

the metabolic responsiveness of S14 and MIG12 in the bovine using real-time RT-PCR. Our initial study compared the expression of S14 and MIG12 in a panel of 9 tissues collected from lactating dairy cows. S14 was predominantly expressed in adipose tissue and moderately expressed in liver, mammary tissue, and skeletal muscle. MIG12 was predominantly expressed in skeletal muscle and moderately expressed in adipose tissue and liver. Next, we investigated the regulation of S14 and MIG12 in the adipose tissue of dairy cows experiencing periods of positive and negative energy balance. Firstly, adipose tissue biopsies were collected from five non-pregnant late-lactation cows when fed 120% of energy requirement or restricted to 30% of maintenance requirement. Feed restriction resulted in over a 90% and 78% decrease in the expression of S14 and MIG12, respectively ($P = 0.02$ and $P < 0.01$). Secondly, adipose tissue biopsies were collected from ten cows during the transition from pregnancy to lactation. Expression of both S14 and MIG12 was decreased over 95% by 8 d postpartum as compared to 28 d prepartum (both $P < 0.001$). Overall, results indicate both S14 and MIG12 are responsive to energy status and that the induction of a negative energy balance, whether by feed restriction or the transition from pregnancy to lactation, results in a down regulation in the expression of S14 and MIG12 in adipose tissue.

Key Words: S14, MIG12, lipogenesis

705 TNF α and factors related to insulin signaling in adipose tissue of dry- and early lactating dairy cows. H. Sadri^{1,2}, A. van Dorland¹, G. R. Ghorbani², H. R. Rahmani², and R. M. Bruckmaier^{*1}, ¹University of Bern, *Veitsuisse Faculty, Veterinary Physiology, Bern, Switzerland*, ²Isfahan University of Technology, *Department of Animal Science, Isfahan, Iran*.

This study was conducted to clarify the mechanisms of insulin resistance in adipose tissue during late gestation and early lactation in dairy cows. The mRNA expression of TNF α , insulin receptor (INSR), insulin receptor substrates (IRS1 and IRS2), regulatory (p85) and catalytic subunit of PI-3 kinase (p110), insulin independent (GLUT1) and responsive (GLUT4) glucose transporters in adipose tissue was measured by real-time RT-PCR, and their relationship with plasma NEFA concentrations was evaluated. Biopsies from subcutaneous fat were taken at the tail head from 30 dairy cows in wk 8 antepartum (a.p.), on d 1 postpartum (p.p) and in wk 5 p.p.. Blood samples were collected every two weeks. The mRNA abundance of TNF α was higher ($P < 0.05$) during p.p. compared to that in a.p. The mRNA encoding for GLUT1 and GLUT4 on d 1 p.p. was lower ($P < 0.05$) compared to the other time-points. There was a trend ($P = 0.09$) for increased mRNA abundance of INSR in p.p. relative to a.p., and decreased mRNA abundance of IRS1 on d 1 compared to wk 5 p.p. The mRNA encoding for IRS2, p85 did not change over time. A tendency ($P < 0.15$) was observed for a negative correlation between plasma NEFA concentration and GLUT4 mRNA abundance in wk 8 a.p., and on d 1 p.p. There was a trend ($r = 0.30$, $P =$

0.11) for a positive correlation between TNF α mRNA abundance and plasma NEFA concentration in wk 5 p.p.. Results show a local role for adipocyte-derived TNF α , and suggest its contribution in adaptation of adipose tissue towards catabolism. Down regulation of GLUT4 expression may be involved in insulin resistance shortly after calving, and may be mediated in part by TNF α and elevated NEFA concentration. The slight decrease in mRNA abundance of IRS1 on d 1 compared to wk 5 p.p. may show an involvement of IRS1 in insulin resistance at the onset of lactation. Changes in gene expression of INSR, IRS2 and p85 show no involvement in promoting insulin resistance in adipose tissue of dairy cows.

Key Words: TNF, adipose tissue, cow

706 Differential effects of propionate on mRNA abundance of adiponectin receptors and G protein-coupled receptor GPR41 in bovine subcutaneous and perirenal adipose tissue explants *in vitro*. A. Hosseini*, H. Sauerwein, and M. Mielenz, *University of Bonn, Bonn, Germany*.

Ruminants entirely depend on the ruminal production of short-chain fatty acids (SCFA) as the main energy source. The SCFA propionate (C3) is an important stimulus to insulin secretion in ruminants. Insulin (100 nM) increases leptin mRNA in bovine adipose tissue (AT) explants (1). C3 activates members of the family of fatty acid binding receptors, e.g. GPR41, which in turn stimulates leptin mRNA in mice (2). In goats, we have previously demonstrated that C3 differentially increases the mRNA abundance of putative GPR41 in subcutaneous (SC) and perirenal (PR) AT *in vivo*. The adiponectin system improves insulin sensitivity in monogastrics but less is known about the situation in ruminants. Therefore, we established an AT explant model for both SC and PR for characterizing the response of the adiponectin receptors (AdipoR1 and AdipoR2) mRNA to C3 *in vitro*. SC and PR AT were obtained from 7 slaughtered Holstein Friesian cows. The tissue was incubated 4 h in basal medium (DMEM/Ham's F-12 with L-Glutamine) or in medium supplemented with either 100 nM insulin or with 0.5, 1, 2, or 3 mM C3. The mRNA of AdipoR1, AdipoR2 and GPR41 was quantified by real-time-PCR. The data were analyzed using the Paired-samples t-test ($P \leq 0.05$; trend: $P \leq 0.11$). C3 significantly, or as a trend, increased the mRNA expression of AdipoR1 and AdipoR2 dose dependent only in SC AT explants. No influence of C3 on the mRNA of GPR41 was observed. Insulin did not influence the mRNA expression of AdipoR1 and AdipoR2, but a trend was observed for GPR41 in SC AT. Our results indicate that short-term C3 treatment *in vitro* affects AdipoR1 and AdipoR2 mRNA only in SC AT which might increase glucose uptake and lipid metabolism or accumulation under increased energy load. Likewise *in vivo* studies, an influence of C3 treatment on GPR41 mRNA in SC AT might not be ruled out. (1) Houseknecht et al. 2000. *J Endocrinol* 164. 51 (2) Xiong et al. 2004. *Proc Natl Acad Sci U S A*. 101. 1045

Key Words: adipose tissue explants, adiponectin receptors, GPR41

Ruminant Nutrition: Dairy 2

707 Effect of grain type and processing method on rumen fermentation and milk rumenic acid production. R. Mohammed^{*1}, J. J. Kennelly¹, J. K. G. Kramer², K. A. Beauchemin³, C. S. Stanton⁴, and J. J. Murphy⁴, ¹University of Alberta, *Edmonton, AB, Canada*, ²Agriculture and Agri-Food Canada, *Guelph, ON, Canada*, ³Agriculture and Agri-Food Canada, *Lethbridge, AB, Canada*, ⁴Teagasc, *Moorepark, Co. Cork, Ireland*.

Eight Holstein cows in mid-lactation were assigned to 4 diets - rolled barley, ground barley, rolled corn and ground corn containing similar starch contents in two 4 x 4 Latin squares with 21-day periods to investigate the effect of grain type and processing method on milk rumenic acid (RA) production. Diets were supplemented with sunflower seed and had forage:concentrate ratios of 42:58. Rumen and milk samples were collected in the third week of each period. Data were analysed by the

MIXED procedure of SAS. Dry matter intakes were greater ($P=0.01$) for corn-based diets (CBD) than for barley-based diets (BBD). Milk yield was not influenced by grain type or processing method. Milk fat content ($P < 0.01$) and yield ($P = 0.03$) were less for BBD than for CBD with greater values observed for rolling compared to grinding. Mean rumen pH was not different; however, daily minimum pH was less ($P = 0.01$; 5.2 ± 0.1 vs 5.5 ± 0.1) and pH duration < 5.8 (h/d) greater ($P 0.03$; 7.4 ± 2.1 vs 4.3 ± 2.1) for BBD than for CBD. Rumen acetate concentrations (mmol/100mol) were greater ($P < 0.01$; 48.4 ± 0.9 vs 45.5 ± 0.9) and propionate concentrations lesser ($P < 0.01$; 22.7 ± 1.2 vs 28.3 ± 1.2) for CBD than for BBD. Rumen ammonia concentration was greater ($P < 0.01$) for CBD than for BBD with greater ($P = 0.04$) values observed for rolling compared to grinding. The concentrations of t10-18:1 and t11-18:1 (% total FAME) were greater for BBD than for CBD in rumen (t10-18:1 - 3.5 ± 0.8 vs 1.3 ± 0.8 , $P < 0.01$; t11-18:1- 3.2 ± 0.5 vs 1.9 ± 0.5 , $P = 0.01$) and milk (t10-18:1- 3.8 ± 1.3 vs 1.0 ± 1.3 , $P = 0.03$; t11-18:1- 2.6 ± 0.3 vs 1.7 ± 0.3 , $P < 0.01$). Milk RA concentrations were greater ($P < 0.01$) for BBD than for CBD (1.46 ± 0.2 vs 0.89 ± 0.2). This study demonstrates the significance of the effect of grain type and processing method on rumen fermentation, PUFA biohydrogenation and milk RA concentration.

Key Words: grain processing, milk rumenic acid, cow

708 Feeding dairy cows barley grain treated with lactic acid and heat increased milk fat content and prevented the decline of rumen pH to sub-clinical ruminal acidosis (SARA) values. Q. Zebeli*, S. M. Dunn, and B. N. Ametaj, *University of Alberta, Edmonton, AB, Canada.*

Rapid degradation of barley grain in the rumen is often related to SARA and low milk fat. The objective of this study was to evaluate effects of feeding barley grain treated with lactic acid (LA) and heat on rumen pH and milk composition in dairy cows. Eight rumen-fistulated Holstein cows (170 DIM) were fed once daily a TMR containing rolled barley grain (32.8%, DM basis) steeped for 48h in equal quantity of water (CTR-diet) or with 1% LA (v/v) and oven-heated at 55°C (TRT-diet) in a crossover design with two 21-d periods. After 11-d of adaptation period, samples of rumen fluid (at 0730) and milk (at 0500 and 1500) were collected on d 1, 3, 5, 7, and 10 of measurements period. Diurnal rumen pH was measured in rumen fluid collected every 2h up to 12h post-feeding on d 10. Data were analyzed statistically by SAS accounting for effects of period, cow, sampling time, treatment, and carryover influences as well as by considering measurements at different sampling days as repeated measures with an autoregressive covariance structure. Results showed higher preprandial ($P < 0.02$) and diurnal ($P = 0.01$) rumen pH for cows fed the TRT diet. Also, cows fed the TRT diet maintained higher rumen pH (5.92 vs. 5.67) at the nadir (8h post-feeding) up to 12h post-feeding (6.10 vs. 5.78) lowering the risk of SARA. Interestingly, across 10-d measurements the treatment increased milk fat content (3.58 vs. 3.12%; $P < 0.01$), fat yield (0.97 vs. 0.83 kg/d; $P = 0.02$), fat-to-protein ratio (1.12 vs. 1.00; $P = 0.02$), and tended to increase fat-corrected (27.4 vs. 25.0 kg/d; $P = 0.06$) as well as the energy-corrected milk ($P = 0.07$) resulting in greater milk energy efficiency ($P = 0.01$). Additionally, cows fed the TRT diet had lower MUN (14.4 vs. 16.8 mg/dL; $P < 0.01$) indicating a better N utilization of the TRT diet. The DMI, milk yield, and other milk variables measured were not affected by diet ($P > 0.10$). In summary, feeding dairy cows 32.8% rolled barley grain treated with 1% LA and heat increased milk fat content and energy efficiency as well as prevented rumen pH from falling at SARA levels.

Key Words: dairy cow, milk composition, lactic acid

709 Overfeeding energy prepartum dramatically affects periparturient expression of mRNA transcripts in subcutaneous adipose tissue compared with controlling energy intake prepartum. N. A. Janovick*, J. J. Loores¹, P. Ji¹, R. E. Everts¹, H. A. Lewin^{1,2}, S. L. Rodriguez-Zas¹, and J. K. Drackley¹, ¹University of Illinois, Urbana, ²Institute for Genomic Biology, Urbana, IL.

A bovine oligonucleotide microarray was used to determine the effects of prepartum plane of energy intake on patterns of mRNA expression in subcutaneous adipose. Fourteen Holstein cows were fed either a moderate-energy diet for ad libitum intake (OVER) to provide at least 150% of NRC (2001) energy requirement for dry cows in late gestation or a diet including chopped wheat straw to limit intake to 100% of energy requirements at ad libitum intake (CON). After parturition, all cows were fed the same lactation diet. Subcutaneous adipose tissue was biopsied before cows were assigned to prepartum diets and on d -14, 1, and 14 relative to parturition. Statistical analysis revealed 3,423 differentially expressed mRNA transcripts as a result diet and day interactions at a FDR-adjusted P -value ≤ 0.05 . K-means clustering revealed 13 unique clusters with functional categories including insulin signaling, lipid metabolism, immune system or inflammatory processes, glucocorticoid signaling, cell death, and free radical scavenging. The largest number of differences between dietary groups occurred on d -14 relative to parturition, where 27 transcripts were downregulated at least 2.5-fold or greater and 55 were upregulated at least 3.0-fold or greater in OVER compared to CON cows. The most notable changes in transcripts of genes related to lipid synthesis were *SCD*, *DGAT2*, *LPL*, *FASN*, *ADIPOQ*, and *LEP*, which were upregulated, and *ADRB3*, which was downregulated in OVER compared with CON cows. Transcript expression patterns on d -14 relative to d 1 revealed very different effects of prepartum diet; cows in the CON group had a much smaller magnitude of fold changes and markedly fewer affected transcripts during this period compared with OVER cows. Most notable was the 5- to nearly 50-fold decreases in expression for 25 lipid synthesis and storage genes in OVER cows on d 1 relative to d -14. Large changes such as these may be detrimental to metabolic adaptation during the periparturient period.

Key Words: prepartum energy intake, mRNA transcript profiling, subcutaneous adipose tissue

710 Effect of antioxidant and energy density on antioxidant status and postpartum performance in transition cows. Y. M. Wang*, C. Wang, J. H. Wang, and J. X. Liu, *Institute of Dairy Science, Zhejiang University, Hangzhou, P. R. China.*

This study was conducted to investigate the effect of antioxidant and energy density on oxidative status and postpartum performance in transition cows. Forty Chinese Holstein dairy cows 3 weeks prepartum were allocated to 4 blocks of 10 cows based on parity, expected calving date, body condition score and previous milk yield, with a 2×2 factorial design. Treatments were antioxidant (AOX, 0 or 5 g/day) and prepartum energy density (1.42 or 1.3 Mcal/kg DM). After calving, all cows were fed the similar lactating diets, except for AOX addition until 3 week postpartum. Feeding high energy prepartum diets decreased the DMI prepartum and 1 week postpartum ($P < 0.05$). Energy balance of dairy cows and birth weight of their calves were unaffected by energy density and AOX. Compared with low energy diet, high energy diet prepartum reduced the milk yield of the first 3 weeks postpartum ($P = 0.03$), and AOX tended to increase the milk yield ($P = 0.06$). There was an interaction of energy density and AOX on milk protein ($P < 0.01$) and total solids contents ($P = 0.02$). Addition of AOX reduced the β -hydroxybutyrate level during 2 and 3 week postpartum ($P < 0.05$). Diet with high energy

increased glutathione peroxidase activity 1 week prepartum ($P < 0.05$), while AOX decreased this enzyme activity during 1 and 2 week before calving, and malondialdehyde contents around calving. Both energy density and AOX affected fatty acids composition of erythrocyte membrane 1 week postpartum. The improvement in fluidity of erythrocyte membrane was observed in high energy treatment. It is suggested that feeding high energy prepartum diets may negatively affect the antioxidant status, DMI and subsequent performance, while addition of AOX may partially alleviate the negative effects by improving the antioxidant status and metabolism.

Key Words: antioxidant, energy density, transition cows

711 Effects of replacing corn grain with molasses on ruminal fermentation and milk component production in dairy cows. C. A. Martel*, E. C. Titgemeyer, and B. J. Bradford, *Kansas State University, Manhattan.*

Previous research demonstrated that replacing corn with 5% molasses partially alleviated milk fat depression (MFD), but also decreased milk protein yield. Six cannulated, multiparous, late-lactation Holstein cows (220 ± 18 DIM) were used to evaluate effects of adding molasses to a high-concentrate diet containing 20% distiller's grains, with or without supplemental amino acids (AA), on ruminal parameters and milk composition. Cows were randomly assigned to dietary treatment sequence in a crossover split plot design with 0% and 5% molasses diets. Dietary treatments were fed for 28 d, with 16 d for diet adaptation, and the final 12 d for 2 abomasal infusion periods in a crossover arrangement. Abomasal infusions of water or AA (5 g/d L-Met + 15 g/d L-Lys-HCl + 5 g/d L-His-HCl-H₂O) were administered 3 times daily for 5 d, with 2 d between infusion periods. Milk production data and samples were collected during d 18-21 and 25-28 for analysis of milk components and fatty acid (FA) profiles. Ruminal fluid was collected on d 26-28. Milk fat percent increased with addition of molasses ($P = 0.01$; 2.71% vs. 2.94%), but molasses had no effect on yield of milk fat ($P = 0.25$; 0.80 vs. 0.84 kg/d) or protein. Administration of AA had no effect on concentration or yield of any milk components. Dietary molasses decreased total VFA concentration ($P < 0.01$; 141 vs. 133 mM), decreased molar proportion of propionate, and increased molar proportion of butyrate in ruminal fluid. Molasses also increased ruminal pH ($P = 0.01$; 5.73 vs. 5.87). Analysis of milk FA profile demonstrated a tendency for an increased proportion of de novo synthesized FA ($P = 0.06$), but yield of de novo FA was not altered. Molasses decreased yield of trans-10 C18:1 and increased yield of trans-11 C18:1, consistent with previous findings. Molasses also decreased delta-9 desaturase index (C14:1/C14). Data provide evidence that molasses may promote mammary de novo FA synthesis in high-energy rations by moderating ruminal pH and promoting normal biohydrogenation of dietary FA.

Key Words: milk fat depression, molasses, biohydrogenation

712 Effects of feeding increasing levels of wet corn gluten feed on digestibility, rumen pH, and VFA concentrations of lactating Holstein cows. C. R. Mullins*¹, L. K. Mamedova¹, K. N. Grigsby², and B. J. Bradford¹, ¹*Kansas State University, Manhattan*, ²*Cargill Inc., Blair, NE.*

Numerous studies have reported production responses to dietary inclusion of wet corn gluten feed (WCGF), but few have reported ruminal effects. Measures of ruminal fermentation and total-tract digestion were

evaluated in four primiparous and four multiparous Holstein cows (90 ± 13 DIM; mean \pm SD) fed differing levels of WCGF. Cows were randomly assigned to square and sequence within square in a replicated 4×4 Latin square design balanced for carry over effects. Treatment periods were 28 d, with the final 8 d used for in situ work, data collection, and sample collection. Treatments were diets containing 0, 12, 24, or 36% WCGF on a DM basis, with alfalfa hay, corn silage, corn grain, soybean meal, expeller soybean meal, and mineral supplements varying across diets to maintain uniform CP, RUP, NDF, and mineral concentrations. Linear and quadratic treatment effects were evaluated using mixed models. Increasing the amount of WCGF in the diet tended to linearly decrease rumen pH ($P = 0.07$; 6.18, 6.12, 6.14, and 5.91). Ruminal acetate concentration decreased linearly and propionate increased linearly ($P < 0.001$) as WCGF inclusion rate increased. Treatment also had a quadratic effect on ammonia concentration ($P < 0.01$), with greater concentrations in the 0% and 36% WCGF diets. In situ digestibility of soybean hulls showed a significant diet by time interaction ($P < 0.001$), and increasing WCGF linearly decreased in situ NDF disappearance at 24 hrs ($P < 0.01$). No differences were observed in total-tract digestibility of DM, organic matter, NDF, ADF, CP, or ether extract. Replacement of both starch and forage fiber with non-forage fiber apparently resulted in increased ruminal fermentation and accumulation of volatile fatty acids, decreasing ruminal pH; however, relatively low mean particle size of experimental diets may have contributed to these effects.

Key Words: corn gluten feed, dairy cows, rumen

713 Effects of wet corn gluten feed inclusion rates on productivity of lactating Holstein cows. C. R. Mullins*¹, K. N. Grigsby², and B. J. Bradford¹, ¹*Kansas State University, Manhattan*, ²*Cargill Inc., Blair, NE.*

Four primiparous and four multiparous ruminally cannulated Holstein cows (90 ± 13 DIM; mean \pm SD) were monitored to evaluate the effects of differing dietary inclusion rates of wet corn gluten feed (WCGF). Cows were randomly assigned to square and sequence within square in a replicated 4×4 Latin square design balanced for carryover effects. Treatment periods were 28 d, with the final 8 d used for data collection and sample collection. Treatments were diets containing 0, 12, 24, or 36% WCGF on a DM basis, with alfalfa hay, corn silage, corn grain, soybean meal, expeller soybean meal, and mineral supplements varying across diets to maintain similar CP, RUP, NDF, and mineral concentrations. Feed intake, milk production, body weight, and body condition score were monitored, and linear and quadratic effects of increasing WCGF inclusion rate were assessed using mixed models. Increasing dietary WCGF increased dry matter intake ($P = 0.03$; 26.7, 25.9, 29.3, and 29.7 kg/d for 0, 12, 24, and 36% WCGF, respectively) and milk production ($P < 0.01$; 36.8, 37.0, 40.1, and 38.9 kg/d). Concentrations of milk components did not differ among treatments ($P > 0.10$); however, protein and lactose yields linearly increased, and fat yield tended to increase linearly when more WCGF was fed. Production of energy corrected milk ($P = 0.01$; 38.2, 38.8, 41.7, and 40.4 kg/d) and solids corrected milk ($P = 0.01$; 35.2, 35.7, 38.5, and 37.2 kg/d) also increased linearly. Efficiency of milk production measured as ECM/DMI linearly decreased as cows consumed greater proportions of WCGF, and change in body condition score increased linearly. As expected, increasing the inclusion rate of WCGF decreased the proportion of particles > 19 mm in the TMR, but all TMR had small proportions of particles > 19 mm (mean 3%). This did not adversely affect milk fat concentrations (mean 3.7%). Results indicate that adding WCGF to dairy rations can increase

ECM yield, and this increase in production is likely driven at least in part by an increase in DMI.

Key Words: dairy nutrition, co-products, gluten

714 Response of lactating dairy cows to high protein distillers grains or three other protein supplements. K. A. Christen^{*1}, D. J. Schingoethe¹, K. F. Kalscheur¹, A. R. Hippen¹, K. Karges², and M. L. Gibson², ¹South Dakota State University, Brookings, ²Dakota Gold Research Association, Sioux Falls, SD.

High protein dried distillers grains (HPDG) was compared against soybean meal (SBM), canola meal (CM), and dried distillers grains with solubles (DGS) as protein supplements in diets for lactating dairy cows. A trial comparing these protein sources utilized 12 multiparous Holstein cows, averaging 78 d in milk at the start of the experiment, in a 4 × 4 Latin square design with 28-d periods. Weeks 1 and 2 of each period were for adjustment and wk 3 and 4 for data collection. Each treatment diet consisted of 55% forage and one of the four protein supplements provided in a concentrate mix. Diets contained 15.3% CP with 38% of the CP supplied by a respective protein supplement. Dry matter intake (24.4 kg/d) was similar for all four treatments ($P > 0.05$). Milk production (31.8 kg/d), protein yield (1.05 kg/d), and fat yield (1.29 kg/d) were similar for all four treatment diets ($P > 0.05$). Milk protein percent was lower ($P < 0.05$) when fed DGS (3.23) than when fed the other three diets (3.34). Total milk nitrogen and true milk protein were higher ($P < 0.05$) when fed the HPDG diet than when fed the other diets. Milk fat percentage was lower ($P = 0.02$) when fed DGS (3.78) than when fed SBM or HPDG (4.21), but similar with CM (4.07). Feed efficiency and nitrogen efficiency were similar for all diets ($P > 0.05$). Molar proportions of acetate, propionate, and the acetate to propionate ratio in ruminal contents were similar for all diets ($P > 0.05$). Total essential AA concentrations in arterial plasma were similar with all diets while concentrations in venous plasma were lower ($P < 0.05$) when fed CM. Extraction efficiency indicated that Met was the first limiting AA by the mammary gland when fed the SBM diet, whereas Lys was first limiting for the other diets. For the milk components measured, HPDG was equal to or better than SBM, CM, and DGS as a protein supplement.

Key Words: high protein distillers grains, canola meal, lactating cows

715 Lactation performance and amino acid utilization of early lactating cows fed regular or de-oiled dried distillers grains with solubles. K. Mjoun^{*}, K. F. Kalscheur, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University, Brookings.*

The objective of this study was to evaluate lactation response and AA utilization in early lactating cows fed either regular or de-oiled distillers grains with solubles (rDGS and dDGS, respectively). Thirty-six Holstein cows 19.7 ± 2.6 DIM at the start of the experiment were used in a randomized complete block design for 14-wk including a 2-wk covariate period. Diets consisted of 1) Control based on soybean products; 2) 22% inclusion of rDGS; and 3) 20% inclusion of dDGS. Distillers grains replaced soybean meal, expeller soybean meal and soyhulls from the control diet. Diets were formulated to contain similar concentrations of CP, RUP, EE, NDF and NEL. Dry matter intake (24.2 kg/d) and milk yield (39.2 kg/d) were similar for all diets. Milk fat, protein, and lactose percentages were unaffected by diets; however, protein yield was greater ($P < 0.001$) for diets containing either DGS diets compared

with control diet (1.14 vs. 1.04 kg/d). Milk urea nitrogen decreased ($P < 0.001$) for cows fed DGS diets and averaged 11.8, 10.8 and 10.1 mg/dl, respectively, for control, rDGS, and dDGS. The efficiency of milk production (1.46, 1.54, and 1.61 ECM/DMI) was different ($P < 0.01$) across diets. Efficiency of N utilization for milk protein was decreased ($P = 0.01$) for cows fed control compared with DGS diets (24.3 vs. 26.8%). Body weight (711 kg) and body condition score (3.38) were similar for all diets. Arterial Lys concentration was lower ($P < 0.001$) with DGS diets (80.0, 58.7 and 55.6 $\mu\text{M/L}$). Cows fed DGS had higher ($P < 0.001$) arterial Met concentration (21.7 μM) compared with (15.2) for control. Arteriovenous difference of Lys was similar across diets, whereas that of Met was greater for the DGS diets compared with control diet 13.3 vs. 10.7 $\mu\text{M/L}$. Extraction efficiency of Lys by the mammary gland was greater for DGS compared with control (76.1 vs. 65.4%). Mammary uptakes of Lys (2.73) and Met (0.80) were similar for all diets. Despite the apparent deficiency of Lys in DGS diets, milk production and milk components were similar to a soybean-based diet.

Key Words: amino acids, distillers grains with solubles, early lactation

716 Effects of forage type on nitrogen utilization in dairy cows consuming diets high in wet distillers grains with solubles. A. M. Gehman^{*} and P. J. Kononoff, *University of Nebraska, Lincoln.*

The objectives of this experiment were to determine the effects of forage type when feeding high levels of wet distillers grains with solubles (WDGS). Primiparous ($n = 8$) and multiparous ($n = 20$) Holstein cows averaging (mean \pm SD) 598 ± 64 kg BW and 99 ± 28 DIM were used in a replicated 4 × 4 Latin square. Treatments were arranged in a 2 × 2 factorial with factors WDGS (0 or 25% DM) and forage type [high corn silage (CS) or high alfalfa haylage (AH)]. Animals were fed one of 4 treatments during each 21-d period: 1) CONT-CS, 0% DM WDGS and high CS; 2) CONT-AH, 0% DM WDGS and high AH; 3) WDGS-CS, 25% DM WDGS and high CS; and 4) WDGS-AH, 25% DM WDGS and high AH. Intake and milk data was collected daily and averaged for d 15 – 21 of each period. There was an interaction ($P < 0.01$) between forage type and WDGS for DMI with AH stimulating DMI for rations without WDGS, while no effects were observed for rations with WDGS (22.5, 24.6, 24.6, and 24.8 ± 0.4 kg/d for CONT-CS, CONT-AH, WDGS-CS, and WDGS-AH). Digestibility of DM, OM, NDF, and N were not affected by treatment, averaging 59.6 ± 0.45 , 62.3 ± 0.27 , 40.1 ± 0.60 , and $58.6 \pm 0.15\%$ across treatments. Excretion of urinary purine derivatives were ($P < 0.01$) elevated for treatments with WDGS compared to control (487.1 vs. 390.5 ± 20.6 mmol/d) but were not affected by forage type. Mass of fecal N was not different among treatments (averaging 287.1 ± 14.8 g/d), but urinary and manure N was ($P < 0.01$) reduced with WDGS compared to control (252.0 and 538.7 vs. 318.4 ± 14.8 and 603.5 ± 21.3 g/d). There were no effects of forage type on N utilization. There was an effect of WDGS ($P < 0.01$) and forage type ($P = 0.01$) on 4% fat-corrected milk with rations containing WDGS or AH having higher milk than control or CS (27.2, 28.3, 29.7, and 30.7 ± 1.0 kg/d for CONT-CS, CONT-AH, WDGS-CS, and WDGS-AH). This research demonstrated rations can be formulated to contain 25% WDGS and result in reduced N excretion regardless of forage type. These rations may also result in improved DMI and milk production.

Key Words: distillers grains, forage, N utilization

717 Effect of management and milk yield on the incidence of lameness in dairy cattle. C. Lira Diaz and J. K. Margerison*, *Massey University, Palmerston North, New Zealand.*

Data was collected from 14 commercial farms, comprising a total of 6412 cows (mean 458 cows per farm). Farms were nominated by a nutrition consultant in 4 districts of the North Island, New Zealand. Data was collected weekly over the period of 1st July 2007 until 31st July 2008 by the same observer during farm visits to monitor overall productivity, nutrition and health. Cows were classified into either Holstein Friesian (HF), Jersey (J) or Jersey cross Friesian (X). Lameness cause, type of lesion, locomotion scoring and location of any lesions were recorded using a 5 point scale and lame cows were inspected to determine the type of lesion and classified into five groups: (1) White line; (2) Sole damage; (3) Foot rot; (4) Laminitis; (5) Tender feet (LS 2-3). Data each cow on the farm was available throughout the lactation and dry cow period, or until any animal was no longer in the herd. Holstein Friesian cows were 7.9 (95% CI=4.18-12.02) times more likely to become lame compared to Jersey cows. Likewise, Crossbred cows were 4.64 (95% CI=2.82-7.63) times more likely to be lame than Jersey cows. Of the cows were lame 0.74 were hind feet compared to 0.14 for fore feet. A higher percentage of cows lame was during winter and spring time, whereas summer time had significantly lower mean percentages than the other seasons. In winter cows were 2.78 (95% CI= 2.58-2.99) more likely to be lame than cows in summer. There was no significant effect of walking distance on frequency of lameness ($P=0.5726$). Cows in early lactation had the highest mean percentages of lameness and were 1.68 (95% CI=1.66-1.70) times more likely to be lame than cows in middle stage of lactation. Higher yielders were 1.95 (95% CI= 1.80-2.11) times more likely to be lame than low yielders and moderate producers were 1.35 (95% CI= 1.35-1.61).

Key Words: lameness, breed, management

718 Competition at the feed bunk affects DMI and feeding behavior of metritic dairy cows. K. L. Proudfoot*, D. M. Weary, and M. A. G. von Keyserlingk, *University of British Columbia, Vancouver, BC, Canada.*

Cows at-risk for metritis after calving decrease dry matter intake (DMI) in the weeks before and after calving. It remains unclear how competition at the feed bunk may impact the DMI and feeding behavior of cows at-risk for metritis. Our aim was to test the effect of a competitive feeding environment on the feeding behavior of cows that become sick after calving versus those that remain healthy. Using an electronic feeding system we monitored DMI and feeding behavior of 76 Holstein cows from 1 wk before to 2 wk after calving. Cows were assigned to a competitive (2:1 cows:bin) or non-competitive (1:1 cow:bin) treatment and were examined for clinical metritis every 3 d after calving. Multiparous cows on the competitive ($n=8$) and non-competitive treatments ($n=8$) diagnosed with clinical metritis after calving were matched with healthy cows on each treatment ($n=8$ /treatment). Using PROC MIXED we tested fixed effects of treatment and health, and a treatment*health interaction for DMI, feeding time and rate of intake for the following 3 periods: wk-1 (d-8 to d-1 pre-calving), wk+1 (d1 to d8 post-calving) and wk+2 (d9 to d16 post-calving). We detected an effect of health on DMI and feeding time where sick cows, regardless of treatment, ate less and spent less time feeding than cows that remained healthy. During wk-1, competitively fed cows tended to eat less than non-competitively fed cows (13.4 ± 0.8 kg/d vs 14.8 ± 0.8 kg/d, $P=0.07$). We found no effect of health on feeding rate, but there was a trend for a health*treatment interaction for feeding rate during the wk+1 ($P=0.10$). When tested separately, competitively fed metritic cows ate faster than healthy cows (139 ± 7 g/min vs 116 ± 8 g/min, $P=0.04$). There were no differences in feeding rate between non-competitive health groups ($P=0.77$). We provide the first evidence that competition at the feeder can alter the DMI and feeding behavior of cows at-risk for metritis after calving. Future work should examine the effect of competition on social behavior before calving, and the links between social status and disease.

Key Words: transition, competition, DMI

Ruminant Nutrition: Minerals

719 Thirty-eight years of vitamin D and calcium research: From dairy cows to humans. R. L. Horst*, *Heartland Assays, Inc., Ames, IA.*

There is a long-standing and continuing interest in the relationship between vitamin D status and calcium nutrition. In that regard, several facts have been well established: 1.) Vitamin D must be converted in the liver to form 25-hydroxyvitamin D, which is considered the most clinically useful metabolite in evaluating vitamin D status and 2.) 25-hydroxyvitamin D must be converted to its active metabolite, 1,25-dihydroxyvitamin D. In mammals and birds, the 1,25-dihydroxyvitamin D acts to maintain calcium homeostasis by stimulating intestinal calcium transport and bone calcium mobilization. All of the compounds in the vitamin D activation cascade (including vitamin D itself) have been used in some form in attempts to prevent periparturient hypocalcemia (milk fever) in dairy cows. These attempts were met with varying degrees of success, which has led to more interest in controlling milk fever by dietary measures. Although vitamin D is mainly associated with calcium metabolism and bone health, it has recently received a lot of attention regarding its relationship with heart health, cancer and infectious diseases. Several epidemiologic studies in humans have suggested that vitamin D may account for several thousand premature deaths due

to colon, breast, ovarian, prostate cancer. The active form of vitamin D, 1,25-dihydroxyvitamin D, has also been shown to up-regulate the innate immune response triggering direct antimicrobial activity against intracellular bacteria such as *Mycobacterium tuberculosis*. So, what was once thought to be a simple vitamin affecting only bone and calcium metabolism is now seen as a complex pre-hormone that is involved not only in calcium homeostasis but also in maintaining, down to the cellular level, the integrity of various organ systems throughout the body.

Key Words: vitamin D, calcium, functions

720 The optimum dietary Ca concentration to minimize the risk of hypocalcaemia in dairy cows is affected by dietary cation-anion difference. M. Oba*¹, A. Oakley¹, and G. Tremblay², ¹*University of Alberta, Edmonton, AB, Canada,* ²*Agriculture and Agri-Food Canada, Quebec, QC, Canada.*

The objective of this study was to determine whether dietary Ca concentration affects the ability to maintain Ca homeostasis in dairy cows fed diets differing in dietary cation-anion difference (DCAD). Eight non-lactating and non-pregnant multiparous Holstein cows (594 ± 80.3 kg