, at 13 mo age), or in the fall of 2010 (April, at 18 mo age). A total of 72 Nellore cows (36 in each group) were used. Cows were continuously grazing Xaraés grass (*Brachiaria brizantha* 'MG5') pastures in Brazilian savannah conditions. The animals were weighed without fasting in February, May, August and November of 2011, and in February of 2012. Energy requirements for maintenance were estimated using the weight of the animals. The birth date was used to estimate the date of pregnancy. The energy requirements for

pregnancy were estimated using information of the dates of pregnancy and parturition, and the average birth weight of calves on the farm. Milk production and composition were analyzed using 8 cows from each group and lactation curves were adjusted to estimate the energy requirements for lactation. Energy requirements were performed using equations proposed by the National Research Council (NRC, 2000) for beef cattle. Calves from the cows of the spring season were weaned in May (fall of 2011) and calves from the cows of the fall season, in August (winter of 2011). Data were analyzed according to a completely randomized design using PROC GLM of the SAS (SAS Institute Inc.). When compared with cows pregnant in spring, cows pregnant in the fall had higher nutritional requirement for maintenance (4028 and 3668 Mcal/year, $P < 0.001$), lower nutritional requirements for pregnancy (225 and 807 Mcal/year, $P < 0.001$), and similar nutritional requirements for lactation (981 and 938 Mcal/year, $P = 0.150$). The total annual energy requirements were lower for cows pregnant in the fall (5126 and 5413, $P < 0.001$) compared with cows pregnant in the spring, mainly due to the lower requirements for pregnancy. Cows pregnant in the autumn season (in April) will weaned a calf in the winter of the following year (in August), and will get pregnant again in the following spring (November), producing one less calf during their productive life.

Key Words: grazing, nutritional requirement, tropical

TH124 Interaction of corn distillers grain and monensin on site and extent of digestion in feedlot heifers. L. Xu^{*1,2}, Y. Jin¹, M. L. He², and W. Z. Yang², ¹*College of Food Science and Engineering, Inner Mongolia Agricultural University, Hohhot, Inner Mongolia, China*, ²*Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada*.

A digestion study was conducted to evaluate the effects of increasing corn distillers grain (DG) and monensin (M) on site and extent of digestion in feedlot heifers. Five ruminally and duodenally cannulated beef heifers were used in a 5×5 Latin square with $2 \times 2+1$ factorial arrangement. Treatments were control (CON; 10% barley silage, 90% barley-based concentrate, and 28 ppm M), and diets substituting 20% or 40% corn DG for barley grain combining with 28 or 48 ppm M. The CON is a standard feedlot diet in western Canada. Yb and ¹⁵N were used, respectively, as digesta and microbial marker. Contrasts were generated to compare CON vs. the average of DG; DG concentration (20 vs. 40%); and the M dosages (28 vs. 48 ppm). DMI (kg/d) tended ($P = 0.10$) to be greater with DG (8.8) than with CON (7.8) without difference between 20DG and 40DG, whereas it reduced ($P = 0.05$) by increasing M (9.4 vs. 8.2). Flow (kg/d) of OM to duodenum was less ($P < 0.01$) for CON (2.9) than for DG (4.0), and for 48M (3.5) than for 28M (4.5) with no difference between 20DG and 40DG (4.0). Ruminant OM digestibility was greater ($P < 0.01$) with CON (75%) than with DG diet (65%); greater ($P < 0.03$) with 20DG (68%) than with 40DG (62%); and greater ($P < 0.05$) with 48M (68%) than with 28M (63%). However, total digestibility (% of intake) of OM was not affected by treatments. Intake (g/d) of N was greater ($P < 0.01$) with DG (255) than with CON (148). Total N flow to duodenum (g/d) was higher ($P < 0.01$) with DG (215) than with CON (137), and reduced ($P < 0.05$) with increasing M (234 vs. 196). Microbial N production (averaged 100g/d) was not affected by treatments, whereas microbial efficiency was improved ($P < 0.04$) with 40DG versus 20DG (21 vs. 17 g/kg fermented OM). Rumen degradability of CP was greater ($P < 0.01$) with CON (72%) than with DG (58%), in contrast the total digestibility of CP was higher ($P < 0.01$) for DG (81%) than CON (72%). These results indicate that

manipulating the levels of corn DG in feedlot diets change DMI, site and extent of OM and CP digestibility. The effects of supplementing M above the industry recommendation on energy and protein supply to animal appear minimal.

Key Words: beef heifer, distillers grain, monensin

TH125 Carcass traits by male beef cattle finished in feedlot with sources of roughage and crude glycerin. A. F. Ribeiro*, J. F. Lage, A. J. Neto, R. A. Silva, L. G. Rossi, E. E. Dallantonia, L. M. Delevatti, G. M. Delamagna, M. B. Abra, M. O. Santana, and T. T. Berchielli, *São Paulo State University, Jaboticabal, SP, Brazil.*

The objective of this study was to evaluate the carcass traits of young bulls fed crude glycerin - 80% of glycerol. Ten percent of crude glycerin was used on concentrate in replacement of corn. Three sources of roughage: corn silage (T1), sugar cane (T2) and sugar cane bagass

(T3) were used at the inclusion level on the diet dry matter of 28, 27 and 17%, respectively. Diets were adjusted to contain 15% of NDF from roughage. Thirty Nellore young bulls with $416\text{Kg} \pm 24.68$ initial BW, were randomly assigned to 3 treatments, with 10 replicates during 90 d. Animals were slaughtered at 550.5 kg BW. The carcasses were weighed for obtained the hot carcass weight (HCW) and dressing percentage (DP). The carcasses were refrigerated for 24 h at 0°C and then rib fat thickness (RFT) and ribeye area (REA) were measured in the region between 12th and 13th rib. Data were analyzed using the GLM procedure of SAS and the treatments effects were considered significant at $P < 0.05$. No difference were detected ($P > 0.05$) for SBW (541.7; 564.4; 558.4 Kg), HCW (297.5; 310.4; 303.5 Kg), DP (54.86; 54.97; 54.37%), RFT (5.9; 4.2; 4.87mm) and REA (75.9; 80.24; 79.18cm²) among treatments T1, T2 and T3 respectively. The results suggested that animals fed with crude glycerin in diets with different roughages have similar carcass traits.

Key Words: corn silage, glycerol, Nellore