Remote, automated data collection may assist in the goal of precision feeding to reduce variation between individual animals. The objective of this study was to evaluate variation associated with integration of 3 different systems, each estimating different parts of the nutritive energy balance in dairy cows. Twenty-nine Holstein cows, 9 primiparous and 20 multiparous, ranging from 22 to 472 DIM were housed in a freestall pen and subjected to automatic data collection for a period of one month. Milk yield in a parlor was recorded at 0530 and 1730 h daily. Milk samples were collected 4 times weekly and analyzed for fat, protein and lactose content. Body weight and BCS were recorded twice daily using an automated scale and 3D imaging camera (DeLaval, Tumba, Sweden) as cows exited the parlor. Intake of a partial mixed ration based on corn and alfalfa silages was recorded continuously using Insensc feeders (Hokofarm, Marknesse, the Netherlands). Respiratory emissions of CO2 and consumption of O2 were recorded with a GreenFeed system (C-Lock Inc., Rapid City, USA), programmed to offer individual cows up to 440 g per visit of a pelleted protein supplement up to 12 times daily. Cows visited the GreenFeed 4.06 ± 1.82 (mean ± SD) times per day, with an average duration of 6.23 ± 1.05 min, for a total of 21.1 ± 9.9 min/d of recorded gas exchange. Diet and milk energy flows were estimated according to NRC (2001). Heat production was estimated from respiratory gas exchange. Variation in observations due to fixed effects of cow and day was estimated by 2-way ANOVA using PROC GLM of SAS (SAS software version 9.4; SAS Institute Inc., Cary, NC). NEL intake was 39.1 ± 5.4 Mcal/d, milk NEL output was 28.1 ± 7.1 Mcal/d, and heat production was 35.7 ± 3.8 Mcal/d. Root mean square errors due to cow and day, respectively, were 57.9 and 25.4% of the mean for NEL intake, 129.2 and 18.6% of the mean for milk NEL output, and 39.2 and 18.7% of the mean for heat production. Variation within cow was less than that between cows. Heat production was the least variable of the 3 energy flows. The integrated systems offer the potential to quantify energy balance in free-moving dairy cows.

Key Words: dairy cows, dietary energy, heat production

Feeding a partially acidified diet prepartum (negative DCAD) can induce metabolic acidosis, thereby decreasing urine pH. The objective of this study was to determine the efficacy of 2 methods to measure urine pH and the effect of urine pH on prepartum dry matter intake (DMI) and milk yield of the first week postpartum. Thirty multiparous, multiparous Holstein cows were provided a DCAD diet (DCAD = −118 mEq/kg) beginning at 28 d relative to predicted calving (DRC) until calving. Urine pH was collected by manual massage at 5 time points (TP1, TP2, TP3, TP4 and TP5). Time point 1 was −30 DRC (±4.2; n = 23) before cows consuming the DCAD diet, TP2 was −23 DRC (±3.9; n = 30), TP3 was −16 DRC (±4.0; n = 30), TP4 was −9 DRC (±3.9; n = 30), and TP5 was −4 DRC (±3.0; n = 24). Cows were blocked (n = 5) by calving month. Urine pH was measured using Fisher pH sticks (pH F; Thermo Fisher Scientific, Waltham, MA), pHion balance test strip (pH I; pHion Balance, Scottsdale, AZ), or a portable pH meter (pH P; Accumet AP115, Thermo Fisher Scientific, Waltham, MA). Cows were categorized as HIGH (urine pH greater than the median) or LOW (urine pH lower than median) for each TP. Individual DMI and milk yield were obtained daily. Cows were milked 2×/d. Statistical analyses were performed using the MIXED and REG procedures of SAS (SAS Institute Inc., Cary, NC). Milk yield and DMI were not different between cows in LOW or HIGH using the pH P at any time point (P > 0.10). Dry matter intake tended (P = 0.06) to be greater in cows classified as HIGH (15.12 kg) compared with LOW (12.79 kg) at TP 1 when pH F and pH I were utilized but not pH P. Milk yield and DMI in cows were not different at TP 2, 3, 4, and 5 when urine was measured using pH F and pH I (P > 0.10). When all TP were pooled (n = 156), the pH P and pH F were positively correlated (P < 0.01; R2 = 0.95; pH P = 0.88pH F+0.94). There was also a positive correlation between pH P and pH I (P < 0.01; R2 = 0.94; pH P = 0.88pH I+0.98). In conclusion, pH F and pH P seems to be accurate methods of urine pH measurement. Additionally, the DCAD diet did not affect milk yield or DMI.

Key Words: dietary cation-anion difference, pH, urine
meal is a high quality protein source for dairy cows and may be used in replacement of canola meal to maintain lactation performance. 

**Key Words:** carinata meal, dairy cow, milk production

**T138** Effect of fresh unsalable grocery waste substituted for corn grain on production in lactating dairy cows. R. Bomberger1, E. Barnolf2, M. Froetschel2, and K. Harvatine*.1, 1Penn State University, University Park, PA, 2Ruminant Nutrition Consulting LLC, Athens, GA.

Up to 40% of human food is wasted in the USA and food is the largest component of landfill waste. Unsalable fresh fruit and vegetables and bakery products at grocery stores provides a convenient point for collection and recycling into animal feed. Our hypothesis was that fresh grocery waste (Fruit Plus, Organix Recycling) would maintain milk production when substituted for ground corn in diets of lactating dairy cows. Forty-five multiparous Holstein cows were blocked by milk production and assigned to either control or Fruit Plus fed at 7.5% or 15% of diet DM in a randomized block design. Treatments were fed for 40 d and milk samples were collected weekly. Fruit Plus product was collected in a storage container at grocery stores and contained various unsalable fruits, vegetables, and bakery products and was delivered to the farms approximately every 4 d. The product was stored on a concrete pad and average pH was 3.5 and was never greater than 4.5 through the entire experiment. Data were analyzed as a randomized block design in PROC MIXED with repeated measures. The model included the random effect of cow within treatment and the fixed effect of treatment, time and their interaction and the pretrial parameter value as a covariant. Subject was cow within treatment and repeated was time. There was a treatment by time interaction for DMI (P < 0.001) as 15% Fruit Plus decreased intake for the first 14 d, but increased intake after 28 d. There was no effect of treatment or interaction of treatment and time on milk yield or milk fat percent or yield. There was a treatment by time interaction on milk protein percent as 15% Fruit Plus decreased milk protein after d 21 (3.15 vs 3.01%). However, there was no effect of treatment on milk protein yield. Milk urea nitrogen was increased by 15% Fruit Plus (12.5 vs 15.7 mg/dL; P < 0.01). In conclusion, fresh grocery waste product can maintain milk yield at up to 15% of the diet when substituted for ground corn and provides an opportunity to increase efficiency of the food system.

**Key Words:** grocery, byproduct, alternate feeds

**T139** The rumen degradability of palm date seeds when treated with sodium hydroxide and ultrasound processing. A. Aboragah*, M. Embaby, and A. AbuGhazaleh, Southern Illinois University, Carbondale, IL.

The effect of chemical treatment and ultrasound processing (sonication) time on the ruminal degradability of palm date seeds (PDS) were evaluated. The PDS were either incubated with 4% NaOH at 50°C for 6 h (T1) or subjected to sonication(900 W, 20 kHz, 100% power level) for 5 (T2), 10 (T3), 20 (T4), and 30 (T5) min in a metal reactor containing 4% NaOH solution. The treated PDS were then recovered, freeze-dried and grounded. A 3 g sample of the untreated PDS (control) or treated PDS (T1 to T5) were placed in Dacron bags and then incubated in the rumen of a cannulated Holstein dairy cow fed a high forage-based diet (80:20; forage: concentrate). After 24 h of incubation, the Dacron bags were removed from the rumen, washed several times with cold water and then analyzed for DM, NDF, and ash to estimate ruminal degradability. Data were analyzed using one-way ANOVA model of JMP.

Up to 40% of human food is wasted in the USA and food is the largest component of landfill waste. Unsalable fresh fruit and vegetables and bakery products at grocery stores provides a convenient point for collection and recycling into animal feed. Our hypothesis was that fresh grocery waste (Fruit Plus, Organix Recycling) would maintain milk production when substituted for ground corn in diets of lactating dairy cows. Forty-five multiparous Holstein cows were blocked by milk production and assigned to either control or Fruit Plus fed at 7.5% or 15% of diet DM in a randomized block design. Treatments were fed for 40 d and milk samples were collected weekly. Fruit Plus product was collected in a storage container at grocery stores and contained various unsalable fruits, vegetables, and bakery products and was delivered to the farms approximately every 4 d. The product was stored on a concrete pad and average pH was 3.5 and was never greater than 4.5 through the entire experiment. Data were analyzed as a randomized block design in PROC MIXED with repeated measures. The model included the random effect of cow within treatment and the fixed effect of treatment, time and their interaction and the pretrial parameter value as a covariant. Subject was cow within treatment and repeated was time. There was a treatment by time interaction for DMI (P < 0.001) as 15% Fruit Plus decreased intake for the first 14 d, but increased intake after 28 d. There was no effect of treatment or interaction of treatment and time on milk yield or milk fat percent or yield. There was a treatment by time interaction on milk protein percent as 15% Fruit Plus decreased milk protein after d 21 (3.15 vs 3.01%). However, there was no effect of treatment on milk protein yield. Milk urea nitrogen was increased by 15% Fruit Plus (12.5 vs 15.7 mg/dL; P < 0.01). In conclusion, fresh grocery waste product can maintain milk yield at up to 15% of the diet when substituted for ground corn and provides an opportunity to increase efficiency of the food system.

**Key Words:** grocery, byproduct, alternate feeds

**T140** Liver composition of dairy cows in two contrasting feeding strategies. M. García-Roche*,1,2 G. Cañibe, A. Casal1, D. A. Matteau1, M. Ceriani 1, A. Jasinsky 1, C. Quijano 2, A. Cassina 2, and M. Carriquiry1, 1Departamento de Producción Animal y Pasturas, Facultad de Agronomía, Universidad de la República, Montevideo, Montevideo, Uruguay, 2Centro de Investigaciones Biomédicas, Departamento de Bioquímica, Facultad de Medicina, Universidad de la República, Montevideo, Montevideo, Uruguay.

The liver plays a key role regulating fatty acid metabolism and gluconeogenesis and failure to adapt during lactation may lead to decreased milk yield and pathologies in dairy cows. Thus, our aim was to study the effect of pasture grazing on changes in liver composition during lactation. Multiparous Holstein cows (n = 24, 664 ± 65 kgBW, 3.0 ± 0.4 BCS, spring calving) were assigned in a randomized block design to (G0) a total mixed ration (TMR) fed ad libitum (70% forage: 30% concentrate) or (G1) grazing plus supplementation from 0 to 180 d postpartum (DPP). The G1 cows grazed Festuca arundinacea or Medicago sativa in 2 (18 h) or 1 (6 h) session depending on heat stress (30 or 20 kgDM/cow/day) and were supplemented with 5.4 kgDM of a commercial concentrate or offered TMR (50% of G0 offer). From 180 to 250 DPP, all cows grazed Festuca arundinacea (10h; 30 kgDM/cow/day) and were offered TMR (50% of G0 offer). Liver biopsies and blood samples were collected at −14, 35, 60, 100, 180 and 250 DPP and protein, free glucose, glycogen and triglyceride concentrations were determined. Data were analyzed with a mixed model using repeated measures. Liver protein peaked (P < 0.001) at 100 DPP for both treatments. While free liver glucose increased (P < 0.001) only at 35 DPP, hepatic glycogen decrease (P < 0.001) in early lactation (35 DPP), increased during mid-lactation and dropped again at 250 DPP. Hepatic glycogen was higher for G0 than G1 cows (1.66 vs. 1.31 ± 0.07% m/m, P < 0.01). Glycogen mobilization at 35 DPP could have led to increased free glucose since the correlation was negative (r = −0.4, P < 0.01). Liver triglyceride concentrations tended to be affected (P = 0.06) by the interaction between treatment and DPP increasing only at 35 DPP for G1 (10.2 vs. 6.3 ± 0.7%, G1 vs. G0 respectively, P < 0.05) and remaining unchanged during the rest of lactation for both treatments. Plasma insulin correlated positively with glycogen (r = 0.3, P < 0.01) and tended to correlate negatively with

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<th>Table 1 (Abstr. T139). The effect of treatments of the palm date seeds ruminal degradability</th>
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<sup>a,b,c</sup>Means with different letters within the same row are significantly different (P < 0.05).

**Key Words:** palm date seeds, chemical treatment, sonication
triglyceride ($r = -0.2, P = 0.08$), confirming the role of this hormone in lipid and glucose metabolism. Our results suggest that liver composition is modified during lactation and nutrition may affect energy reserves.

**Key Words:** liver, dairy cow, grazing

T141 Effects of increasing exogenous carbohydrases levels on intake, milk yield and composition, and production efficiency of dairy cows. J. Marques¹, L. Ghizzi¹, G. Silva¹, M. Dias¹, A. Nunes¹, L. Sakamoto¹, L. Fernandes¹, T. Silva¹, L. Gheller¹, N. Scognamiglio¹, C. Cortinhas*², T. Acedo², and F. Renno¹, ¹University of São Paulo, Pirassununga, São Paulo, Brazil, ²DSM Nutritional Products, São Paulo, São Paulo, Brazil.

Our objective in this study was to evaluate the effects of feeding increasing exogenous carbohydrases levels on dry matter intake, milk yield and composition, and production efficiency of lactating dairy cows. Eight rumen cannulated Holstein cows [27.8 ± 5.3 (mean ± SD) kg of milk yield per day, 182 ± 58.6 d in milk, 590 ± 85.9 kg of body weight, 2.78 ± 0.160 of body condition score] were blocked by parity and milk yield, divided in 2 replicated Latin squares $4 \times 4$ and randomly assigned to the following treatments: 1) Control, basal diet with no enzyme; 2) Carb 1 (carbohydrases): diet with 10 g of a blend of 2 enzymes (xylanase, Ronozyme WX; β-glucanase, Ronozyme VP, DSM Nutritional Products, Basel, Switzerland); 3) Carb 2: diet with 20 g inclusion of a blend of 2 enzymes (xylanase, Ronozyme WX; β-glucanase, Ronozyme VP); 4) Carb 3: diet with 30 g inclusion of a blend of 2 enzymes (xylanase, Ronozyme WX; β-glucanase, Ronozyme VP). Experimental diets were formulated according to NRC (2001), with a 50:50 roughage to concentrate ratio and corn silage as unique roughage source. Each experimental period included 14 adaptation days and 7 sampling days. Individual dry matter intake and milk production were recorded daily; milk samples were collected for 3 consecutive days, during the morning and afternoon milking. Data were analyzed using the MIXED procedure of SAS Inst (2001), using linear and quadratic contrasts to evaluate dose response of enzyme inclusion and control vs. enzyme contrast. Carbohydrase inclusion increased ($P = 0.027$) milk fat yield (1.00 vs. 1.06 kg/d), while tended to increase ($P \leq 0.071$) 3.5% fat-corrected milk yield (28.1 vs. 29.3 kg/d) and milk fat percentage (3.70 vs. 3.86) in contrast to control. Furthermore, carbohydrase tended to linearly increased ($P \leq 0.089$) 3.5% fat and energy-corrected milk production efficiency. There were no effects on feed intake, milk yield, milk protein and lactose content, and milk production efficiency. Therefore, exogenous carbohydrase inclusion increases milk fat yield and brings benefits to dairy cows performance.

**Key Words:** additive, milk fat, performance

T142 Addition of grape marc to dairy sheep diet improves milk yield and affects oxidative status of animals. A. Nudda*¹, G. Buffa¹, E. Tsiplakou², M. Cappai², M. Battacone¹, N. Macciotta¹, and G. Pulina¹, ¹Dipartimento di Agraria, University of Sassari, Sassari, Italy, ²Agricultural University of Athens, Athens, Greece, ³Dipartimento di Medicina Veterinaria, University of Sassari, Sassari, Italy.

The aim of this study was to evaluate the effect of diets containing dried grape marc and tomato pomace on productive performance, and milk and blood oxidative status. Twenty-four mid lactating Sarda ewes were used. One group of ewes received a total mixed ration as a control diet (CTR group) and other the same total mixed ration supplemented with 100 g/d of grape marc (GM group) or 100 g/d of tomato pomace (TP group) for 8 weeks. Daily intake, milk production, milk composition and blood parameters were affected by the inclusion of byproducts in the diet. Ewes supplemented with byproducts showed lower DM intake compared with CTR. The ewes fed GM produced more milk, protein and fat in milk than did the CTR group. The addition of TP did not affect production traits in comparison to CTR group. The blood parameters were within the physiological range for sheep in all groups, evidencing good health conditions of ewes throughout the experiment. GM group evidenced a higher antioxidant capacity measured either ferric reducing antioxidant power (FRAP) and including 2,2-azinobis (3-ethyl-benzothiazoline-6-sulfonic acid) (ABTS) in blood in comparison with the CTR. In conclusion, the GM at the inclusion level of 100 g/day, turned out to be an appropriate byproduct to improve milk yield and maintain animals health status. Research funded by Mignini-Petrini S.p.a. (Perugia, Italy) and Animal New Technology (ANT s.r.l.).

**Key Words:** dairy sheep, milk production, hematological parameters

T143 Switchgrass (Panicum virgatum) as a replacement for wheat straw in lactating dairy cow rations. B. R. Lemay*¹, R. L. Nagle¹, J. C. DeBruyn², A. Heeg³, M. Thimmanagari², and A. J. Carpenter¹, ¹Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, ²Ontario Ministry of Food, Agriculture, and Rural Affairs, Guelph, ON, Canada, ³Ontario Ministry of Food, Agriculture, and Rural Affairs, Woodstock, ON, Canada, 4Department of Animal Biosciences, University of Guelph, Ridgetown, ON, Canada.

Switchgrass (Panicum virgatum) is a native tall grass which has been researched as a novel species in the biomass industry, but also as a promising crop in the area of livestock feed. This study aimed to determine if switchgrass can be used as a replacement for wheat straw in lactating dairy cow rations in a crossover design. Holstein cows (n = 24, DIM = 129 ± 16.0) were randomly assigned a TMR containing equal amounts of either wheat straw (CON) or switchgrass (SGR) over 2 periods consisting of 17 d of adaptation and 4 d of sampling, where milk, blood, and feed samples were collected. Statistical analysis was conducted by a repeated measures analysis using PROC GLIMMIX of SAS with the fixed effect of treatment, day, and treatment x day, and the random effect of cow in the model for milk production, components and blood metabolites.DMI was consistent between groups (SGR = 25.1 ± 0.74, CON = 24.2 ± 0.74 kg/d; $P = 0.17$), but cows on the CON diet tended to produce greater daily milk yield (SGR = 34.2 ± 1.25, CON = 36.3 ± 1.24 kg/d; $P = 0.07$). Milk yield (kg) per kg of DMI was not significant between treatments but tended to be better for cows given the CON diet (SGR = 1.4 ± 0.12, CON = 1.6 ± 0.12; $P = 0.09$). Blood sample analysis for glucose, BHBA, and NEFA showed no differences between diets ($P \geq 0.32$). Fat yield between diets was consistent (SGR = 1.46 ± 0.064, CON = 1.54 ± 0.064 kg/d; $P \leq 0.01$), while protein was different (SGR = 1.09 ± 0.045, CON = 1.19 ± 0.045 kg/d; $P = 0.03$). Analysis of feed samples indicated no significant differences between the 2 diets in terms of NDF or NEl (SGR = 33.5 ± 0.74, CON = 34.8 ± 0.74; $P = 0.26$; and $SGR = 1.6 ± 0.01$, CON = 1.6 ± 0.01% diet DM, $P = 0.29$, respectively); however, CP tended to be different between the diets (SGR = 7.5 ± 0.31, CON = 6.6 ± 0.31% diet DM; $P = 0.06$). The switchgrass crop used in this trial was infected with head smut; however, these results suggest that replacement of wheat straw with switchgrass at an inclusion of 0.5 kg DM/d does not affect the metabolic health or fat production of Holstein dairy cows. Future trials should be repeated with different switchgrass crops to determine the effect of uninfected switchgrass under similar conditions.

**Key Words:** switchgrass, milk production, DMI
T144  Effects of metritis treatment strategies on metabolites and rumination and activity of dairy cows. V. R. Merenda1,2, D. Lezier3, A. Odetti4, C. C. Figueiredo1, C. A. Risco1, and R. C. Chebel1,2, 1Department of Large Animal Clinical Sciences, University of Florida, Gainesville, FL, 2Department of Animal Sciences, University of Florida, Gainesville, FL.

Objectives of the study were to compare the effects of 2 metritis treatments on metabolite concentrations and rumination/activity before and after diagnosis. Cows were examined at 4, 6, 8, 10 and 12 DIM for metritis (fetid, watery, red/brown uterine discharge). On the day of enrollment (d 0), cows were paired by parity and severity of metritis [metritis vs. puerperal metritis (rectal temperature ≥ 39.5°C)] and assigned randomly to Ampicillin (AMP) or Ceftiofur Crystalline Free Acid (CCFA) treatments. Cows enrolled in the AMP (n = 307) treatment were moved to a hospital pen where they were treated once daily for 5 d and were moved back to their original pen 72 h after the last treatment (d 7). Cows enrolled in the CCFA (n = 306) treatment remained in their original pen and received 2 doses of CCFA, 72 h apart. Contemporary healthy cows (POS = 636) were paired by parity with metritic cows and were enrolled in the study. A subgroup of cows (AMP = 95, CCFA = 106, POS = 122) had blood sampled on d 0, 1, 2, 6, 7, 8, and 14 after enrollment for determination of glucose, nonesterified fatty acid (NEFA), and BHB concentrations. Automated devices that record rumination/ activity were fitted on a subgroup of animals (AMP = 102, CCFA = 90, POS = 416) 21 d before expected calving date. Cows treated with AMP had greater glucose concentration (67.8 ± 5.1 vs. 64.4 ± 5.1 mg/dL; P < 0.01) and reduced BHB concentration (750.8 ± 38.5 vs. 919.7 ± 36.8 μmol/L; P < 0.01) from d 1 to 8 compared with CCFA. Concentration of NEFA from d 1 to 8 did not differ between treatments (P = 0.74) and the interaction between treatment and day relative to enrollment (P = 0.15) did not affect rumination. The interaction between treatment and day relative to enrollment affected (P < 0.01) activity because on d 7 (458.2 ± 4.6, 432.3 ± 4.0 arbitrary units) and 8 (445.0 ± 4.7, 428.5 ± 5.0 arbitrary units) post-enrollment cows treated with AMP had greater activity than cows treated with CCFA. In conclusion, treatment of metritic cows with AMP vs. CCFA resulted in greater glucose and lower BHB concentrations in metritic cows treated with AMP vs. CCFA. Mildly altered metabolic parameters and activity, but their biological significance are likely negligible.

Key Words: metritis therapy, metabolites, behavior

T145  Energy utilization in lactating Jersey cows consuming a mixture of distillers dried grains with solubles and straw in replacement of alfalfa hay. A. L. Knoell1, J. V. Judy1, H. C. Wilson1, K. J. Herrick2, S. C. Fernando1, and P. J. Kononoff1, 1University of Nebraska-Lincoln, Lincoln, NE, 2POET Nutrition LLC, Sioux Falls, SD.

In some areas of the world irrigation is needed to grow alfalfa and the use of crop residues and feed coproducts in dairy rations may represent opportunities to reduce the dairy industry’s use of water. A study using indirect calorimetry and 12 multiparous lactating Jersey cows (BW = 447.5 ± 43.7 kg; DIM = 71 ± 11 d, mean ± SD) was conducted to determine the effect of feeding a mixture of straw and distillers dried grains with solubles (DDGS) in replacement of alfalfa hay on milk production and energy utilization. A replicated 4 × 4 Latin square design was used to evaluate the replacement of alfalfa hay with a coproduct mixture (CoP) containing approximately 1/3 wheat straw and 2/3 DDGS. The experimental treatments were as follows (proportions on a DM basis): a control diet (CON) containing 18.2% of alfalfa hay, a low coproduct diet (LCP) that contained 8.1% of CoP, a medium coproduct diet (MCP) that contained 16.3% of CoP, and a high coproduct diet (HCP) that contained 24.3% of CoP. No differences (P ≥ 0.307) were observed for dry matter intake, milk, and protein yield averaging (mean ± SEM) 19.5 kg ± 0.60, 29.6 kg ± 0.91, and 1.05 kg ± 0.04, respectively. Increasing the proportion of CoP tended to result in a quadratic (P = 0.06; SEM = 1.06) effect in energy corrected milk which increased from 37.6 to 39.0 in CON and MCP but then decreased to 36.6 in HCP. Increasing the proportion of CoP linearly (0% to 24% total DM) decreased free water intake (P = 0.02; 17.2% reduction) and methane production (P < 0.01; 19.7% reduction). The concentration of gross energy in the diet increased (P < 0.01) linearly with the inclusion of CoP with the concentration of digestible energy (P < 0.09) and metabolizable energy tending to increase (P = 0.07) linearly with the inclusion of CoP. The concentration of net energy balance was not observed to be affected by treatment. Results of this study indicate that alfalfa hay with a mixture of straw and DDGS can maintain milk production and dry matter intake but the replacement with the CoP mixture may result in some differences in energy utilization mostly driven by effects on methane production.

Key Words: coproducts, energy utilization, indirect calorimetry


Feed efficiency has become a strong driver for dairy cattle selection, but the underlying physiological sources of between-cow variation are unknown. One possible contributor could be differences in post-absorptive nutrient utilization. The objective of this study was to compare arterial-venous differences (AVdiff) of circulating energy metabolites in cows with high and low residual feed intake (RFI). Mid-lactation primiparous and multiparous (PP, MP) Holstein cows (n = 61/replicate) were housed in a freestall pen with Insentec feeders (2 replications; 45d). Residual feed intake was calculated (PROC MIXED, SAS 9.4) by regressing energy intake on milk energy output (parity), median DIM (parity), metabolic BW (parity), and ΔBW (parity). Plasma samples were collected concurrently from the tail vessel (TV) and the subcutaneous abdominal vein (MV). Plasma was analyzed for glucose (g/l), nonesterified fatty acids (NEFA), BHB, and triglycerides (TG). Cows within the top and bottom third (PP n = 17/group; MP n = 23/group) were deemed high RFI (least feed efficient) and low RFI (most feed efficient). The effect of RFI group on metabolite concentration and AVdiff was determined using PROC MIXED accounting for the fixed effect of group, parity, and group × parity, and the random effect of replicate. Concentration of TV NEFA (P = 0.09) and TG (P = 0.013) were greater in low RFI (least feed efficient) and low RFI (most feed efficient). The effect of RFI group on metabolite concentration and AVdiff was determined using PROC MIXED accounting for the fixed effect of group, parity, and group × parity, and the random effect of replicate. Concentration of TV NEFA (P = 0.09) and TG (P = 0.013) were greater in low RFI cows. AVdiff of NEFA (0.016 vs. −0.001 ± 0.022 mM) and TG (6.0 vs 4.8 ± 0.4 mg/dL) were also greater (P < 0.05) for low RFI cows. Glucose (16.9 vs 12.9 ± 1.8 mg/dL) and TG (6.1 vs 4.7 ± 0.4 mg/dL) AVdiff were greater (P < 0.02) for MP cows. In MV, concentration of g/l, TG, and BHB were greater (P < 0.02) in PP animals. Interestingly, the percent of TV g/l and TG sequestered by the mammary gland was greater (P < 0.01) in MP than PP cows. The observed parity differences in mammary uptake of metabolites suggests altered post-absorptive metabolism in PP and MP animals. Differences in mammary gland uptake of NEFA and TG between low and high RFI groups could contribute to individual cow variation in feed efficiency.

Key Words: feed efficiency, nonesterified fatty acids, triglyceride

T147  Methyl donor supplementation strategy in fresh cows. A. Van Der Kerchove1, A. Delaquis2, F. Mueller3, T. Steen4, J. Guyader5,
Betaine and choline were compared as supplementation strategies in fresh cow diets. Sixty multiparous cows at 14 d in milk were housed and randomly assigned to a treatment in a randomized design (4 cows per pen) across 15 pens. Supplements were control (CON), Reashure choline (CHOL, 55 g/cow/d), or betaine (BET, 25 g/cow/d) and were fed for 14 weeks. Cows were milked 3 times per day with daily individual milk yield averaged by week. Dry matter intake (DMI) per pen was averaged by week as well as individual milk composition was averaged by week (2 d average). Individual bodyweight and condition score occurred at initiation, d 28, d 70, and d 98 in lactation. Plasma concentrations of albumin, aspartate amino transferase, urea nitrogen (PUN), nonesterified fatty acids (NEFA), BHB, and haptoglobin were determined at d 0, d 28, d 77. Proc GLIMMIX procedure of SAS with repeated measures over time was utilized to analyze the data. Differences were noted at P < 0.05 and trends at P < 0.15. The BET treatment reduced pen DMI compared with CON cows (25.35 vs 26.18 kg/d; P < 0.05) and trends at P = 0.07 and have differences at days to peak or peak milk yield. Choline lowered PUN levels (13.59 ± 0.16 vs 12.21 mg/dL; P = 0.005) in DMI in the week before calving and rumination (CON = 5.5 ± 0.27, LFI = 5.8 ± 0.24; P = 0.52). WAT cows consumed their feed faster (0.09 ± 0.01 vs 0.08 ± 0.01 kg DM/min; P = 0.05) compared with CON cows. Regardless of treatment, cows sorted against the longest ration particles, with cows on the CON sorting more against these (81.8 ± 2.3 vs 95.6 ± 2.4%; P = 0.002). Treatment did not influence how cows sorted for or against the other particle fractions. Post-calving DMI and feeding behavior were not affected by dry diet treatment. The results suggest that decreasing the moisture content of high-straw dry cow diets, by adding water, may reduce sorting against the longest ration particles, which may help promote consistency in targeted nutrients consumed during the dry period.

Key Words: dry cow diet, feeding behavior, sorting

T149 Effect of wheat straw chop length in high-straw dry cow diets on intake, behavior, and health of dairy cows across the transition period. C. Havekes*1, T. F. Duffield2, A. J. Carpenter1, and T. J. DeVries1, 1Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, 2Department of Population Medicine, University of Guelph, Guelph, ON, Canada.

The objective of this study was to determine the effect of wheat straw chop length in a high-straw dry cow diet on intake, feeding sorting, and health of dairy cows. Holstein cows (n = 40) were enrolled at dry off (~45 d before expected calving) and assigned to 1 of 2 treatments, a high-straw (29% wheat straw on DM basis; 13.2% CP, 1.5 Mcal/kg NE\textsubscript{L}) dry cow diet with straw chopped with a: 1) 10.16cm screen (Long; n = 20), or 2) 2.54cm screen (Short; n = 20). At calving all cows were fed the same lactating TMR (16.0% CP, 1.64 Mcal/kg NE\textsubscript{L}) and followed for 28 d. DMI was recorded automatically, reticulorumen pH was recorded using wireless telemetric probes, and blood BHB was recorded cow-side. TMR and ort samples were collected 2x/wk to determine differences in sorting. Feed samples were separated into 4 particle fractions: long (>19 mm), medium (<19 mm, >8 mm), short (<8 mm, >4 mm), and fine (<4 mm) particles. Feed sorting was calculated as actual intake of each particle fraction expressed as a % of predicted intake. Data were analyzed in mixed-effect linear models, treating day as a repeated measure. DMI (CON = 13.8 ± 0.3, WAT = 14.2 ± 0.2 kg/d) and rumination (CON = 534.4 ± 9.1, WAT = 516.6 ± 8.1 min/d) did not differ (P ≥ 0.17) between treatments. WAT cows tended to spend less time feeding (173.5 ± 11.7 vs 205.1 ± 12.3 min/d; P = 0.07) and have shorter meals (51.9 ± 2.8 vs 60.7 ± 3.0 min/meal; P = 0.04) compared with CON cows, although the frequency of meals did not differ between treatments (CON = 5.5 ± 0.27, LFI = 5.8 ± 0.24; P = 0.52). WAT cows consumed their feed faster (0.09 ± 0.01 vs 0.08 ± 0.01 kg DM/min; P = 0.05) compared with CON cows. Regardless of treatment, cows sorted against the longest ration particles, with cows on the CON sorting more against these (81.8 ± 2.3 vs 95.6 ± 2.4%; P = 0.002). Treatment did not influence how cows sorted for or against the other particle fractions. Post-calving DMI and feeding behavior were not affected by dry diet treatment. The results suggest that decreasing the moisture content of high-straw dry cow diets, by adding water, may reduce sorting against the longest ration particles, which may help promote consistency in targeted nutrients consumed during the dry period.

Key Words: dry cow diet, feeding behavior, sorting

T148 Effect of adding water to a high-straw dry cow diet on the intake and behavior of Holstein dairy cows. C. Havekes*1, T. F. Duffield2, A. J. Carpenter1, and T. J. DeVries1, 1Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, 2Department of Population Medicine, University of Guelph, Guelph, ON, Canada.

The objective of this study was to determine the effect of adding water to a high-straw dry cow diet on intake and behavior of dairy cows. Multiparous Holstein cows (n = 40) were enrolled at dry off (~45 d before expected calving) and assigned to 1 of 2 dietary treatments, a high-straw (35% wheat straw on DM basis; 11.6% CP, 1.35 Mcal/kg NE\textsubscript{L}) dry cow diet with: 1) no water (CON; n = 20; DM = 53.6%) or 2) water added to decrease the DM by ~10% (WAT; n = 20; DM = 45.4%). At calving all cows were fed the same lactating TMR (16.0% CP, 1.64 Mcal/kg NE\textsubscript{L}) and followed for 28 d. DMI was recorded automatically, reticulorumen pH in wk 1 post-calving (P < 0.05) and against the fine particles (91.8 ± 1.8%) did not differ (P ≥ 0.6), although Long cows tended to have a greater decline in rumen pH in wk 1 post-calving (P = 0.07). Long cows had higher BHB in the wk 3 post-calving (1.3 ± 0.11 vs 0.8 ± 0.10 mmol/L; P = 0.05). The results suggest that decreasing the chop length of straw in dry cow diets may improve pre-calving intake, reduce feed sorting, and promote greater health across the transition period.

Key Words: dry cow diet, sorting, health
Lactating dairy cows partition absorbed nutrients to milk and body components and catabolism. Nutrient catabolism results in O₂ consumption and CO₂ production which can be measured remotely and automatically in individual free-moving cows. To manipulate the partitioning of nutrients into milk vs. other sinks, a model that estimates each of the major nutrient flows would be useful. The objective of the present study was to modify the National Research Council (2001) model to estimate respiratory CO₂ output by lactating dairy cows. The predictions were compared against observations collected from 29 Holstein cows (22 to 444 DIM; 9 primiparous and 20 multiparous) housed in a freestall pen for a 29-d period, where daily DMI, milk yield and composition, BW, BCS, and respiratory O₂, CO₂ and CH₄ exchanges were monitored automatically. NRC (2001) equations were used to estimate digestible carbohydrate, fat and protein supplies from observed DMI and ration composition. Rates of incorporation of glucose into lactose, acetate into milk fat, fatty acids into milk fat, and amino acids into milk protein were estimated from observed milk and component yields. Incorporation of acetate into body fat and amino acids into body protein was estimated from the surplus of NEL between intake and production + maintenance. The balance of absorbed glucose, fat and amino acid was assumed to be catabolized, resulting in O₂ consumption and CO₂ production according to established stoichiometry. Net catabolism of glucose to acetate was assumed to occur in both the GI tract and the cow body, where observed CH₄ production determined the former rate. Average daily CO₂ production by cows on trial was 14567 ± 1700 g/d and predicted CO₂ output was 20619 ± 3234 g/d with a root mean square prediction error (MSPE) of 6729 g/d. Decomposition of MSPE indicated 0.2% of the MSPE was due to slope bias and 18.9% was attributed to random disturbance. The modified NRC model offers a means to describe nutrient partitioning that can be applied to optimize nutrient supplementation on dairy farms.

**Key Words:** carbon balance, nutrient partitioning, precision feeding