0727 Repeatability of residual feed intake across dietary forage concentration. M. J. Carrasquillo-Mangual*, E. Liu, and M. J. VandeHaar, *Michigan State University, East Lansing*.

Residual feed intake (RFI) has received considerable attention as a possible breeding goal in the near future. For RFI to be useful as a breeding goal, it should be repeatable for cows under different types of diets. Our objective for this study was to determine the repeatability of RFI across two levels of dietary forage NDF. Holstein cows in mid lactation were studied in winter (n = 32) and summer (n = 32). The study followed a crossover design with 2 treatment periods of 31 (winter) and 28 d (summer). Cows were milked twice daily and fed treatment diets once daily. Treatments were a high-forage–low-starch diet (HF; 36% NDF and 19% starch) and a low-forage–high-starch diet (LF; 26% NDF and 32% starch). Forage composed 70% of the DM in the HF and 47% in the LF. Dry matter intake and milk yield were recorded daily. Body weight was measured 3x weekly and milk composition was measured for 4 consecutive milkings each week. Body condition score was measured at the beginning and end of each experimental period. Statistical analysis was performed using the GLM procedure (SAS 9.4). An RFI value was obtained for each cow under each treatment; cows were ranked using SD of the RFI value as HRFI (greater than +0.5 SD), MRFI (±0.5 SD) or LRFI (less than −0.5 SD). A group rank was established for all cows under each treatment diet. The HF decreased DMI by 2.5 kg/d and milk yield by 3 kg/d when compared with the LF. Body weight changed by 0.4 kg/d on the LF but 0.2 kg/d on the HF. Fat yield, BW, and BCS were not altered by treatments. The decrease in DMI as well as the difference in energetic density of the diet could explain the differences observed in production performance as there was no significant difference in energy partitioned toward milk production. The RFI ranking was relatively repeatable (r = 0.44). Of all animals, 48% maintained their group ranking across treatments whereas 47% changed ranking by 1 group. Only 5% moved in the ranking from the HRFI to the LRFI group or vice versa. In conclusion, although intake, production, and energy partitioning were significantly altered by dietary treatments, RFI was relatively repeatable across these diets. Therefore, genomic breeding values of RFI estimated from cows fed a high-starch diet should still be useful when animals are fed more forage and less starch.

Key Words: dairy cow, residual feed intake

ADSA PRODUCTION DIVISION GRADUATE STUDENT ORAL COMPETITION: PHD

0728 Effects of supplementing rumen-protected methionine on lactational performance of Holstein dairy cows during early and mid lactation. M. A. Fagundes*[1], S. A. Blaser[2], S. Y. Yang[2], J. S. Eun[1,2], and J. O. Moon[3], *[1]School of Veterinary Medicine, Utah State University, Logan, [2]Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan, [3]CJ CheilJedang Research Institute of Biotechnology, Suwon, the Republic of Korea*.

Supplementing rumen-protected methionine (RPMet) has been shown to maintain milk and milk protein yields when dietary MP is decreased by 5% due to its direct impacts on milk protein synthesis in the mammary gland. The present study investigated production responses of lactating dairy cows to RPMet supplementation in suboptimal protein (SOPD; 15.5% CP) and normal protein diet (NPD; 16.5% CP). Eight lactating dairy cows (53 d in milk, on average) were blocked by parity and days in milk, and the experiment was performed in a duplicate 4 × 4 Latin square design. Within each square, cows were randomly assigned to a sequence of 4 diets during each of the four 21-d periods (14 d of treatment adaptation and 7 d of data collection and sampling). A 2 × 2 factorial arrangement was used; SOPD or NPD was combined without or with RPMet: SOPD without RPMet, SOPD with RPMet (S+Met), NPD without RPMet, and NPD with RPMet (N+Met). An experimental RPMet product from CJ CheilJedang (Suwon, the Republic of Korea) was supplemented in the S+Met and the N+Met at 30 g/cow per day. Supplementation of RPMet did not affect DMI (25.4 kg/d) and milk yield (40.6 kg/d). Supplementing RPMet resulted in a similar milk true protein concentration (2.80%) with a numerical increase in milk protein yield at 3.6%. In contrast, supplementing RPMet increased milk fat concentration (P = 0.02) and yield (P = 0.03) and 3.5% fat-corrected milk (FCM) yield (P = 0.05) and tended to increase energy-corrected milk (ECM) yield (P = 0.06) regardless of CP level. In addition, trends were observed for increased 3.5% FCM yield/DMI (P = 0.09) and ECM yield/DMI (P = 0.10), and the positive effects were greater under NPD than SOPD, resulting in trends toward interaction between CP and RPMet (P = 0.06). Overall results in the current study suggest that supplementing RPMet in SOPD and NPD improved milk fat concentration, possibly due to increases in apolipoprotein and phospholipid syntheses in the liver, leading to an increase in fatty acid supply to the mammary gland via very-low-density lipoproteins.

Key Words: feed efficiency, lactational performance, rumen-protected methionine

0729 Effect of dextrose and purified starch at two levels of rumen degradable protein on lactation performance and enteric methane emission in dairy cows. F. Sun*, M. J. Aguerre, and M. A. Wattiaux, *University of Wisconsin-Madison, Madison*.

The objective of this study was to evaluate the effect of source of nonfiber carbohydrate (NFC) at two levels of rumen degradable protein (RDP) in the diet on lactation performance and enteric methane (CH_4) emission. In addition, hourly CH_4 emission rate relative to time of feeding was studied. Eighteen Holstein cows (mean ± SD; 148 ± 10 d in milk and 644 ± 41 kg BW) housed in a tie-stall barn were used in a split plot study. Cows were randomly assigned to either (DM basis) 11 (11-RDP) or 9% RDP (9-RDP) diets as whole plot. To lower diet RDP, soybean meal was partially replaced with expeller soybean meal and blood meal. Subplot treatments, which were allocated in three 3 × 3 Latin squares (28-d period) were (DM basis) 10% dextrose (DX), 5% dextrose and 5% purified starch (DX-ST), and 10% purified starch (ST). Cows were fed a total mixed ration with 61% forage and 39% concentrate, with approximately 16.5% CP and 45.5% NFC, once daily and milked twice daily. During wk 3 of each period, enteric CH_4 emission was measured at 1, 2.5, 4, 5.5, 10, 11.5, 13, 14.5, 16, 17.5, and 22.5 h after feeding, over a 4-d interval with GreenFeed (C-lock Inc., SD). The SAS mixed procedure with Tukey option was used to analyze the data. There was no NFC × RDP interaction ($P > 0.05$), and therefore, main effects are presented in table below. Cows fed 9-RDP had greater yield of fat–protein corrected milk (FPCM), milk (37.4 vs. 34.8 kg/d), milk fat (1.57 vs. 1.44 kg/d), and lactose (1.80 vs. 1.63 kg/d) compared with cows fed 11-RDP. Cows fed ST had lower DMI, greater feed efficiency (FPCM/DMI), and lower enteric CH_4 emission than cows fed DX and DX-ST. The hourly CH_4 emission rate was lower for the 22.5-h sampling time compared with all others (15.9 ± 2.8 vs. 20.1 ± 4.9 g/h). Dietary treatments did not influence CH_4/DMI (20.0 ± 3.5 g/kg) or CH_4/FPCM (13.1 ± 2.6 g/kg). In conclusion, the level of RDP did not influence the responses to the source of NFC in the diet. Compared with dextrose as a source of NFC, starch reduced DMI, increased feed efficiency, and reduced daily CH_4 emission.

Key Words: feed efficiency, greenhouse gas, nonfiber carbohydrate

0730 Influence of mixed cropping of corn and soybean with different seeding rates on forage yield, quality, and nutrient yield grown under organic condition. I. P. Acharya*[1], X. Gu[2], and D. P. Casper[1], *[1]Dairy Science Department, South Dakota State University, Brookings, [2]Deparment of Plant Science, South Dakota State University, Brookings*.

A field plot study was laid out using a randomized complete block design with three replicates to evaluate two organic corn hybrids (MC 5300 [N] and MasterGraze [MG]) with two soybeans (Viking 2265 [R] and Vining [V]) at four seeding rates (R1 = 65:35, R2 = 55:45, R3 = 45:55, and R4 = 35:65 of corn:soybean) in terms of forage yield, nutrient yields, and quality. Forage was hand harvested 101 (MG corn with both soybeans) and 116 d (N corn with both soybeans) after planting during 2015 season, inoculated, packed into buckets, weighed, and ensiled for 90 d. Buckets were then reweighed and opened and forage samples were collected and analyzed for nutrient composition. The main effect of corn for DM yield (DMY) was greater ($P < 0.05$) for N compared with MG (27.73 and 19.90 T/ha for N and MG, respectively), whereas the main effect of soybean for DMY was similar ($P > 0.05$; 23.77 and 23.86 T/ha for R and V, respectively). Main effect of seeding rate on DMY was higher ($P < 0.05$) for R1 and R2 compared with R3 and R4 (25.38, 24.48, 21.81, and 23.59 T/ha for R1, R2, R3, and R4, respectively). Yields of digestible DM (DDM; 19.55 and 13.67 T/ha) and CP (2.40 and 2.12 T/ha) were greater ($P < 0.05$) for N corn compared with MG corn, similar ($P > 0.05$) for both soybean (DDM: 16.65 and 16.57 T/ha and CP: 2.33 and 2.19 T/ha for R and V, respectively) and higher ($P < 0.05$) DDM for R1 and R2 compared with R3 and R4 (17.70, 17.08,15.13, and 16.54 T/ha for R1, R2, R3, and R4, respectively). Yield of starch (7.78 and 2.45 T/ha for N and MG) and 30-h NDF digestibility (NDFD30; 44.47 and 52.49% for N and MG) for main effect of corn were different ($P < 0.05$), whereas they were similar ($P > 0.05$) for the main effect of soybean (starch yield: 5.25 and 4.98 T/ha and NDFD30: 48.58 and 48.38% for R and V, respectively). The combination of N corn with either R or V soybean at the ratio of R1 or R2 resulted in the greatest yield of DM, DDM, and starch. A forage blend produced through mixed cropping of corn and soybeans holds a great potential for increasing the forage and nutrient yields to meet the nutrient requirements of lactating dairy cows.

Key Words: corn, forage, soybean

0731 Association between circulating progesterone during the luteal phase and estrous activity detected by automated activity monitoring in dairy cattle. J. Denis-Robichaud*[1], S. J. LeBlanc[1], A. Jones-Bitton[1], and R. L. A. Cerri[2], *[1]Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada, [2]Applied Animal Biology, Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC, Canada*.

The objective of this study was to evaluate the association between circulating progesterone (P4) concentration during the luteal phase (LP) and estrous activity detected by automated activity monitoring. The hypothesis was that a shortened LP would decrease the intensity of estrus expression. A total of 48 cows at the UBC Dairy Center were assigned to one of two treatments: a short (n = 23) or a normal P4 (n = 25) LP. The short LP was achieved by injecting 25 mg of prostaglandin F2α at d 7 of the cycle; normal LP cows were not treated. Ultrasound of the reproductive tract was performed at Day 0, 2, 5, 7, 9, and 11 of the cycle and then daily until ovulation to identify and measure the dominant follicle. Blood samples were taken on the same days to measure serum P4. Cows were equipped with two activity monitoring devices: Heatime HR System (SCR, Israel) and SmartDairy (BouMatic, United States). The peak activity score (Heatime), peak of relative activity (%; SmartDairy) and duration of the estrus (both systems) following the LP were recorded. Linear regression models were used to calculate marginal means (least squares means ± SEM). As expected, P4 at d 14 of the cycle differed between the short and normal LP (2.9 ± 0.4 vs. 7.6 ± 0.4 ng/mL, respectively; $P < 0.01$). The number of estrus events detected was not different between treatment groups for Heatime (short: n = 15; normal: n = 20; P = 0.25) or for SmartDairy (short: n = 15; normal: n = 16; P = 0.93). Using the Heatime system, the peak activity score differed between the short and normal LP groups (73.3 ± 4.0 vs. 84.3 ± 3.5; P = 0.05) and the duration of estrus tended to differ (10.8 ± 1.0 vs. 13.1 ± 0.9 h; P = 0.09). Using the SmartDairy system, neither the peak activity (434 ± 39 vs. 465 ± 38%; P = 0.57) nor the duration of estrus (8.0 ± 1.2 vs. 10.0 ± 1.2 h; P = 0.25) differed. There was no difference in serum P4 concentration (0.89 ± 0.14 vs. 0.95 ± 0.13 ng/mL; P = 0.75) or in ovulatory follicle size (18.7 ± 1.4 vs. 18.1 ± 1.4 mm; P = 0.78) on the day of estrus. The number of cows that ovulated was not different between short and normal LP groups (short: n = 14; normal: n = 18; P = 0.41). The shortened LP moderately reduced the intensity of estrus expression but did not affect ovulatory follicle size or ovulation. Decreased LP duration or peak circulating concentration of P4 may reduce the intensity of estrus-related activity.

Key Words: automated activity monitoring system, estrus detection, luteal phase

0732 Effect of prepartum physical activity on behavior and immune competence of dairy cows. R. A. Black*, G. M. Pighetti, and P. D. Krawczel, *University of Tennessee, Knoxville*.

The objective was to determine the effect of prepartum exercise, pasture turnout, or total confinement on activity and immune competence of dairy cows. Sixty pregnant, nonlactating cows were assigned to control (19 Holstein and 1 Jersey × Holstein), exercise (19 Holstein and 1 Jersey × Holstein), or pasture (20 Holstein) treatments using rolling enrollment from Jan. to Nov. 2015 at dry-off. Cows were balanced by parity (1.8 ± 0.9), projected ME fat-corrected milk yield (13,831 ± 2,028 kg/lactation), and projected due date. Cows were housed in a naturally ventilated, 4-row deep-bedded sand freestall barn at the University of Tennessee's Research Unit (Walland, TN). Cows were moved to a maternity pen with a rubber mattress to calve. Fitted 3 d before dry-off, accelerometers determined lying time (h/d), lying bouts (number/d), lying bout duration (min/bout), and steps (number/d) at 1-min intervals. Data were averaged by four periods relative to actual calving date: −58 to −15 d (FO), −14 to −1 d (CU), d 0 (CA), and 1 to 14 d (PP). Exercise was done on five consecutive days per week for 1.4 ± 0.1 h/d (targeted 1.5 h/d), at a pace of 1.88 ± 0.58 km/h. Pasture turnout occurred on a grassy paddock five consecutive days per week for 1.8 ± 0.3 h/d (targeted 1.5 h/d). Control cows remained in the home pen throughout the dry period. Blood was sampled on d −3 and 42, relative to dry-off, to assess immune competence via ROS generation using PMA. A mixed model determined the effects of treatment, period, and treatment × period on daily lying behavior and steps and the effect of treatment, day, PMA level, and their interactions on ROS generation. Cow within treatment was the random variable. Exercise cows lay down less frequently at CA (11.6 ± 1.0 bouts/d) compared with control cows (14.6 ± 0.9 bouts/d; P = 0.03). However, lying bout duration and lying time did not differ among treatments at CA ($P > 0.31$). Exercise cows were more active at FO, CU, and CA (2,895.4 ± 107.6, 2,614 ± 125.2, and 2,824.6 ± 224.4 steps/d, respectively) than control (1,788.8 ± 103.9, 1,840.8 ± 120.7, and 1,969.3 ± 216.2 steps/d) and pasture (2,132.0 ± 103.6, 1,951.6 ± 120.9, and 2.234.9 ± 216.3 steps/d; $P < 0.01$). ROS production was not affected (P = 0.63). Exercised cows took more steps but had fewer lying bouts around calving, suggesting more comfort during calving. Furthermore, physical activity did not alter immune competence. Prepartum exercise may be a viable management strategy to improve calving performance.

Key Words: dairy cow, immune competence, physical activity

0733 Associations between preventive hoof trimming, activity, and resting behaviors. G. Stoddard*[1] and G. Cramer[2], *[1]University of Minnesota Twin-Cities, Saint Paul, [2]Department of Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, St. Paul*.

Hoof trimming is a commonly recommend practice to prevent lameness, one of the dairy industry's biggest animal well-being and economic issues. Unfortunately, limited scientific data exists to support our current hoof trimming (HT) practices and what affects HT has on cow behavior. The objective of this research is to determine the association between HT of non-lame cows and activity and resting behaviors. A convenience sample of farms from the United Kingdom and Canada were recruited to participate. Selection criteria required that farms used free-stall housing, have a regular hoof trimming schedule, and use either Afi PedoPlus or AfiACT2 (Afimilk, Ltd.) pedometers. Activity, milk yield, resting time, and resting bout information was collected daily at the time of milking. Hoof trimming data was collected from on farm records. The association between activity, resting behaviors, and HT was evaluated by comparing the averages of the behavior parameter at different time points before and after HT. Time periods evaluated included 1 to 10 d before HT; day of HT; and 2 to 3, 4 to 7, and 8 to 10 d after HT. Models were created using linear regression with behavior as the outcome variable and including the fixed effects of farm, lactation number, milk yield, and days in milk. Time period was forced into each model and a robust SE was used to account for repeated measures. A total of 1,393 cows were used in the analysis with average days in milk, lactation, and milk yield being 182, 1.9, and 33.6 kg/d, respectively. Activity and resting bouts were associated with every time period except for on the day after HT. Resting time was positively associated with all time periods after HT. Resting time increased from 21 to 27 min/d between 1 and 10 d after HT. Activity between 2 and 10 d after HT decreased by a minimum of 20 steps/h and reached a maximum decrease of 27 steps/h. Resting bouts increased from 0.2 to 0.4 bouts between 2 and 10 d after HT. These results show that the HT process is associated with changes in activity, resting time, and resting bouts of the cow during the 10 d following HT. This indicates that there is an adjustment phase either due to the actual HT or due to the disruption of the cow's daily routine during the HT process.

Key Words: activity, hoof trimming, rest

0734 Enhanced preweaning nutrition increases mammary gland development without negatively affecting tissue composition in Holstein heifer calves. A. J. Geiger*[1], R. M. Akers[1], and C. L. M. Parsons[2], *[1]Virginia Tech, Blacksburg, [2]Virginia Polytechnic Institute and State University, Blacksburg*.

We have reported that enhanced feeding of prepubertal Holstein heifer calves increased mass of mammary parenchyma (PAR; 7.9x) and mammary fat pad (MFP; 5.3x). Our objective was to measure fat, protein, and DNA content of PAR and MFP in restricted- and enhanced-fed calves with or without estrogen. For 8 wk, 36 Holstein heifer calves received 1) a control milk replacer (MR) fed at 454 g powder/d (R; 20% CP and 20% fat) or 2) an enhanced MR fed at 1,135 g powder/d (E; 28% CP and 25% fat). At weaning a subset of calves were sacrificed (n = 6/diet). Remaining calves received E_2 implants and were sacrificed at wk 10. Treatments were 1) R, 2) R + E_2 (R-E2), 3) E, and 4) E + E_2 (E-E2). At sacrifice, udder haves were removed and snap frozen. Dissected MFP and PAR were analyzed for fat, protein, and DNA (Daniels et al., 2009). At weaning, E-fed calves had greater MFP protein (2.11 vs. 0.46 g; $P < 0.01$), DNA (22.1 vs. 4.5 mg; $P < 0.01$) and fat (116 vs. 3.3 g; $P < 0.01$). R-fed calves had increased MFP protein concentration (15.6 vs. 12.2 mg/g; $P < 0.01$), but MFP DNA concentration was not different. E-fed calves had increased PAR total protein (1.36 vs. 0.20 mg; $P < 0.01$) and DNA (20.4 vs. 2.7 mg; $P < 0.01$). After estrogen administration, E-E2 calves had more MFP total protein ($P < 0.01$) and fat ($P < 0.01$) and greater fat concentration ($P < 0.01$) than all other treatments. Calves fed E-E2 had greater MFP total DNA than R and R-E2 calves ($P < 0.01$) but not E-fed calves. In addition, E-E2 calves had greater PAR total protein ($P < 0.01$) and DNA ($P < 0.01$) compared with all other treatments. Even further, E-E2 calves had increased total PAR fat compared with R-E2 calves ($P < 0.02$) and R-fed calves had decreased PAR fat content compared with all other treatments ($P < 0.01$). Results reinforce that composition of MFP is nutrient responsive. Moreover, data indicate that the impact of an enhanced diet on PAR tissue composition is likely positive, but more research is needed to determine if observed results would correlate to altered future milk yield.

Key Words: mammary gland, milk replacer, parenchyma

0735 Effects of fuels derived from starch digestion on feeding behavior of cows in the postpartum period. L. B. Gualdron-Duarte* and M. S. Allen, *Michigan State University, East Lansing*.

Absorbed fuels from the digestion of starch include propionic acid (P) produced by ruminal fermentation and glucose (G) from intestinal digestion that is partially metabolized to lactic

acid (L). Our objective was to evaluate effects of these fuels on DMI and feeding behavior of cows in the postpartum period. We hypothesized that effects of these fuels on DMI and ME intake (MEI) are consistent with their ability to stimulate hepatic oxidation. Little or no G is extracted from blood by the liver. Although both L and P are anapleurotic and can stimulate oxidation of acetyl CoA, hepatic extraction of P is greater than L, which depends on cytosolic redox state. Continuous isoenergetic (150 kcal/h) infusions of P, L, or G were abomasally administered to eight rumen-cannulated multiparous Holstein cows (12.4 ± 6.2 DIM) in a duplicate 4 × 4 Latin square design experiment balanced for carryover effects. Treatment sequences were randomly assigned to cows. Treatments were control (C; no infusion) and P (99.5%; 0.41 mol/h), L (88.0%; 0.46 mol/h), and G (99.9%; 0.22 mol/h) infused at 500 mL/h for 22 h/d and providing 3.3 Mcal/d. Feeding behavior was recorded by a computerized data acquisition system. Gross energy digestibility of the diet was determined for each cow and used to calculate MEI from the diet. Total MEI was calculated as the sum of MEI from the diet plus energy from infusions. Data were analyzed by ANOVA; the model included random effects of block, cow within block, and period within block and fixed effects of treatment. Treatments were compared with C by preplanned contrasts. Propionic acid decreased DMI by 24.3% (14.3 vs. 18.9 kg/d; $P < 0.001$) and MEI 13.4% (34.8 vs. 40.2 Mcal/d; $P < 0.04$) compared with C by tending to decrease meal frequency ($P = 0.087$). Lactic acid decreased DMI by 13.8% (16.3 vs. 18.9 kg/d; $P < 0.05$) compared with C by decreasing meal size 19.8% ($P < 0.05$) but did not affect MEI. Glucose infusion did not affect DMI or MEI. Treatment effects on DMI and MEI were consistent with their expected effects on hepatic oxidation. Propionic acid production from highly fermentable diets might reduce energy intake of cows in the PP period.

Key Words: anapleurosis, fresh cows, hepatic oxidation

0736 Fetuin-A: A novel biomarker for lipolysis-induced metabolic stress in transition dairy cows.

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Periparturient cows that experience severe adipose tissue lipolysis are at a higher risk for inflammatory and metabolic diseases. Fetuin-A (FetA) is a glycoprotein that inhibits insulin signaling and enhances inflammatory responses in adipose tissues, which are known to exacerbate lipolytic responses in humans and rodents. However, little is known about its role during lipolysis and its use as a biomarker for metabolic stress and lactation performance in dairy cows. Our objective was to determine the dynamics of serum and adipose FetA concentrations and its association with metabolic markers during negative energy balance (NEB)–induced lipolysis at different stages of lactation. In Experiment 1, 26 multiparous cows were followed through the transition period. Blood samples and subcutaneous adipose tissue were collected at dry-off (DO; −51 ± 3 d), close-up (CU; −14 ± 2 d), and early lactation (EL; 7 ± 0.5 d). In Experiment 2, FetA response to lipolysis was evaluated independently of parturition-associated metabolic challenges using midlactation cows (119–210 DIM) assigned to one of two feeding protocols: ad libitum (AL; $n = 3$; +EB = 3.2 ± 0.66 Mcal/d) or feed restricted (FR; $n = 3$; EB = −13.3 ± 0.5 Mcal/d). Blood and subcutaneous adipose tissue were collected after a 4-d period of feed restriction. FetA was determined by ELISA and western blot. Data were analyzed using a repeated measures mixed model. Serum and adipose FetA concentrations were affected by lactation stage. In Experiment 1, serum FetA concentrations were lower at EL (DO: 1.31 ± 0.06 mg/mL; CU: 1.27 ± 0.09 mg/mL; and EL: 1.14 ± 0.06 mg/mL; $P < 0.05$) when NEFA concentration was greatest (DO: 0.34 ± 0.02 mEq/L; CU: 0.63 ± 0.2 mEq/L; and EL: 1.19 ± 0.14 mEq/L; $P < 0.05$). Unlike in serum, adipose FetA expression decreased at CU (relative band density; DO: 1.5 ± 0.4; CU: 0.2 ± 0.02; EL: and 1.6 ± 0.6; $P < 0.05$). Circulating FetA concentration was higher in overconditioned dry cows (BCS ≥ 3.75; $P < 0.05$) and was positively associated with BCS ($R^2 = 0.24$, $P < 0.0001$) and BCS loss ($R^2 = 0.43$, $P = 0.0005$) during the transition period. Cows with high BCS and increased serum FetA concentrations at DO had lower serum glucose concentrations at EL ($P < 0.05$). In Experiment 2, despite the feed restriction-induced lipolysis (NEFA; FR = 0.47 ± 0.05 mEq/L and AL = 0.09 ± 0.08 mEq/L), neither serum nor adipose FetA concentrations were affected in midlactation cows ($P > 0.05$). These results demonstrate that serum and adipose FetA concentrations during lipolytic states are determined by lactation stage and BCS around parturition. Fetuin-A is a potential novel biomarker for metabolic stress induced by lipolysis during the transition period. Future work will determine the mechanisms by which FetA affects lipolytic and inflammatory responses in adipose tissues of transition dairy cows.

Key Words: adipose, biomarker, lipolysis

0737 The effect of trace mineral source and fiber source on total-tract nutrient digestion.

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Excess rumen soluble Cu and Zn can reduce fiber digestion and alter rumen microbial populations. Substitution of forage with nonforage fiber sources (NFFS) can be economically beneficial, but the reduction in particle size can decrease rumen pH, increase fiber passage rates, and decrease fiber digestion. Eighteen multiparous cows were used in a split-plot replicated Latin square with two 28-d periods to evaluate the effects of Cu, Zn, and Mn source (sulfates or hydroxy;

Micronutrients Inc., Indianapolis, IN) and dietary NDF source (forage diet = 26% NDF vs. NFFS = 36%) on total-tract nutrient digestibility. We hypothesized that hydroxy trace minerals, which are soluble at a lower pH compared with sulfates, would increase digestibility regardless of fiber source. During the entire experiment (56 d), cows remained on the same fiber treatment but the source of supplemental trace mineral was different for each 28-d period so all cows were exposed to both mineral treatments. During each of the two 28-d periods, cows were fed no supplemental Cu, Zn, or Mn for 16 d followed by 12 d of feeding supplemental Cu, Zn, and Mn from either sulfates or hydroxy sources. Basal Cu, Zn, and Mn concentrations for the forage diet were 9, 30, and 38 mg/kg, respectively, whereas basal concentrations were 11, 50, and 47 mg/kg, respectively, for the NFFS diet. Supplemental concentrations of Cu, Zn, and Mn fed were approximately 9, 30, and 30 mg/kg, respectively. No mineral source × fiber interactions were observed for production measures or digestibility. Treatment had no effect ($P \geq 0.38$) on DMI (24.2 kg) or milk production (34.9 kg). Mineral source had no effect on macronutrient intakes ($P \geq 0.63$), but feeding hydroxy Cu, Zn, and Mn increased NDF digestibility (48.5 vs. 46.4%). Cows fed NFFS had decreased DM digestibility (65.9 vs. 70.2%), OM digestibility (67.4 vs. 71.7%), CP digestibility (58.8 vs. 62.1%), and starch intake (4.3 vs. 8.8 kg) and increased starch digestibility (97.5 vs. 96.3%), NDF intake (8.6 vs. 6.0 kg), and NDF digestibility (50.5 vs. 44.4%) compared with cows fed the forage treatment. Digestible OM (DOM) was reduced (62.0 vs. 66.8%) for cows fed NFFS compared with those fed forage, indicating a reduced concentration of DE. Mineral source did not affect DOM ($P = 0.32$). Replacing dietary forage with NFFS reduced dietary energy and although hydroxy minerals increased NDF digestibility, the effect was not great enough to influence DOM.

Key Words: fiber, total-tract nutrient digestion, trace minerals

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0738 Economic value of cooling dry cows across the United States. F. C. Ferreira*[1,2], A. De Vries[2], G. E. Dahl[2], and R. Gennari[2], [1]*Embrapa Gado de Leite, Juiz de Fora, Brazil,* [2]*Department of Animal Sciences, University of Florida, Gainesville*.

Heat stress during the dry period reduces milk yield in the next lactation. Our objectives were to quantify the economic losses due to heat stress of dry cows and to evaluate investment in cooling of dry cows. We used weather data from The National Oceanic and Atmospheric Administration to quantify the average amount of heat stress for the 48 contiguous U.S. states. A heat stress day was declared when the average daily temperature–humidity index was ≥68. A spreadsheet was developed for economic analyses. Assumptions were that 15% of the cows were dry at any time, the dry period length was 46 d, and only cows in parities ≥2 increased milk yield if cooled in the dry period. Milk yield decreased by 0.11 kg/d in the next lactation (305 d) per heat stress day in the dry period based on a review of the literature. Marginal decrease in DMI was 0.4 kg per 1 kg less milk. Marginal value of milk minus feed cost was $0.33/kg. Economic analysis included investment in fans and soakers and use of water and electricity. Building investment was considered separately at a price of $2,500 per stall. On average, a U.S. dairy cow is under heat stress 96 d during the year and loses 271 kg of milk in the subsequent lactation if not cooled when dry. Weighted by the number of cows in each state, annual losses would be $820 million if dry cows were not cooled ($89/cow per year). For the top 3 milk-producing states (California, Wisconsin, and New York) and Florida, the average milk loss in the next lactation was 316, 212, 234, and 726 kg and profit loss/cow per year were $104, $70, $77, and $238, respectively. The average benefit:cost ratio of cooling dry cows in the United States is 2.46 (dry cow building already present) and 1.59 (including building a dry cow barn) in the baseline scenario. For positive net present values, 18 and 27 d are necessary when a building is not built (considering marginal milk prices of $0.33 and $0.22, respectively). If a barn is built, minimum days of heat stress would be 47 and 69, respectively. Other benefits of dry cow cooling, such as increased health and more productive offspring, were not considered. In conclusion, cooling of dry cows was profitable in all 48 states and very profitable in most states.

Key Words: dry cows, economics, heat stress, temperature–humidity index

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0739 Palmitic acid feeding increases hepatic ceramide accumulation and modulates expression of genes responsible for ceramide synthesis in midlactation dairy cows. J. E. Rico*, A. T. Mathews, and J. W. McFadden, *West Virginia University, Morgantown*.

Circulating sphingolipid ceramides are associated with elevated NEFA availability and reduced insulin sensitivity in dairy cows transitioning from gestation to lactation. In monogastrics, palmitic acid (C16:0) can increase hepatic synthesis and lipoprotein secretion of ceramides, lipid mediators that inhibit insulin action in skeletal muscle. Increasing ceramide synthesis by feeding C16:0 may be a means to restore insulin resistance and enhance milk yield during midlactation. Therefore, our objective was to determine whether dietary C16:0 can augment liver and skeletal muscle ceramide concentrations in midlactation dairy cows. Twenty multiparous Holstein cows were enrolled in a study consisting of a 5-d covariate and a 49-d treatment period. Cows were randomly assigned to a sorghum silage–based diet containing no supplemental fat (control; $n = 10$; 138 ± 45 DIM) or C16:0 at 4% of ration DM (PALM; 98% C16:0; $n = 10$; 136 ± 44 DIM). Blood was routinely collected, and liver and skeletal muscle tissue was biopsied at d 47 of treatment. Intravenous glucose

tolerance tests (GTT) were performed at d −1, 21, and 49 relative to start of treatment. Tissue concentrations of sphingolipids were determined using liquid chromatography tandem mass spectrometry. Expression of ceramide synthesis genes was evaluated using real-time PCR. Data were analyzed under the generalized linear model. Pearson correlations were analyzed. The most abundant liver and muscle sphingolipids detected were C24:0-ceramide, C24:0-monohexosylceramide (GlcCer), and C16:0-lactosylceramide (LacCer). Relative to control, PALM increased C24:0-ceramide and total hepatic ceramide levels by 29 and 20%, respectively, at wk 7 ($P < 0.05$); a response not observed in muscle. Similarly, PALM increased hepatic C22:0-, C22:1-, C24:1-, and C26:0-ceramide at wk 7. PALM increased C16:1- and C24:1-GlcCer in liver ($P < 0.05$). Plasma total ceramide and C24:0-ceramide were positively associated with hepatic total ceramide and C24:0-ceramide ($r = 0.63$ and $r = 0.58$, respectively, $P < 0.05$). Hepatic total ceramide and C24:0-ceramide were positively associated with plasma NEFA ($r = 0.63$ and $r = 0.57$, respectively, $P < 0.001$) and negatively associated with NEFA disappearance during GTT ($r = -0.57$ and $r = -0.65$, respectively, $P < 0.001$). Ceramide synthase-6 (CerS6) was the predominant hepatic CerS isoform followed by CerS2 and CerS5. Surprisingly, PALM decreased CerS2 and CerS5 mRNA and sphingomyelinase mRNA by 35, 36, and 62%, respectively ($P < 0.05$). We conclude that feeding midlactation dairy cows C16:0 can increase hepatic ceramide accumulation and generate hepatic ceramide profiles that are similar to circulating ceramide. Our work also demonstrates a possible relationship between hepatic ceramide supply and adipose tissue insulin sensitivity.

Key Words: ceramide, insulin resistance, lactation

0740 Assessment of performance, oxidative stress status, and plasma amino acid profiles in peripartal dairy cows supplemented with rumen-protected methionine or choline and with different liver functionality indices. Z. Zhou*[1], M. Vailati Riboni[1], E. Trevisi[2], D. N. Luchini[3], and J. J. Loor[1], *[1]University of Illinois, Urbana, IL, [2]UniversitaÂ Cattolica del Sacro Cuore, Piacenza, Italy, [3]Adisseo S.A.S., Alpharetta, GA*.

Objectives were to evaluate performance, oxidative stress status, and plasma AA profiles of peripartal dairy cows with different liver functionality indices (LFI). Forty multiparous Holstein cows were randomly assigned to control (CON), no methionine (MET) or choline (CHO), CON+MET, CON+CHO, and CON+MET+CHO treatments. Cows received the same diet (1.52 Mcal/kg DM) from −21 d (close-up) to calving. Cows were on the same diet (1.71 Mcal/kg DM) after calving and continued to receive the same treatments through 30 d. Blood samples were taken at −30, −10, 4, 14, and 28 d relative to calving. Liver samples were harvested at −10, 7, 20, and 30 d relative to calving. Methionine supplementation was adjusted daily at a rate of 0.08% (DM basis) of diet and CHO was supplemented at 60 g/cow per day. Main effect of LFI was analyzed using PROC MIXED in SAS. The LFI is an index assessing transition cow metabolic health by measuring changes in plasma albumin, cholesterol, and bilirubin. A high LFI (better liver function) is characterized by lower bilirubin and higher cholesterol and albumin, and the opposite is true for low LFI. Cows were ranked retrospectively and assigned to low (L; LFI < 0), medium-low (ML; 0 < LFI < 1.5), medium-high (MH; 1.5 < LFI < 3), and high (H; LFI > 3) groups according to LFI regardless of MET or CHO supplementation. Most (13/20) of the MET cows fell into the MH and H groups, whereas CHO cows were evenly distributed across the 4 LFI groups. Close-up and lactation DMI, milk yield, and protein yield increased ($P < 0.01$) with higher LFI. Compared with L and ML, cows in MH tended ($P = 0.08$) to have greater total and reduced hepatic glutathione concentration. Similarly, compared with L, plasma paraoxonase was greater ($P = 0.04$) in MH and H, suggesting better oxidative stress status in cows with higher LFI. A main effect of LFI was detected for essential AA ($P < 0.01$) and branched-chain AA ($P = 0.04$) concentration due to increased ($P < 0.05$) concentration of methionine, lysine, histidine, arginine, tryptophan, valine, leucine, and isoleucine with higher LFI. Concentrations of serine, asparagine, proline, alanine, tyrosine, citrulline, and ornithine also increased ($P < 0.05$) with higher LFI and contributed to greater ($P < 0.05$) total AA concentration. Overall, results indicate that cows with higher LFI had improved production performance, a reduction in oxidative stress, and a better plasma AA profile.

Key Words: amino acid, liver functionality index, transition cow

ADSA PRODUCTION DIVISION GRADUATE STUDENT POSTER COMPETITION: MS

0741 Effect of intrammamary infusion of chitosan hydrogels on bovine mammary gland involution after drying-off. S. Lanctot*[1], X. Zhao[1], P. Fustier[2], A. Taherian[2], B. Bisakowski[2], and P. Lacasse[3], *[1]Department of Animal Science, McGill University, Montreal, QC, Canada, [2]Food Research and Development Centre, St-Hyacinthe, QC, Canada, [3]Agriculture and Agri-Food Canada, Sherbrooke Research and Development Centre, Sherbrooke, QC, Canada*.

The transition from lactation to the dry period in dairy cows is a period of high risk for acquiring new intramammary infections. This risk is reduced when the involution of the mammary gland is completed. Accordingly, approaches that accelerate the involution process after drying-off could reduce